

Seven Decades of MTT-S

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ABSTRACT This paper will present a historical overview of the IEEE Microwave Theory and Technology Society (MTT-S) from its inception in 1952 to the present times. As there is a vast amount of activities to cover, this paper will just provide a high-level summary of some of the more notable activities and trends. The paper will be organized on a decade-by-decade basis. In each decade, there will be coverage of the major activities of MTT-S by following the actions of the Administrative Committee, the conferences and symposiums, the publications, and the growth of the membership and chapter activities. Additionally, there will be brief discussions on the key relationships that MTT-S had with other professional groups inside and outside of the IEEE and of the key technologies that the MTT-S community was involved with at the time. For brevity, individual names will generally be left out but pointers to internet listings of major contributors will be provided.

INDEX TERMS History, microwave, MTT-S, Survey, MTT 70th Anniversary Special Issue.

I. INTRODUCTION

Today's IEEE Microwave Theory and Technology Society (MTT-S), which was changed from Microwave Theory and Techniques Society in 2021, was founded in 1952 as a Professional Group (PG) of The Institute of Radio Engineers (IRE). As an organization, MTT has focused on providing opportunities for like-minded individuals to share and exchange information in MTT's Field of Interest (FOI). Initially, this was work in frequencies between 1–100 GHz, where the structures had dimensions comparable to the wavelength. The FOI has broadened over the years to cover topics in the theory, technology, and applications of guided wave and wireless technologies spanning the electromagnetic spectrum from RF and microwave through millimeters and terahertz. The most up-to-date FOI can be found at MTT-S Field of Interest Statement.

To appreciate the role of MTT, it is useful to go further back in history. The work of Heinrich Hertz in the 1880's in adapting and proving that James Maxwell's equations did indeed describe the propagation of electromagnetic waves through the atmosphere is considered a cornerstone of "microwave technology." The work of these two individuals is considered so foundational, two of the IEEE's highest honors are named after them (the Hertz Award was retired in 2009 in favor of the IEEE Electromagnetics Award).



FIGURE 1. 1958 AdCom dinner.

At about this same time, the American Institute of Electrical Engineers (AIEE) was founded in 1884 and included some of the most prominent inventors and innovators in the then new field of electrical engineering. In 1912, the Institute of Radio Engineers was founded. The IRE was devoted initially to wireless radio, and then more broadly to electronics. These groups merged in 1963 to form today's Institute of Electrical and Electronics Engineers (IEEE).

Based on this early pioneering work, numerous early investigators developed wireless radio communication systems. While these were at first lower frequency applications, with time they gradually moved into the RF and Microwave spectrum. Also, during this time “active” devices such as vacuum tubes, and magnetrons were developed along with microwave guiding structures (waveguides) allowing for more sophisticated systems. While most of the activity was focused on lower-frequency wireless, there was a small but active microwave community.

The term microwaves (or sometimes labeled micro-waves in early British work in 1931) first appeared in the American engineering literature in 1932 in the Proceedings of the Institute of Radio Engineers article, “The Detection of Microwaves.”

While communication systems were the primary focus of early microwave developments, the first non-communication uses for microwaves were medical treatments, and industrial heating (a large-scale version of today’s home microwave ovens).

However, there is no doubt it was World War II that led to the huge explosion of interest in microwave technologies. While the concept of using radio-waves to perform radar-like functions dates back to 1903 and ship navigation and was further enhanced in the 1920’s and 1930’s, it was the war activities that brought a new sense of urgency in using radar as an early warning system for detecting aircraft or surface ships. Additionally, long-range aircraft navigation systems, anti-aircraft gun aiming systems, and secure communications were key newly developed applications. Much of this work was done at the MIT Radiation Lab with the aid of the British. It should be noted that there were other activities on similar projects taking place around-the-world, in this time frame, but as this paper is focusing on MTT, the Rad Lab work was the key nexus to the formation of MTT.

Due to the classified nature of microwave activities, very little was publicly published, and information sharing was on a need-to-know basis. After the end of WWII, the public publishing of the 28-volume MIT Radiation Laboratory Series provided a huge body of research and applications for others to leverage. Microwave technology also was becoming visible in other journals.

In the pre-MTT days, the microwave community would use sessions at the IRE General Convention/Meeting as a place to gather and exchange information. Due to WWII and where the work was being done, it was a small community that knew each other and had been sharing information among the community verbally and by letters.

IRE started forming topical groups in 1948, later to be called Professional Groups. A petition for a microwave IRE professional group was circulated in 1951. The IRE leadership had concerns with overlap with existing groups for antennas, electron devices, and instrumentation, an overlap that continues to this day, but the microwave community persisted. There was strong positive support for the petition with 185 IRE

members expressing interest in this new professional group. The petition was soon submitted to the IRE for approval.

The 1951 petition stated that the scope of the group if approved, would “encompass microwave theory, microwave circuitry and techniques, microwave measurements, and microwave tubes.” The scope would also include “scientific, technical, industrial, and other areas that contribute to the field of interest, or to utilize techniques or products of the field where necessary to advance the art and science of the field, subject, as the art develops, to additions, subtractions, or other modifications directed or approved by the Institute Committee on Professional Groups.” This scope would undergo multiple revisions in the early years.

Note: MTT has had many formal names over the years such as Professional Group on Microwave Theory and Techniques (PG-MTT) in the IRE years. After the creation of IEEE, it became the Professional Technical Group on Microwave Theory and Techniques (PTG-MTT), followed by Group on Microwave Theory and Techniques (G-MTT), then the Society on Microwave Theory and Techniques (S-MTT), the Microwave Theory and Techniques Society (MTT-S) and in 2022 Microwave Theory and Technology Society (MTT-S). While it will be noted when these changes occurred, for this paper MTT will be used interchangeably throughout the decades. A similar convention will be used for other IRE/IEEE groups, such as AP (Antennas and Propagation), and ED (Electron Devices).

Likewise, T-MTT will be used to refer to the MTT Transactions publication that also went through a few name changes.

II. 1952-61 FORMATION

The formation of an IRE Professional Group (PG) on Microwave Electronics was approved by the IRE on 7 March 1952. While awaiting approval from the IRE, a small group exchanged thoughts on the structure and governance of the group. The IRE provided a model constitution and bylaws, and the initial core group developed a draft committee structure and thoughts about membership recruiting.

A. ADCOM

The first meeting of the new PG was held at the IRE Headquarters at 1 East 79th Street in New York City on 1 May 1952. The primary order of business was to put the finishing touches on the formation of the PG.

As an initial start, the Administrative Committee (AdCom) of the IRE Professional Group on Microwave Electronics was created with 10 members having a very Northeast USA focus, with only one member from the West Coast and one from the South. The AdCom was increased to 15 members in 1953. The IRE PG model constitution provided for the AdCom itself to elect future members and to elect the officers of the PG. The term of AdCom membership would be three years. These practices are still the norm today. And as a bit of trivia, this new PG was the 17th for the IRE and today inside the IEEE the numeric coding for MTT is 17xx.

The proposed name of the group, Microwave Electronics, was under some challenges, even as a petition circulated. There were concerns of potential overlap with existing IRE professional groups, such as Electronic Devices, and Instrumentation. So, it was agreed to rename the group to the IRE Professional Group on Microwave Theory and Techniques (MTT), a name that would be used for 70 years.

As a new PG, AdCom was very busy putting all the aspects of a technical group in place, such as membership, symposia, publications, and awards. And a keen focus was defining the scope of the group while cooperatively working with other groups in the many overlapping areas of interest. This scope issue was many times a bit contentious but always professional. While the specific subject areas have changed over the decades, this working out of the scope between groups is a theme that repeats itself over and over. In these early years it was technologies like microwave vacuum tubes, magnetrons, satellite beam power, Masers/Lasers, magnetic ferrites, microwave communication systems, microwave measurements, and as times changed other items. There were regular discussions of concerns with the PG on ED, PG on AP, PG on Communication Systems (later just Communications or ComSoc), PG on Instrumentation (later Instrumentation and Measurement), and others. It was suggested by the IRE and discussed many times that a merger with one or more of the PGs might make sense but that was repeatedly dismissed by the various PGs including MTT.

Early AdCom meetings were held at IRE Headquarters and later at Essex House. There were 3 meetings in 1952, 4 in 1953, 7 in 1954, and then 5-6 meetings a year for many years before dropping to 4 in 1967, and the now standard 3 annual meetings in 1977. Early on, meetings were held mostly in NYC but also at the MTT National Symposium site. By 1959, meetings started to be held at future National Symposium sites. Starting in 1954, a Newsletter was published after every AdCom meeting to keep the chapters and membership informed.

The AdCom immediately started planning technical meetings and investigating an MTT publication. In 1954, initial work on award and recognition activities took place. A new Awards Committee started annually proposing names for IRE award nominations and IRE Fellows. They then created an MTT Annual Award proposal, first given in 1957, which would be later known as the Microwave Prize.

As the membership and activities grew, the AdCom membership increased to 18 in 1955 (6 elected annually with 3-year staggered terms). This provided more focus on symposia, publications, membership, finances, awards, newsletters, and nominations, Also, the T-MTT Editor and past AdCom chair were made voting ex-officio positions. In 1958 the first Honorary Life AdCom Member/Emeritus was selected with the intent of continuing to have such experience and knowledge to stay engaged with the AdCom. It was only afterward that the AdCom realized there was no governance supporting such a role, so there was a hurried effort to revise

FIGURE 2. IRE 1952 PG membership application.

the constitution and bylaws to create the role. It would not be the only time the bylaws were updated after the fact.

There were regular updates of the FOI as new opportunities arose and as MTT was expanding its scope. And MTT was not the only PG looking to expand its FOI and capture new technologies. This led to regular discussions on scope and “ownership.” To minimize these disputes, IRE leadership would regularly suggest mergers in which none of the PGs were interested.

Finances have been an on-and-off issue throughout the history of MTT. During the 1950’s, with the rapid expansion of MTT and member benefits, there were times when expansion plans had to be scaled back due to financial strains, another reason IRE leadership kept suggesting merger discussions. A controversial step was to raise the \$2 MTT dues to \$3 in 1956.

As the decade of the 1950’s was ending MTT was turning to a more international posture and developed affiliations with six European societies plus forming a Canadian chapter (1958) and a Tokyo, Japan chapter (1959).

During an FOI update, a couple of overlap areas were exposed, the most prominent was lasers and masers, an area MTT strongly wanted to keep. In years to come, after sharing with other groups, today’s IEEE Photonics Society would become the home for those and other lightwave technologies. Other topics were microwave instrumentation, microwave circuits, and overlaps on antennas.

As the first decade of MTT was ending, a revised constitution was adopted and the AdCom learned of the proposal to merge IRE and AIEE. This raised many concerns as the

culture and operating style of the two groups were very different. But since the AIEE did not have an equivalent to IRE's MTT group this meant MTT would merge intact. As there were significant operational efficiency benefits with the merger, MTT AdCom voted to support the merger.

B. SYMPOSIUMS

By the second meeting of the AdCom on 20 June 1952, the discussion quickly moved to create topical symposiums in addition to sponsoring sessions at the IRE National Convention as a place for the community to meet and exchange technical activities. The first symposium topic for late 1952 was "Microwave Circuitry" supported with initial funding of \$150 from the IRE. The twelve papers presented at the symposium were later published as the first issue of the PG-MTT Transactions in March 1953. The price per copy, to members of MTT, was \$1.10.

In 1953, MTT joined with the PGs on Communication Systems and ED to put on the "Microwave Radio Relay Systems Symposium" and again, the MTT papers appeared as the third issue of the T-MTT dated April 1954.

In 1954, MTT co-sponsored "Modern Advances in Microwave Techniques" with the Polytechnic Institute of Brooklyn (PIB) and the Microwave Research Institute (MRI) which resulted in a 492-page digest.

While all the early events were in the New York City area, in 1956, in conjunction with AP, MTT, and the IRE Philadelphia Section held the "National Symposium on Microwave Techniques", in Philadelphia, PA. The 27 contributed papers in the program were published as the October 1956 issue of the T-MTT.

Also in 1956, the first Boston event, "Symposium on Microwave Properties and Applications of Ferrites" was sponsored by the Air Force Cambridge Research Center, MTT, and Harvard University. Twenty-eight papers were presented at the Symposium and attendance was just under 300.

These early events showed the emphasis of the new MTT on providing opportunities for information exchange and working with other groups. Multiple sessions at the annual IRE National Convention were regularly organized by MTT.

The AdCom chose to start a multi-topic Annual Meeting in 1957 which was first held at the Western Union Auditorium, NYC, May 9-10. There were 306 in attendance with 20 accepted papers ending with an awards banquet presenting the first Microwave Prize Award (initially called the Annual Award). The event was jointly organized by the NY, Long Island, and Northern NJ MTT chapters. It was a very successful event with a \$910 surplus with a member registration fee of \$6 and laid the groundwork for future annual events.

In 1958, the Annual Meeting was renamed the PG-MTT National Symposium and held on the west coast at Stanford University in Palo Alto, CA establishing the tradition of moving the annual event around the USA. A 3-day event, with the 1st day on Ferrites, 2nd on Microwave Physics, and 3rd on microwave techniques and filters. The banquet speaker was Dr. Terman, later to be known as the Father of Silicon

Valley. The steering organization structure of a general chair, technical program committee, local arrangements committee, publicity committee, and finance committee with written final reports was to become the norm for future years. Despite being located on the West Coast, the 1958 event exceeded the results of 1957 with an attendance of 437, a surplus of \$929 (with just a \$3 registration fee), 33 accepted papers, and the proceedings were published in T-MTT (January 1959).

In 1959, the National Symposium returned to the East Coast and was held in Cambridge, MA in September. Following the 1958 organizational model, it was again highly successful with an attendance of 615, a surplus of \$1377, 44 accepted papers plus 11 invited (including one international paper from Japan), and one evening session.

For 1960, the symposium alternated back to the West Coast in San Diego, CA, at the Del Coronado Hotel (the first "resort" location but attendance was still strong). This was the first competitive site selection (San Diego vs Los Angeles and a tie in the 1st round). Attendance was strong at 584 with 29 accepted papers (1 international) plus 10 invited and a surplus of \$343. Due to increasing costs and falling surplus, a proposal was made to accept industrial sponsorships or ads in attendee materials, but this was declined by the MTT AdCom as "commercialism is not desired at such technical events."

For 1961, Washington, DC was selected among four proposals. It featured the first archived digest that was not republished in T-MTT with 64 pages of abstracts, a total of 545 attendees, but no surplus even with member advance registration returning to \$6. With 20 accepted papers plus 7 invited, there were some parallel sessions that which was not well received.

While the IEEE MTT-S International Microwave Symposium (IMS) of today is much larger and more diverse, many traditions were started in those early years: rotating between East Coast and West Coast with the occasional mid-country site, strong volunteer engagement in planning the event, competitive site selection process, strong focus on a local theme, and more.

In addition to MTT-organized events, the group also sponsored sessions at the annual IRE National Conventions and the Western Electric Show and Convention (later to be called Wescon), MTT also regularly worked with ED and AP on topical meetings along with the International Union of Radio Science (URSI), AIEE and nearly annual events with the Polytechnic Institute of Brooklyn (PIB).

By the end of MTT's first decade, there were concerns the Annual Symposium was drawing content away from the IRE National Convention and Wescon. It was decided it would be best to use panels and/or invited papers for those events.

C. PUBLICATIONS

From the beginning, there were plans to have a regular publication. It was initially named Transactions of the IRE Professional Group on Microwave Theory and Techniques (T-MTT). The first issue was in March 1953 and was conference paper reprints. The second issue in November had mostly

invited papers. For several years, the T-MTT was the principal method for distributing the papers of symposiums and workshops to non-attendees. Getting original submissions was at first challenging, as an unknown journal from an unknown group. The T-MTT Paper Procurement team spent most of its time and energy on recruiting submissions. The funding for the transactions was challenging as it was expensive to print and distribute. While the IRE provided publications subsidies, with rising costs the T-MTT was regularly financially constrained. Early issues cost \$2000 and this quickly grew to over \$3000.

An early key feature of the T-MTT was an Annual Technology Review providing an overview of the state of the art in the MTT field of interest. This took an extensive effort to create but was widely appreciated. While initially domestically focused, this was increased over the years to include more international content with translated abstracts of relevant internationally published articles. Eventually, the national technology review was dropped, and emphasis was given to international reviews as the regular reader would have a good perspective on the national situation.

The early issues were a bit crudely formatted but in 1955 the IRE and T-MTT adopted a professional 2-column format not too dissimilar from today's IEEE format. But this additional copy-editing added to the cost. The title was changed to the IRE Transactions on Microwave Theory and Techniques. All issues of the T-MTT, back to 1952, are available on IEEE Xplore.

During this time there were "Contributions", full-length papers, and "Correspondences", short papers or reports, like what one might call "letters" today.

To build visibility of the Transactions, free subscriptions were offered to prominent international research libraries. This was later extended to leading researchers around the world. This was to encourage those leading researchers to provide submissions and was part of positioning T-MTT as an international journal vs just a national journal.

To address the funding issue, the transaction introduced "Institutional Listings", a form of brand name advertising on the back pages of the Transactions. In exchange for funding, there would be an acknowledgment of the support of the institution for the Transactions. MTT was more aggressive and more successful with this external funding source than most IRE Transactions and it allowed T-MTT to have more pages and articles. This success was tied closely to the strong links MTT had with the microwave industry. There was a short period of more traditional ads, but IRE changed its policy and that ended. Additionally, Position Available notices, primarily for academic institutions were provided for a fee. At this time there was no page or author charges as they were explicitly disallowed by IRE.

In 1958, given the increasing workload due to submissions, the AdCom approved paid help for the Transactions editor, at this time called the Technical Editor. With increased funding, the Transactions increased from two issues in 1953 to bi-monthly in 1960 (676 pages) and 1961 (585 pages).

Generally, acceptance rates were high (due to invited papers) but as submissions increased and finances got tighter, acceptance rates began to fall.

MTT started a second publication in September 1954, the PG-MTT Newsletter. Its original purpose was to provide updates on the AdCom activities to the membership. The Newsletter was published after each AdCom meeting with meeting summaries. It started as a modest, black-and-white format with 6 pages that grew to 12 pages in a couple of years. Unfortunately, many of the early newsletters have been lost to history and only those starting in 1968 are available. With the increased page count, each of the officers and committee chairs would write a short activity report, and notable actions of the AdCom were reported.

While well received by the membership for timely updates, to increase the interest in reading the Newsletter in 1958, extra discussion items were added, sometimes controversial, other times jokes, and witty sayings. Content expanded to include chapter activities and various symposium reports. This helped increase the engagement with the membership. The Newsletter, starting in 1957, used ads to cover the costs of its publishing and distributing costs, allowing for expanded coverage.

D. CHAPTERS/MEMBER GROWTH

At formation, MTT had 185 IRE members expressing interest in the new PG. By the end of 1952, there were 471 paid members (dues \$2 to receive Transactions,) and an equal number of non-paid members with MTT totaling 942 out of the 29408 members of IRE. There was a Membership Chair appointed at the first AdCom meeting and a membership drive was immediately initiated.

Chapters started forming in 1954, with Albuquerque-Los Alamos, Boston, Buffalo-Niagara, and Chicago first and then Long Island and NY, Los Angeles, Philadelphia, and Baltimore before the end of the year. Given the broad interest to form chapters, Regional Membership Chairs (IRE regions) were appointed. Chapters quickly reported the need for funding and speakers, to which AdCom responded with support for both.

By yearend of 1956, there were 12 chapters and 2908 paid members, 183 paid student members, and 50 unpaid, for a total of 3141 members. An issue arose after a couple of years that some chapters were too geographically large to properly serve members, and some were struggling with too few active members, so it was proposed to form joint chapters. Initially, this was opposed by some on the AdCom as diluting the chapter focus but eventually, joint chapters were formed, first with AP and then ED, a practice very common today to help serve less dense areas.

By the end of 1961 membership was over 5500 with 25 chapters of which 7 were joint. The Membership Committee had identified at least 5-10 more locations with sufficient membership. MTT tied as the third largest PG of IRE's 28 PGs (IRE's membership was 89117). Dues were raised to \$4 because of increased operating costs and to be able to

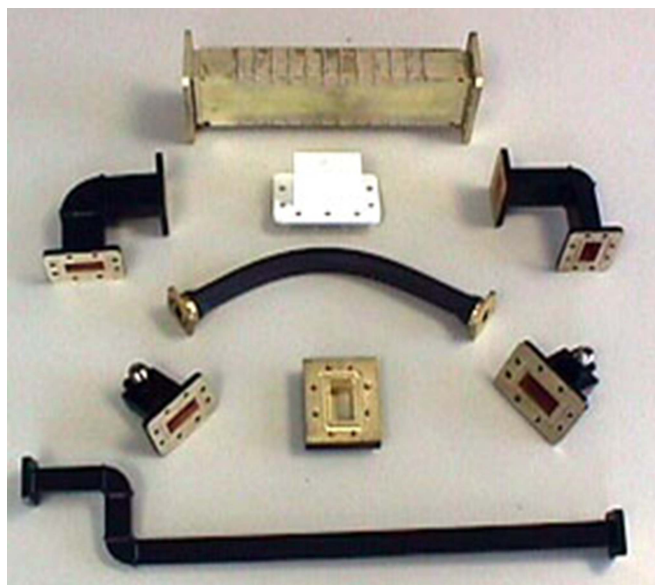


FIGURE 3. Waveguide, a microwave engineer's plumbing, circa 1950 (courtesy of IEEE history center).

provide Chapters with funding. The average chapter was 125 members, the LA chapter the largest with 300+ members. New chapter formation required at least 25 members. Early on, Chapter Chairs had a greater role in AdCom and were often polled for their opinions, however, as the number of chapters grew this involvement decreased.

Unfortunately, due to the extent of chapter activities, we will not be able to go into individual chapter activities.

E. INTERSOCIETY

Early on MTT developed working relationships with other groups to jointly sponsor conferences this included other PGs inside of IRE, such as AP, ED, and Communication Systems, and groups outside the IRE, such as USRI, AIEE, and Polytech Institute of Brooklyn (PIB). Joint chapters with AP and ED were common.

F. TECHNOLOGY FOCUS

As the technology that led to the formation of MTT was heavily influenced by WWII activities, areas like waveguide (plumbing), filters, dielectric WG, rotatory joints, electroforming, WG chokes backward wave oscillators (BWO), klystron, traveling-wave tube (TWT), standardization of waveguide and coaxial connectors, and low noise amps/parametric amps continued to be key topics. However, there were many new or evolved technologies emerging in these early years: stripline, microstrip, planar transmission lines, ferrite device YIG filters, early solid-state devices, GaAs point contact diodes, Masers, and therapeutic use of microwaves. Additionally, early concerns about the impacts of microwaves on humans and safe levels were topics closely followed.

In March 1961, as part of a larger, Constitutional update, the MTT FOI changed from

Section Ia. The Field of Interest of the Group shall be Microwave Theory, Microwave Circuitry and Techniques Microwave Measurements and the generation and amplification of microwaves and shall include scientific, technical, industrial or other activities that contribute to this field or utilize the techniques or products of this field, subject, as the art develops, to additions, subtractions, or other modifications directed or approved by the Institute Committee on Professional Group.

to

Section Ia. The Field of Interest of the Group shall be Microwave Theory, Techniques and Applications; Microwave Components, Devices and Circuits; the Generation, Amplification, Transmission and Detection of Microwaves. It shall include scientific, technical, industrial and other activities that contribute to this field or utilize the techniques or products of this field, subject, as the art develops, to additions, subtractions, or other modifications directed or approved by the IRE Profession Groups Committee.

With no change in

Section Ib. The generation and amplification of microwaves is a part of the field of interest with the provision that it does not conflict with the interest of the Profession Group on Electron Devices in matters relating to research, design, manufacture, and testing of electron tubes and semiconductor devices. It is recognized that a desirable overlap exists between the two Groups in relation to the use of such devices.

III. 1962-71 REFINING SCOPE & IEEE INTEGRATION

As MTT entered its second decade, it was a well-functioning professional group but in the next decade, there would be many changes.

A. ADCOM

By 1962, MTT had a strong membership and chapter structure, with an increasingly respected journal and annual symposium and links to many other international groups. A lot had happened in the first 10 years but much more was to happen in the next decade.

In advance of the IEEE merger, MTT revised its Constitution and Bylaws, barely getting the required 20% membership response to affirm the updates. That low response led to a Constitution and Bylaws change a few years later, requiring the posting of the proposed changes and allowing members to object. If an insufficient number objected in 30 days, the changes would take effect.

With AdCom having 5 or 6 meetings a year, now spread across the country, AdCom was struggling at times to get a majority in-person attendance at meetings. The MTT constitution allowed AdCom to act in these cases by setting the quorum at 1/3 of the AdCom and if non-attending members did not object to actions taken. Additionally, after some debate on whether all past AdCom Chairs should have a formal ex-officio role, it was agreed that the past 3 Chairs would have

a voting ex-official role for continuity. An AdCom handbook was drafted to capture common practices.

With a bit of a slowdown in the US economy in the early 1960's, the MTT membership growth slowed. This tracking between the US economy and MTT membership would repeat itself multiple times over the years. Attempts to stimulate membership seemed to have little ability to counter the economic trends. New member activities worked best when the economy was strong.

Just before the merger, IRE reduced the publication subsidy and asked PGs to limit spending. This was just another of the periodic financial cycles MTT had to deal with and tended to foster an environment of financial conservatism. This led to some cutbacks in publication, and more use of Correspondences vs Contributions. A high number of delinquent memberships led to a difficult decision to terminate memberships after attempts were made to re-engage.

On 1 January 1963, MTT became the "IEEE Professional Technical Group on Microwave Theory and Techniques" (PTG-MTT). This was soon shortened in May 1964 to "IEEE Microwave Theory and Techniques Group" or "Group on Microwave Theory and Techniques" (G-MTT). The terminology of society was not to come about for another 10 years.

With the IEEE merger, two recurring issues arose. A push from the new IEEE leadership to consider mergers or at least mergers of the transactions. AP was the most mentioned in conjunction with MTT, but neither was interested. The second was "FOI ownership." An area of dispute was lasers, quantum electronics, and fiber optics, as there were multiple other PTGs (particularly ED) also believing they had a claim. This led to the formation of a couple of "councils." First was the Joint Council on Quantum Electronics (JCQE) where MTT worked with other societies to manage these topic areas until the councils became IEEE societies. The journal editors played a significant role in refereeing FOI issues, handling this among themselves by the placement of papers into the right journal.

Solid State Circuits (SSC) became another council (that MTT initially resisted) with a journal and conference, and then later a full society. Numerous discussions were needed to resolve overlaps in conference topics and transactions.

Not all went well in the early years of the IEEE merger. Multiple members stopped receiving their publications, others were dropped from the membership rolls, including a member of the IEEE Board of Directors. Multiple letters of concern to IEEE leadership were endorsed by AdCom.

Expanding MTT's international visibility was a key goal for AdCom. AdCom was keen to support the Japan MTT Chapter to have a local symposium (1964) that eventually turned into an event broader than just MTT's scope. The event attracted much interest, and a group chartered a plane from the USA to Japan to attend.

MTT continued to provide free subscriptions to key international researchers and institutes. While MTT was trying to be an international organization, it was still principally domestic.

There were some international members or affiliate members in Europe and Japan, but no European chapters yet. The first non-US resident AdCom member had to resign in 1969 due to travel issues that made regular attendance an issue.

Finances continued as a cyclic issue. Voluntary Page Charges (VPC) (1966) were allowed by the IEEE for publications with free reprints for authors. MTT, at first, was unsure of VPC but eventually did adopt them in 1968. Transactions ads once again became allowed, but MTT decided not to pursue them. So, T-MTT institutional listings, Newsletter ads, dues (increased to \$7 in 1971), nonmember subscriptions, and conference surpluses were the principal sources of revenue. The original IRE, and now, IEEE publication subsidies continued for a bit longer but soon ended. AdCom also pushed to increase symposium registration fees, but the concept of symposium exhibits was still regularly rejected, fearing the exhibits would turn the technical event into a "salesman convention".

The non-IEEE International Microwave Power Institute (IMPI) was formed in 1966 as an industry group. IMPI was mostly focused on industrial heating uses of microwaves (and eventually home microwave ovens). There was little technical overlap with MTT, but each had a shared interest in the public's concerns about microwave safety. This safety issue would be a major issue for the next 20 years and MTT worked frequently with IMPI on the issue. The IEEE also worked jointly with American National Standards Institute (ANSI) to create IEEE/ANSI C95 standard on RF Radiation Hazards Levels.

AdCom was continuously making governance changes for more efficient operation. The role of Technical Committees (TCs) was created with 9 TCs initially as well as a Long Range Planning Committee was formalized. In 1968 AdCom went to calendar year terms, to align with IEEE and most other groups (previously was 1 July to June 30) and settled on four 1 1/2 to two-day meetings a year with pre-ADCOM committee meetings. The first meeting of the year remained at the next symposium site, the spring meeting in the New York area, the summer meeting at the symposium site, and again back to the New York area in the fall which later evolved to going to the symposium site 4 years out.

Providing a scholarship fund was a regular topic as was the desire to get industry financial support of them but that never worked out. The IRE did not allow PGs to fund scholarships, but the new IEEE did. So, in 1971, AdCom started looking into offering graduate student merit scholarships or grants for up to \$1000 (max 3 years).

In 1971 IEEE and TAB (Technical Activities Board - a group of all the IEEE society and council presidents) restructured, replacing Directors-at-Large with six technical Divisional Directors (Divisional Directors are also members of the IEEE Board of Directors). MTT was placed in Division IV, the Electrosiences Division. With MTT, there was AP, ED, Magnetics (MAG), Sonics and Ultrasonics (SU), Parts, Materials, and Packaging (PMP), and the Quantum Electronics (QE) Council. The first Division IV Director elected was MTT's Leo Young who later became the IEEE President

(1980) (other MTT members to be IEEE President were Bruno Weinschel in 1986 and Peter Staecker in 2013). Other MTT members have long been involved in the Publication Services and Products Board (PSPB)/TAB/TAB committees providing high visibility and influence for MTT.

B. IMS, CONFERENCES

When the 1962 National Symposium was held in Boulder CO, it had been clearly established the National Symposium was the premier symposium for MTT and the microwave community in North America. Each year the steering committees would enhance the event. Some notable items for 1962 were an improved digest, a tour of the National Bureau of Standards (NBS), and a tour of the Air Force Academy laboratories in Colorado Springs as part of the program.

Some other innovations included in 1963 (Santa Monica, CA), in a desire to keep the registration fee low (\$6 for IEEE members), Institutional Listings were sold for the digest, and commercial sponsorships were used for invited speakers. Members from the East Coast chartered a jet to travel to the 1963 National Symposium (\$210 roundtrip).

Desiring to increase the MTT's and the symposium's international stature, the name was changed from National Symposium to the MTT International Symposium for 1964 (Long Island, NY) which was held near the site of the 1964 World's Fair and reflecting the international nature of the IEEE. IMS1966 (Palo Alto, CA) was the first formal use of the "International Microwave Symposium" (IMS) which would become the standard name going forward.

IMS1971 (Washington DC) had several firsts: the first student paper contest, the first full-size 8 1/2 x 11 digest, a press room, and a very forward-looking presentation on automotive radar for collision avoidance and blind spot warning for personal vehicles. It also started the tradition of a symposium site-specific logo plus the first use of the new MTT Magic Tee logo at IMS.

International participation started slowly but with the encouragement of invited papers and sessions focused on international work, participation did start to increase. At IMS1966, there were 10 invited international speakers out of 93 total. Another practice was the "reading" of contributions from international researchers by a colleague familiar with the work. For IMS1967 (Boston, MA) a team in Japan selected papers and presenters for a special Japan-focused session. IMS Technical Program Committees (TPCs) began including several international members with some reviewing remotely. International attendance was growing each year with 28 (of 730) in 1969 (Dallas, TX).

At this point, two parallel sessions for three days were the norm (although four days were used for a few events), with 80-100 presentations and an acceptance of around 50%. Attendance was typically 500-750 and generally on an upward trend with east coast events and west coast events alternating besting previous results, a trend that would generally continue. A Ladies' Program was standard (would be years before this

was renamed the Guest Program). The event was returning \$2000-\$3000 in surplus each year.

As the event was growing it became increasingly necessary to "reserve" sites multiple years (3-5 years) in advance. This advance selection process would continue to go out further in the future.

Post-event Symposium Digest sales had started becoming a substantial revenue source which led to increasing the quality of the digest, hardback binding was added and the formatting of printed papers was improved, to aid sales.

While the annual symposium was the primary event for MTT, MTT continued with annual sessions at the IRE National Convention/IEEE Convention and Wescon. Additionally, MTT continued work with prior partners, but AdCom was cautious about sponsoring too many new events and having the bandwidth to properly engage. AdCom tightened up the rules and processes for co-sponsorship after MTT's involvement was attributed to several events without prior authorization.

Each year MTT did get involved with multiple events including the occasional URSI, PIB, Cornell University, and the National Electronics Conference (NEC) plus events with other IEEE entities, such as ED, AP, and Communications. A particularly successful series was the Joint Council on Quantum Electronics event, held first in 1966, with the highly successful 1968 event having 1200 in attendance, and 215 papers. There was some early involvement with the emerging European microwave event and MTT sponsored their 1969 event, but each side was initially cautious of becoming too engaged.

C. PUBLICATIONS

The second decade of the T-MTT would see many publication changes. The transition to the IEEE in 1963 would mean a name change to "IEEE Transactions on Microwave Theory and Techniques" and in 1965 the cover was changed leading to a common nickname, "The Green Book". Another formatting change (1966) was to move the Table of Contents to the front cover (and back cover at times). The outside of today's T-MTT and 1966 look very similar. A technological innovation of the day was microfiche subscriptions, saving library shelf space.

By mid-decade T-MTT moved to a monthly and the average article had grown to 6.6 pages. This trend would continue placing financial pressure on the T-MTT and page count. With reluctance, a VPC was added in 1969. Correspondingly the workload on the editor was exploding, so some changes were made to address this growth. A topical Associate Editor role was created and first used for Lasers, and the T-MTT Editor's financial support was increased for editorial/secretarial support.

In 1965 a new section, with a separate Associate Editor, "International Abstracts" was added, with international journal article abstracts from Japan, the United Kingdom, multiple Scandinavian countries, Italy, and Germany. Additional countries were added later as this practice continued for several years. This was done to provide access to these works for the

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FIGURE 4. The T-MTT green book.

American audience but also to build on the desired international image of the journal.

Through the strength of the authors and editors, T-MTT was building recognition as a leading journal inside and outside of the IEEE. T-MTT had more citations than any other IEEE/IRE transactions in 1965. Only the Proceedings were higher, T-MTT was 10% of all IEEE citations. In 1968, T-MTT ranked in the top 5 of transactions with member reader scores similar to #4 T-AP, #8 T-ED, and #1 T-IT. Among T-MTT subscribers, research and teaching professionals scored the T-MTT 100% but development (industry) readers scored it a lower 80%. These lower industry scores were common across the IEEE. This was also an indication that IEEE transactions were increasingly focused on theoretical works and decreasing publication of application work, which was usually relegated largely to the Correspondence section.

By 1969, T-MTT had published nearly 10000 accumulative pages, and over 2000 articles, an impressive amount but making it very difficult to find prior papers. This led to the discussion to create a master index of articles, subjects, and authors. Initially intended to be a 20-year index, this would turn out to be more difficult than anticipated.

Special issues were becoming a regular feature with an annual symposium issue at the end or beginning of the year and generally 2 other special issues annually. It is interesting to look at the topics of the special issues to

get a sense of the emerging hot topics. These included millimeter and submillimeter wave technology, the use of a computer for the design of microwave components and devices, biological effects of microwaves, multiple issues on microwave integrated circuits, microwave acoustics plus more traditional topics like microwave filters.

By 1971, T-MTT was 957 pages, and the 3-year average was 1100 pages, almost double the pages of 10 years earlier. The acceptance rate was in the 40-50% range with an equal number of full and short papers.

MTT also published with other IEEE groups in various ways. Joint issues with other groups were used to bring a variety of important topics to the MTT readers and share MTT content with other communities. This did introduce operational issues at times due to the shared roles. Also, as councils formed, they would create journals where MTT had a significant role: such as the Journal of Quantum Electronics which MTT and ED jointly published, and the J-SSC which involved multiple societies including MTT.

The other MTT publication, the Newsletter, was now regularly 16-20 pages and very popular for its informative content as a communication vehicle to the membership. The Newsletter was often used to run surveys of the membership on MTT activities. The editors also added fun content, so it wasn't just a dull technical publication. One such example was running a contest for the logo of the Newsletter which attracted many suggestions. Some early contenders, such as a modified IEEE symbol (right-hand rule) or Smith Chart-based logos (much later in 2015, IEEE/MTT would acquire the IP and copyright for the Smith Chart from the family) were dropped due to legal issues. The eventual selection was the Magic Tee logo, now the standard logo for MTT, which first appeared in the October 1970 Newsletter.

D. CHAPTERS/MEMBER GROWTH

In the early 1960's membership growth began to flatten and dipped a bit but recovered by 1967. By 1971 MTT had 6288 members out of 156229 for the IEEE. This put MTT in a 4-way tie for the 4th largest among IEEE groups. By 1971 there were 37 MTT domestic chapters with Canada and Japan each having one.

The main requests from the chapters were for funding and speakers. The National Lecturer program was started in 1967 and was an immediate hit. The National Lecturers were soon doing 15+ events each by 1971. A less formal Speaker Bureau was also heavily used by the chapters.

Chapters themselves were generally very active and in addition to chapter meetings, regularly held mini-events using local speakers. A few chapters started to have more major events, including weekend workshops and symposiums. The Orlando chapter's 1963 Millimeter Wave Symposium was large enough to raise concerns that it took papers away from National Symposium.

AdCom regularly surveyed the chapters to determine needs. One disturbing result which was a change from the earlier years of MTT, was the Chapters were not feeling engaged

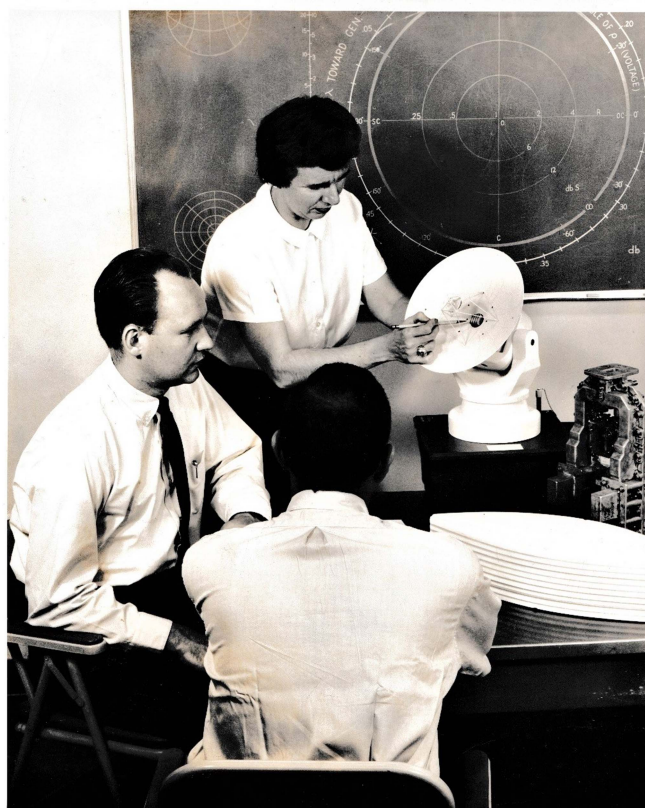


FIGURE 5. Robert Puttre, wheeler labs 1960's, on the left, creator of MTT logo and pat loth holding Nike Zeus cassegrain-type target-track antenna.

with AdCom. A source of this feeling probably came about because the Chapter Chairs were consulted less than before on AdCom decisions (but still included as non-voting members). Regular Chapter Chair Meetings (CCM) were started at the IMS to improve communications and provide training for new Chapter Chairs. Other feedback from Chapter Chair was a desire for IEEE to lobby for member and portable retirement plans, and more focus on professional activities. This would become of greater urgency soon.

E. INTERSOCIETY

While MTT focused most of its conference energy on IMS, the IRE National Convention, and Wescon, MTT did maintain relationships and co-sponsor smaller workshops with URSI, Cornell University, PIB, and the National Electronic Conference (NEC) plus its now IEEE partners. IEEE put all the technical groups together at TAB which provided opportunities to share ideas and best practices with AP, ED, Communications, and others. The JC-QE was another opportunity to interact with IEEE partners. There were some tentative interactions with an emerging European conference.

F. TECHNOLOGY FOCUS

By the end of the second MTT decade, WWII technologies were waning and MTT was focusing on many new technologies. Miniaturization and integration were common driving

themes. New classes of semiconductor devices such as GaAs MESFET (which would be the core of future GaAs ICs), Gunn diode, IMPATT diode, tunnel diode, and PIN diode, ... would be foretelling of major technology changes to be coming. Machined structures were being replaced by photolithographic structures such as stripline which then were key to the miniaturization of many building blocks like directional couplers, power dividers, and filters, and new structures like coplanar waveguides. New components based on material properties, like YIG filters or surface wave acoustic/piezoelectric filters, provided new building blocks. Large-scale microwave systems for satellites and phase arrays for radars were appearing. Early computers were used both as CAD design tools and as support for improved measurements. It was an exciting time for a microwave engineer.

After years of revision, MTT's Field Of Interest was as follows (from the July 1971 Newsletter):

Section Ia. The Field of Interest of the Group shall be Microwave Theory, Techniques, and Applications, as they relate to components, devices, circuits, and systems involving the generation, transmission, and detection of microwaves. It shall include scientific, technical, and industrial activities, subject to timely modifications approved by the IEEE TAB.

Section Ib. Microwave Theory and Techniques relates to electromagnetic waves usually in the frequency region between 1–100 GHz; other spectral regions and wave types are included within the scope of the Group whenever basic microwave theory and techniques can yield useful results. Generally, this occurs in the theory of wave propagation in structures with dimensions comparable to a wavelength, and in the related techniques for analysis and design. Examples are optical waves in suitably scaled structures, as well as the applications of acoustic, magnetic, and domain waves to microwave systems.

Section Ic. Considerable overlap exists with several other Groups. Specific areas are electron tubes and semiconductor devices for the Group on Electron Devices; radiating elements and propagation for the Group on Antennas and Propagation; and acoustical waves for the Group on Sonics. In each case, activities in areas of common interest shall be coordinated to assure a constructive and mutually satisfactory result.

IV. 1972-81 COMING OF AGE

While there was increasing international focus in the publications and symposiums, AdCom was still very focused on domestic issues.

A. ADCOM

The third decade of MTT found the USA in a prolonged recession after a long period of growth. The recession hit the aerospace and defense sectors particularly hard. This led to calls by impacted engineers for more employment, layoff, and pension protections. IEEE formed the IEEE United States Activities Board (USAB) in 1973 and change its tax status to 501(c)6 (business association with members) to allow lobbying.



FIGURE 6. RARRF, antenna reflecting array radio frequency, raytheon, 1968-1969, Ku-band, with over 3500 phase shifting modules.

The AdCom supported those calls but preferred the IEEE to take the lead. There were regular discussions on how the IEEE and MTT could support those members impacted. Profession Action Committees (PACs) became active at all levels of the IEEE, including MTT chapters. The IEEE (and MTT) created a list of experts willing to talk with legislators on the importance of the engineering workforce, and that of the microwave and high-tech industries to the nation. The concept of engineering unions was raised but there was little support. A key request from the PACs, supported also by multiple technical professional associations, was portable pensions. These efforts were a key driver for the creation of portable pensions, 401(k)s, in 1978 by the US federal government.

To further increase the awareness of the impact of microwave researchers and engineers, and of MTT, AdCom created the Microwave News Release (MNR) activity (1973). This was well received by trade magazine editors and continued for years before being discontinued.

As not all the TAB technical groups liked the term “Group”, IEEE allowed some groups to rebrand themselves as a “Society”. Society sounded more prestigious to some and was more in line with worldwide usage. AdCom at first was reluctant to

change, unsure why to change, and concerned with the loss of identity of the prior 20 years. After some deliberation, in 1974, MTT became the “Society on Microwave Theory and Techniques” and in 1976, the “Microwave Theory and Techniques Society.” Eventually, all of TAB’s technical groups evolved to society branding.

AdCom continued to meet four times a year until dropping the Spring meeting in 1980 and going to today’s three-times-a-year format which was common for other IEEE OUs. Also, in alignment with much of IEEE, the AdCom Chair was retitled MTT President. This renewed the discussion on if the President’s term of office should be increased from 1 year to 2 years as TAB had been urging MTT to consider. AdCom resisted the suggestion concerned that it would limit those willing to take on the long office term, particularly difficult for those from industry. Another TAB suggestion of member-at-large elections was tested with the membership and supported but only 2% responded, much less than prior issue surveys. AdCom took this as an indication of little interest in the suggestion. During the governance discussions, it was noted MTT’s governance document exclusively used masculine pronouns, but it would be a couple of decades before action was taken.

In response to media coverage of potential electromagnetic radiation hazards (such as from microwave ovens, radars, or communication systems) that increasingly created public misunderstandings, in 1972 the IEEE formed the Committee on Man and Radiation (COMAR) to respond to these problematic reports. COMAR, MTT, and other societies joined together to produce fact-based information for the public. COMAR, supported by MTT, participated in 1977 congressional hearings and published rebuttals to false media reports. MTT provided \$5K to fund an educational film on non-ionizing radiation. MTT also participated in TAB’s EM Radiation Committee.

As a side note, in 1981, when TAB reorganized the Technical Division structure, Divisions IV was labeled “Electromagnetic & Radiation.” Despite MTT’s and others’ objection to the problematic word, “Radiation”, it remained until the Technical Division labels were dropped. MTT was also upset that ED, its frequent partner, was moved to a different division.

Awards and recognition are a major role of any professional group and MTT had been slow in getting an appropriate program operational. This started to change with the Microwave Career Award and Microwave Application Award, both first awarded in 1973. The use of certificates of appreciation was introduced and regularly awarded to those providing exceptional service to MTT. A Hall of Fame plaque including major awardees, past presidents, and other distinguished members was created and first displayed at IMS1980. In 1978, MTT became a major supporter of the IEEE Edison Medal.

A major controversy rose between the IEEE Board of Directors (BoD) and TAB, and the Societies in 1977, as the IEEE BoD wanted governmental bodies to reserve the title of Engineer for Licensed/Registered/Professional Engineers. This was strongly resisted by most of the TAB societies including MTT. The BoD did adopt the policy, but it was rescinded after more discussion. This was just one clash, with more

to come, between the BoD and TAB/Societies that generated much angst and distrust.

Finances as always were front and center. Budgeting accuracy was proving to be difficult as volunteers (and the IEEE) were financially conservative, regularly overestimating expenses and underestimating revenues. This was common for IMS, committee projects, and IEEE publications leading to major swings in yearend outcomes from budgets.

A major change in revenue distribution occurred in 1978 when revenue from the IEEE All Transactions Package started being credited to the societies (it had previously gone to the IEEE General Fund). This significantly improved society's financials but would lead to issues in the future. This came with a promise to cover IEEE central operations deficits if they occurred. Soon afterward, in 1980, that did occur and there was a standoff on covering the General Fund deficits between TAB and the BoD until the BoD agreed to raise dues to lessen future deficits.

By 1981, MTT's reserves were nearly equal to annual expense, a target level considered appropriate by TAB. Feeling less pinched for funds, AdCom began looking at scholarships and fellowships.

B. IMS, CONFERENCES

The formula for the G-MTT Symposium/Annual Symposium/IMS had been fairly stable in prior years, but in the coming years, IMS would see many changes.

One of these changes was the growth in the technical program due to the growth of new technologies, such as microwave semiconductors, III-V devices, early integrated circuits, and new fabrication technologies. As there was a firm desire to stay within 3 days, this led to more parallel sessions, first 2, then 3, and then 4 became the norm. This was not without controversy as many felt unable to attend all the presentations they wanted.

Also, international participation was increasing. The apt-themed IMS1972 (Arlington Heights, IL) as "Microwave International" had paper submissions from eleven countries, totaling 39% of the submissions. While this was partially due to a recession in the USA, this was a sign of things to come. For the coming years, submissions from 10-15 countries and 1/3 of the total became the norm. MTT was beginning to achieve the international stature it had long wanted.

There were focused sessions on international developments such as in 1975 (Palo Alto), a session on Japanese activities, and in 1979 (Orlando, FL) a session organized by researchers from Japan. Also in 1979, there was an evening session on Engineering Technology and Microwave Education in China. The first non-USA IMS was in 1978 (Ottawa, Canada).

And while the core IMS would stay 3 days, the event expanded with Monday workshops at the beginning of the week (IMS1973Boulder, CO) and in later years more workshops were added on Friday. Also, several other events began to co-locate with IMS. At times these would overlap and have joint sessions and other times they would be more separate.

In 1974 (Atlanta, GA) "Together in '74" was 10 days of multiple events. MTT organized joint sessions with AP and URSI. There were separate symposiums on Submillimeter, and Electromagnetic Windows. While convenient and a great opportunity to do multiple activities in a single trip, it was a grueling 10 days for those attending all these events. Additionally, it was a very complex activity to manage for the steering committee. Another multi-event year was IMS1978 in Ottawa with IMPI and CPEM.

One of the most significant changes for IMS was the introduction of commercial exhibits. This had been widely resisted by the AdCom but the financial issues of the early 1970's required changes. Exhibits had been held by other IEEE groups without negative consequences to the technical program and would provide badly needed additional revenues. So experimenting, IMS1972 (Arlington Heights, IL) had a volunteer organized commercial exhibitions and they were able to sign-up 19 companies with 16 booths. This was judged to be a successful test by attendees and organizers, yielding an overall \$7300 surplus, significantly larger than any previous year.

In 1975, Horizon House/Microwave Journal (HH/MWJ) proposed to professionally manage IMS, where MTT would handle only the technical program. After a study by AdCom, a 3-year agreement was made, starting with IMS1977, with HH professionally managing just the exhibition. While the volunteer effort had doubled the exhibition size in 5 years to 43 booths, HH in their first year nearly tripled this to 119 booths and by 1981 had 154. Given HH's success, the agreement was extended again for 4 more years in 1981 (and again multiple times afterward).

Another expansion of the IMS was Historical Exhibits. First done at IMS1972 with mostly posters and photographs and repeated in some following years. At IMS1980 (Washington, DC), the historical exhibit had 72 artifacts, almost all of which were on loan, and these were placed in formal showcases. This became a permanent IMS feature with donations coming from a variety of industrial companies, including Raytheon, Westinghouse (radar set), M.O. Valve Co., England (magnetron artifacts) plus items from the MIT Radiation Laboratory Collection, NRL, and the Signal Corps. Between IMSs events the MTT historical exhibits were stored in a member's warehouse.

One practice tried and not continued was offering university housing (IMS1973, IMS1974, ...), common for some other events. Attendees seemed to prefer the creature comforts of traditional hotels, so the university housing option was discontinued, although, still used for student attendees when readily available.

IMS had doubled in size during this period. Attendance was now consistently over 1000, with IMS1981 getting 1500. The IMS mailing list was now over 17000 names. The norm for the technical program was 250 submitted papers with typically 160 presented yielding a 60-70% acceptance rate. With increased attendance and commercial exhibits, the surplus ballooned to \$63K for IMS1980 and \$88K for IMS1981. This growth did mean having to select sites five years in the future.



FIGURE 7. IMS1981 exhibits, Los Angeles.



FIGURE 8. IMS1980 history exhibits, Washington, DC.

MTT continued to sponsor other events with previous partners. MTT was looking for ways to increase engagement in Europe. It was decided not to directly compete with the existing European Microwave Conference (EuMC was founded in 1969) but rather to support and co-sponsor. While some Europeans urged this, others were apprehensive of MTT's motives. MTT also looked at cooperating with U.K.'s Military Microwave event, but little came of that.

Another cooperative conference was a submillimeter (terahertz) event with OSA that first collocated with IMS1974. MTT continued to sponsor this event until 1983 when the issue of working with an outside party became too difficult and the AdCom felt MTT was not a full partner.

C. PUBLICATIONS

The early 1970's were years of fiscal belt-tightening for MTT and T-MTT but after finances improved, T-MTT grew to record page counts, due to backlog, of 1491 pages in 1980 and 1377 pages in 1981.

Before finances improved, as the T-MTT was as much as 85% of MTT's budget, several T-MTT cost reductions were implemented. Some content (such as foreign abstracts) was

moved to the Newsletters, Later as finances improved, Patent Abstracts were added to T-MTT. Some changes were made in the page layout and fonts to squeeze a little more in fewer pages. The paper weight was reduced but that got negative feedback and was restored. But the reality was that, with increasing submissions, costs were rising, and more editorial support was needed.

Looking at improving the revenue side, more attention was given to the shortfall in the collection of Voluntary Page Charges (VPC) and AdCom pushed to always achieve at least 50-55% collection. Some suggested the T-MTT editor should slow the publication of those not providing VPC. This was controversial but a trial of 1 year was approved. The trial showed no improvement in VPC results, and the quota was dropped. Mandatory Overlength Page Charges (OPC) for over five pages were instituted in 1975 and it was required OPC must be paid before completing Galley Proofs. Unfortunately, as interest had waned, the Institutional Listings in the T-MTT were phased out in 1979. MTT declined to add advertising when allowed.

Other editorial changes in the late 1970's included replacing short papers (previously called correspondences) with shorter single-page tech notes requiring camera-ready copy. Letters to the Editor were more narrowly defined as corrections or comments, and not mini-submissions. However, this accelerated the shift to more theoretical papers and a decrease in application-oriented submissions. An attempt to counter this shift was to have issues focusing on applications, but the submission trend of more theoretical papers predominated.

By 1977, T-MTT was 3-4 months to acceptance and another 6 months to print and distribute. Other IEEE transactions tended to be at least 1 year and a few as long as 2 years. The rejection rate for T-MTT was about 20% although another 20% needed revisions. International submissions were starting to approach 50% of the total.

Work continued on the long-delayed 20-year index, which was retargeted to be a 25-year index with release in Dec 1978. Getting pre-IEEE papers indexed, and adding keywords continued to make this a major effort. The 1953-1979 Cumulative Index was first published in T-MTT November 1980 Part II, and to the great consternation of all, it was riddled with errors. The IEEE took responsibility for the errors It was agreed to republish at IEEE's cost with the MTT just paying the costs to add another year. This was released as T-MTT 1953-1980 Cumulative Index, June 1981 Part II. Future indexes would combine the T-MTT index and Symposia digest index as info was available.

There continued to be two topical special issues annually on average, and issues with selected contributions from the annual symposium. Associated Editors/Special Issues Editors became standard for special issues to divide the workload and drive more timely publication. A policy was instituted that symposium contributions needed to have significant new content to be eligible for T-MTT.

A typical special issue would contain 10-15 papers, with solid-state devices and circuits, millimeter/submillimeter and

optics, microwave communications, and high power having the most repeat issues. But there were a variety of other topics such as microwave acoustic signal processing, computer-oriented microwave practices, and gigabit logic. Additionally, there were joint special issues on SAW devices with the Sonics Ultrasonics Society (SU) and Open Guided Wave Structures with the new IEEE Quantum Electronics and Applications (QEA) Society. (Later, in 1985, renamed IEEE Lasers and Electro-Optics Society {LEOS} and then in 2009 as IEEE Photonics {PHO} Society).

The Spring 1981 Newsletter was the 100th Newsletter issue. As the primary communication method to the membership, it had grown from 12 pages (1972) to 24 pages including a President's column, AdCom report, TAB report, Symposium updates, selected opinion pieces, chapter reports, and Letters to the Editor. Some limited advertising was added to the Newsletter to offset costs.

Starting with the 85th issue, Winter 1977, for MTT's 25th anniversary, each newsletter covered a year of MTT's history. This ran until Issue 103 Spring 1982 covering the first 15 years of MTT.

In the late 1970s IEEE society magazines with more general technical content, as a replacement or alternative to newsletters, started to appear. The AdCom considered this but decided to continue as a newsletter. It would not be until 2000 that MTT would publish a magazine.

D. CHAPTERS/MEMBER GROWTH

With the economic impacts of 1970's, membership was essentially flat for the decade and ended 1981 at 6638 members while the IEEE had grown 40%. As new societies/councils were created, some previous MTT members left to join the new societies. MTT incurred a 9% membership decrease with QE/QEA's elevation to a society, in 1977. A positive membership note was an increase in international members and chapters. By 1981 MTT had 30% international memberships, with members in 75 countries. This international percentage was about the same as other societies, but IEEE was only 17%. MTT had 43 chapters (7 inactive) with 3 Canadian (Ottawa, Montreal, and Kitchener) chapters, and 4 additional international chapters in India, Japan, Tel Aviv, and Benelux.

[The IEEE organizes the world into 10 geographic regions. They are Regions 1-6 for the USA, Region 7 for Canada, Region 8 for Africa, Europe, and the Middle East, Region 9 for Latin America, and Region 10 for Asia and the Pacific. For more detail see - IEEE Regional World Map.]

With concerns about weakening membership, AdCom focused on providing more support for chapters and chapter chairs. This included more chapter training at the annual IMS Chapter Chair Meeting, a formal chapter operations handbook, guides to creating a local 1-day symposium, and reviving the Speakers' bureau for chapters. More funding for chapters was provided with additional support for chapter meeting publicity and seed funding for local symposiums. A cash award was created for the chapters with the largest increase in membership year over year. Dues were kept low,

well below costs, with a minor increase to \$8 in 1977 (the first in six years).

The National Lecture program was of increasing value to chapters. To provide more access, the filming of National lecture talks started in 1973. By 1980, National Lectures were each doing 20-25 live presentations annually. Their travel budget was frequently increased over the years to fund more in-person presentations and some international travel. Chapters were asked to pick up local costs.

E. INTERSOCIETY

While continuing to work with prior IEEE partners such as AP, ED, and ComSoc, and those outside the IEEE, PIB, and URSI. MTT, with other IEEE societies, developed connections with international groups such as the IEE, the Russian Popov Society, and various technical groups in China. Multiple exchange visits occurred with the international groups.

The Automatic Radio Frequency Techniques Group (ARFTG) with its focus on computer-assisted measurements was first co-located with IMS1979. MTT encouraged ARFTG to become more integrated with MTT and, in 1981, it became MTT TC-12 but as an independent, separate organization with a formal Memorandum of Understanding (MOU) with MTT.

F. TECHNOLOGY FOCUS

The number of technical committees expanded to 16 as MTT's technology areas expanded. Semiconductors, especially GaAs devices with their higher Ft (gain bandwidth) and lower noise were becoming mainstream. Device variations included HBT and pHEMT. True monolithic microwave ICs were appearing, including gigabit digital circuits, with the help of US Defense Advanced Research Projects Agency (DARPA) funding.

Commercial EDA CAD for microwave circuits and devices making use of analysis methods first presented in MTT journals and conferences were making great advancements. In turn, these tools became crucial to new developments in MTT's FOI. As covered in T-MTT special issues, material properties were being exploited for SAWs, Bragg cells, and other acoustical processes and dielectric materials for filters and oscillators. Major large microwave systems were regularly being developed for defense systems, like AEGIS, and commercial communications. New medical uses of microwaves were regularly reported.

So, while the formation of the QEA as a society meant the loss of lasers and optics, MTT was the home to an expanding and diverse set of technologies. There were no meaningful changes to MTT's written FOI for this decade.

V. 1982-1991 ADVENT OF COMMERCIAL MICROWAVES

MTT resumed its growth as microwaves started to be used in more commercial non-defense applications. T-MTT would continue to grow in respect and page count. IMS likewise would grow in attendance and exhibition size. MTT would use the financial rewards of this growth to significantly increase its activities.

A. ADCOM

MTT would start its fourth decade with a greater focus on its international presence. MTT and TAB both created Transnational Committees to focus on these goals. MTT grew from 7 International chapters (1982) to 29 chapters (40% of the total) by 1991.

Region 8 grew from 2 to 16 chapters, from Finland to South Africa. Europe was a delicate case as most countries had their own professional groups and there was the existing EuMC since 1969. While there appeared to be concern about an American take-over attempt, MTT pursued a path of support and co-sponsorship. Annual speaker exchanges were arranged between IMS and EuMC.

The international outreach also included Region 10. Japan was the largest MTT Chapter, and the affiliate membership option was expanded by including Japan's Institute of Electronics, Information, and Communication Engineers (IEICE) members. However, there was little MTT activity outside of Japan and India in Region 10. MTT joined the 1982 (and again in 1989) TAB Region 10 grand tour (Japan, India, China, and Australia). This was followed by a National Lecturer visit to China and a 1983 MTT delegation to China that visited many prominent Chinese universities. The Chair of China's Society of Microwaves spoke at IMS1982 (Dallas). The Beijing China MTT chapter was formed in 1986, one of the earliest Chinese IEEE chapters. By 1991, there were seven Region 10 chapters.

Earlier, except for one brief period (1968), AdCom lacked international members, but since 1989 there has been continuous and expanding international representation, including the first female member, who was also an international AdCom member, in 1991.

MTT also focused on domestic issues. In 1983, the US Department of Commerce announced funding cuts for the National Bureau of Standards (NBS). TAB, with MTT and other societies, formed an AdHoc Committee on Promoting National Microwave Standards (PNMS) and MTT provided some funding. The AdHoc's membership included many prominent representatives from commercial & defense industries (and MTT members). PNMS created a white paper on the importance of NBS and microwave standards to US industries and their worldwide competitiveness and national security. USAB endorsed the PNMS white paper. PNMS met with US Congress members and testified before congressional committees. Some of the NBS funding decisions were reversed but those financial pressures would reappear in the future.

Another pressing issue was the microwave radiation misinformation issue. COMAR had been created earlier and release a detailed position paper on human exposure to microwaves detailing that at normal exposure levels, there were no risks. The COMAR reports were widely shared, and IEEE Standards picked up the ANSI C95 work. MTT continued to participate and fund both groups as this issue would reappear periodically. COMAR eventually became a technical committee of the IEEE Engineering in Medicine and Biology (EMB) Society.

The Education Committee, with the improved MTT financial situation, developed multiple scholarships and fellowship programs for undergraduates, graduates, and post-grads. These programs went through multiple iterations including a program for children of MTT members which was later dropped as inappropriate for a non-profit. There were proposals to use industry donations but that was never successful, so scholarships were funded by MTT as an operating expense. Initially, this activity level was constrained by an IEEE 3% budget cap on awards and scholarships but once removed, MTT increased the number of recipients. Funding quickly reached over \$50K and higher in future years.

MTT's Awards Committee also added new major awards. The Distinguished Service Award was upgraded from a certificate to a major award. A Pioneer Award was added in 1990. A new service award was created and named after Walter Cox, a Georgia Tech professor, active MTT volunteer, and AdCom member who passed away far too early.

MTT's Educational Committee, created in 1982, jointly with the IEEE Educational Activities Board developed a series of emerging technology and home tutorial (VCR) videos (much like today's webinars). These were very popular with industry and academia and were offered to members at a major discount. They were provided to the chapters for free and could be checked out for personal use. This program was popular for several years and was a net revenue contributor.

Several areas that MTT had a strong interest in, first became separate councils, and later some as full societies, such as QE/QEA, and as would IEEE Solid State Circuits Society. New councils included IEEE Council on Electronic Design Automation CEDA (1982) and IEEE Council on Superconductivity (1991). While MTT provided funding and representation to the councils, it did lead to a loss of membership and papers as the councils or the new societies had their own publications and conferences.

As the overall financial picture improved due to greater publication revenue and IMS exhibition revenue, MTT reserves continued to grow and the AdCom began to look for opportunities to expand member and professional services. Some are covered above. Another way was to increase the publication page count, which would run a deficit until article revenues would catch up, fortunately, IMS surpluses would help fill that gap. The hiring of support staff was considered but other than editor support, this was again dismissed. Dues were increased in 1988 to \$12 (the last increase was 10 years earlier) but still were far below the \$31 cost of a member. MTT started discussions about creating a second publication that would take a significant investment but would provide opportunities to focus on new topics. And there was always the possibility that the societies would need again to cover IEEE General Fund deficits.

So, while the expenses grew from \$350K in 1982 to \$1,450K in 1991, the reserves grew from just under \$500K to \$1,450K in 2002. At this point, societies had several investment options, including a money market, bond fund, or equity

fund, to place their reserves. Investment income, which was larger than dues, was considered part of the operating budget. MTT created an Investment Advisory Committee to assist the MTT Treasurer and AdCom in these allocations. MTT did take a less conservative approach than some other societies. The concept of a single IEEE-managed Long Term Investment Fund (LTIF) was to come later.

B. IMS, CONFERENCES

The 1980's would be a period of topic expansion and large growth of IMS requiring the use of convention centers and multiple hotels. Many new activities would be added, and the look and feel of the event would be significantly changed forever.

Technical attendance grew from a typical 1000+ a decade earlier to a nominal 1700 (and total attendance of 8000-9000) with 1775 technical registrants at IMS1991 (Boston). The technical program doubled in size and never again would be below 600 submissions and 300 presentations (not including MMWMC). Workshops also doubled. The exhibition paid booths tripled in time to 450-500. The number of exhibit-only attendees became an important audience for the exhibitors (hitting a peak at IMS1991 of 2108).

IMS1982 (Dallas) would be the first year of the Microwave and Millimeter Wave Monolithic Circuits Symposium (MMWMC), an initially co-located event focusing on the emerging MMIC world. The first event had 447 registrants securing its continuing place in future IMS (and eventually becoming the RFIC Symposium in 1997).

During the 1980's there would be multiple (first at IMS1983, and again for IMS1984, and later in future years) International Traffic in Arms Regulations (ITAR) incidents. ITAR is a United States government restriction on the public release of certain defense and military-related technology information. This necessitated a "digest party" where the steering committee members had to razor blade out the violating papers from 2000 paper digests. New author requirements were instituted to prevent this, but it would repeat in future years causing MTT/IMS to look at employers to bear some of the costs of redacting the faulty papers.

Each year, IMS steering committees would add some notable innovations and firsts:

The Interactive (Open) Forum with poster papers versus the normal podium technical presentations first appeared at IMS1983 (Boston) and has been a permanent feature since.

The switch to convention centers first occurred at IMS1984 (San Francisco). With the increasing number of submissions, IMS1984 used some shorter paper presentations (10 minutes vs the normal 20 minutes) to allow for more presentations.

IMS1986 (Baltimore) had a live video link during plenary with the West Germany chapter. The IMS crab feast served 1050 attendees.

IMS1987 (Las Vegas) was the first non-chapter location and the first with two volume digest.

IMS1989 (Long Beach) had the "World Premiere" of "One Penny Opera" arranged for MTT.

IMS1990 (Dallas) was the first three-volume digest.

Registration was a re-occurring IMS issue, IMS had used a paper-based pre-registration (with a discount) since the beginning of IMS. And those who waited to register onsite would then fill out the same paper forms. As the event grew to multi-thousands of attendees, this grew more and more cumbersome. In 1982, it was decided to engage a multi-year provider instead of volunteers. Eventually, the exhibit manager, HH, was engaged to provide IMS registration but there were still periodic issues, such as long lines onsite due to staffing and complex registration options. Credit card payment was first offered at IMS1985 (St Louis) making the cash and check handling a bit more manageable.

Several special IMS historical sessions were held in various years for the IEEE Centennial (IMS1984), the Hertz Centennial (IMS1988), and the 50th anniversary of MIT Radiation Laboratory (IMS1991). These special sessions included retrospective historical presentations and the Rad Lab event had 300 alumni attending. Technical registrants for IMS1991 received an updated copy of the "Five Years at the Radiation Laboratory" memory book originally presented to Rad Lab employees in 1947.

There was a desire to share the IMS technical content more widely with the membership as republishing in the T-MTT was only feasible for a few papers. MTT arranged for a digest pre-order checkbox in the annual membership renewal process. A 30-year index of prior IMS papers (a total of 2210 papers) was distributed at IMS1984.

The MTT History Exhibit continued to grow with donations. By 1988 it was arranged to be stored at the Historical Electronics Museum (later renamed the National Electronics Museum, NEM) in the Baltimore area. It would be stored and partially on display except when needed for IMS. Each IMS would pay the shipping costs from and back to NEM and MTT would annually provide a donation for NEM support.

Given IMS's increased size and facility complexity, possible sites were becoming limited, so AdCom form a Site Negotiating Committee (later to become SINC) and started site selections 7 years out.

By 1990, MTT was involved with a dozen international events. IMS1990 was joint with AP and URSI with a single registration, which did get complex in dividing the surplus. MTT engaged with several regional microwave events: EuMC, Asia Pacific Microwave Conf (APMC), and the Brazilian Society of Microwaves and Optoelectronics (SBMO)/International Microwave and Optoelectronics Conference (IMOC). Other events included GaAs IC (with ED), Cornell Conference, International Microwave and Radar Conference (MIKON), Military Microwave (U.K.), IR &



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FIGURE 9. MGWL 1991 volume 1 issue 1.

MMwave Symposium, ARFTG, and Conference on Electrical Performance of Electronic Packaging (EPEP).

C. PUBLICATIONS

After a period of constrained publication, T-MTT would publish 50% more papers in this 10-year period compared to the previous 10 years. Hitting peaks of 2228 pages in 1982 and regularly 2100-2200 pages by 1990-1991. Given the large increase in workload, the use of general Associate Editors was raised multiple times but no consensus was reached. Submission-to-Publication was generally running 8-9 months with acceptance rates ranging from 60%-70% (including revisions). T-MTT regularly was rated as the top journal in microwaves and among the top IEEE journals.

In 1983, MTT purchased a computer and developed software for the editor to track and process submissions (which were still paper). In 1986, as editors changed and the paper submission reach 1 per calendar day, a new computer and software were obtained for the new editor given the age of the prior computer. By this point, the reviewer database contained 500+ names. Yet again in 1988, new hardware and software were developed. This is a cycle that would repeat as there were no standard systems for this activity.

Special topical issues continued at a rate of two per year. Five special issues were on active devices and integrated circuits. Other repeat issues were numerical and CAD methods, guided waves, microwave systems, optical/lightwave devices, and millimeter devices. There were special issues for the IEEE Centennial (1984) and another for Hertz Centennial (1988). The T-MTT IEEE Centennial Issue was devoted to "Historical Perspectives of Microwave Technology." It is the only hardcover Transaction ever published and it was awarded an IEEE Centennial medal as the best IEEE transactions issue in celebration of the 100th anniversary of the IEEE (AIEE). There were regular symposium (IMS and MMWMC) special issues, but caps had to be placed on their page counts due to costs and they were limited to just expanded versions of the symposium paper.

While shorter papers had originally been a part of T-MTT, they got squeezed out and did not fit with the regular T-MTT. AdCom had many discussions on the need for a fast publication cycle periodical with a greater emphasis on application and emerging technologies. It had many proposed names, but eventually "Microwave and Guided Wave Letters" (MGWL) was settled on and it debuted in January 1991 after getting TAB approval. Initially with a 400 page budget and cost of \$76K in the first year. It was originally just 3-page submissions but was later lengthened to 4 pages (2010) based on author feedback. To start with it would be bundled with T-MTT in the basic MTT membership without an increase in dues.

In 1983, after long discussions, MTT with multiple societies started a shared-ownership, the Journal of Lightwave Technology (J-LT). As many groups felt they had an interest in this technology area, this was a way to pull those interests together in a cooperative way.

The Newsletter was now regularly over 40 pages (from 16 pages) with more content on the society, professional information, conference calendar and reports, technology reports, AdCom committee reports, DML overviews, and discussion items. With other societies going to magazines, that question was raised many times. A member survey in 1988 polled strongly in favor of staying as a newsletter.

MTT worked with IEEE Press for much of this period producing 2-3 books annually, some of which were very successful. Books on Low Noise amps, MMIC design, and Numerical Methods were particularly successful. IEEE Press was a regular exhibitor at IMS and did brisk business.

D. CHAPTERS/MEMBER GROWTH

MTT broke through 11000 members in 1988 and exited 1991 at 10856, with over 60% growth in 10 years. Likewise, chapters grew to 70 (29 international) versus 43 chapters (7 international) in 1981. While the increase was in a large part due to MTT's international growth, the improved economy in the US also contributed.

AdCom increased chapter financial support (\$500 for MTT-only chapters and \$350 for joint chapters), passed the IEEE new member rebate on to the chapters, and provided options

for an additional \$100 funding for up to 3 special events. 1-day local seminars became very popular and were a good recruiting tool. Other recruiting activities included membership booths at all major microwave conferences and first-year free membership for IMS technical attendees. Student members were eligible for a first-year membership at any time. New members received a welcome message and lapsed members were surveyed for their reason not to renew. MTT placed membership ads in several trade journals.

Microwave Distinguished Lecturers (MDL or DML) (previously National Lecturers) terms were lengthened to 2 years with a new appointment every year making two DMLs available each year. Later, one would be European-focused. DMLs were doing an increasing number of talks in their two years terms peaking at 60 to 70 with many international. As this was discouraging some from becoming a DML, the number of live talks was reduced to 10 or 20 annually. More use of videotaped talks was made. Plus, the dormant Speaker's Bureau was re-instituted.

More emphasis was placed on Chapter Chair meetings at IMS and one-time travel funding to IMS was provided for eligible attendees leading to 45% attendance at IMS1990. In 1990 Chapter Chair Meetings started also to be annually held at EuMC and APMC. These meetings provided a good opportunity to exchange best practices and receive updates on support available from MTT.

A 1982 Doublet study of MTT membership showed 20% were MTT-only members, while another 36% also had AP memberships. The next most common additional societies were ED, ComSoc, Circuit & Systems, and Computers.

After over 10 years of no increase, dues were raised, in 1988, to \$12 and again in 1990 to \$15, still well below costs.

E. INTERSOCIETY

By 1991, MTT had formal links with 20 other IEEE and non-IEEE technical groups and other informal links. Many of these links had been going on for years and provided MTT with useful connections and influence. Such as, in 1987, USRI-USNC restored MTT's official seat and MTT agreed to have an official representative, who then was elected Chair of USRI Commission D. And through IEEE USAB, there were multiple committees (e.g., Defense R&D, Energy, Engineering R&D, ...), with MTT representation, working to influence US government spending. Other long-time links include AP, ED, LEOS, SSC, OSA, IMPI, and ANSI C-95 (COMAR).

F. TECHNOLOGY FOCUS

MTT Technical Committees had grown to 18 by 1991. Three new areas had been added: Microwave & Millimeter Wave Packaging, Manufacturing Technology, and Microwave Superconductivity Applications. ARFTG was changed to an MTT-sponsored conference (when collocated with IMS), eliminating its MTT-12 role, and linked instead to MTT-11 Microwave Measurements. The Technical Coordinating Committee started an emerging tech workshop before the IMS TPC meeting in 1989.



FIGURE 10. 1983 MTT AdCom China visit.

The most notable area focus changes from prior years were commercial applications, such as communications links, microwave backhauls, and satellite links. The commercial applications would come to dominate but there would still be significant defense electronics: radars, ECM, ECCM, T/R modules, phase/active arrays, and systems like AWACS and AEGIS which were microwave intensive.

For both defense and commercial applications key technology advancements were higher levels of integration of GaAs MIMICs and evolving technologies like pHEMT, HBT, silicon bipolar, and indium-based semiconductors, in the search for higher Ft and lower noise. Hand-in-hand was higher physical integration and packaging, and substrates with new guided wave structures and integrated inductors and capacitors. Also, a part of this miniaturization trend were dielectric resonators and dielectric resonator oscillators.

Another advancement was better modeling due to improved instrumentation with better fixturing and on-wafer probing using load-pull techniques and pulsed measurements. These improved models linked with linear and non-linear CAD tools allowed for accurate designs of more complex assemblies.

Other mixed-use technologies were high-power semiconductors, digital technology, digital radios, and analog and digital signal processing. On the emerging technology side, there were high Tc superconductivity and biological uses of microwaves.

There were no changes in the FOI in this decade.

VI. 1992-2001 OPENING OF EASTERN EUROPE AND THE REST OF THE WORLD

This time period would open and close with tremulous geopolitically events. The fall of the iron curtain and the end of the cold war would lead to the opening of Eastern Europe/Former Soviet Union (EE/FSU) countries for engagement with MTT but the resulting decrease in domestic defense spending

would negatively impact many MTT members and MTT finances. And as 2001 closed, the tragedy of 9/11 happened.

A. ADCOM

MTT had long been working on becoming a truly international organization and created a Transnational Committee in 1992. With the opening of EE/FSU, MTT's Transnational Committee (and ED) led by Region 8 MTT leaders reached out to the microwave communities that had been behind the iron curtain and not previously allowed to interact with the West. A key obstacle that quickly arose was financial, as EE/FSU researchers and their universities or institutions could not afford IEEE dues, periodicals, or conference travel.

In 1995, MTT and ED agreed to share the costs of covering the IEEE low-income reduced dues and free MTT or ED memberships for 3 years for 12 qualified individuals each at 6 separate chapters, 4 in Russia plus Ukraine and Bulgaria. Region 8 and other societies (ComSoc) had similar programs. This was later increased to 6 additional chapters and the time-frame was further extended. It was then expanded to chapters in low-income areas around the world allowing an individual to get dues relief for up to two years.

By 2001, the longtime effort to internationalize MTT was having an impact with 50% of the membership outside of Region 1-6 (USA). The AdCom also began to be more representative with the first Region 10 AdCom member in 1992, and by 1995, there were 3-4 members from Region 8 and 10 each year. In 1998, there was the 1st non-Region 1-6 Society President. Then just after 9/11, the first non-North American AdCom meeting was held in September 2001 at EuMW, a common practice that continues today.

MTT award activities stayed strong even during these uncertain financial times, MTT created its 7th major award in 1993, the Distinguished Educator Award. MTT's Awards committee was assigned the role of making the 2000 Millennium Medal Awards selection for MTT (34 medals). MTT increased the number of undergraduate scholarships (up to 10 @\$1200) and fellowships (up to 6 @\$6K plus \$1K travel to IMS) administered by the MTT Education Committee.

AdCom commissioned, in 1997, a project to scan all back issues of T-MTT, MGWL, and proceedings of IMS and MMWMC/RFIC. This would be over 70000 pages with full optical character recognition (OCR), fully searchable, and take 20 CDROMs. The archive was available for purchase to members, and non-members and reduced the need for 40+ years of paper. Annual update CDROMs were free to members to keep their archives fresh. This took two years and \$254K to complete. Over 9000 archive sets were sold. Annual updates continued until 2008 when using IEEE Xplore made more sense. In the end, the project likely covered all costs and made money. In 2002, the MTT Archive was integrated into Xplore, and MTT was refunded some of its costs as IEEE covered the costs for other journals.

MTT began making more use of electronic communication tools with the adoption of email by AdCom and the tentative use of the World Wide Web (Internet). AdCom

communications had previously been paper and surface mail but switched to email in 1994. Starting in 1997 some in-between meeting actions were handled by email ballots. MTT provided reimbursement to AdCom members needing email accounts (such as CompuServe, or AOL). This funding support was then expanded to the TCs and Chapters. MTT's first web page was hosted by the IEEE in 1995 and changed to an externally hosted one in 1999 to give MTT more freedom in modifying or updating the content. By 2000, nearly all MTT communications were electronic.

AdCom decided to increase the number of elected members from 18 to 21, and these three new members would be elected At-Large by the membership versus being AdCom selected. This started with the 2000 elections for the 2001-2003 term. Going forward, each year there would be 1 At-Large and 6 AdCom selected members.

One reason for adding more AdCom members was the increase in activities and services by MTT. Additionally, there were regular discussions about using paid staff to support these new activities. MTT was the largest IEEE society without paid professional staff. The cons were cost and concerns that other society AdComs with paid staff seemed to let the staff run things. Many had strong feelings that the high engagement of the AdCom and volunteers was a key part of MTT's culture and success, and that paid professional staff would negatively impact that. As financial issues deepen and reserves drained, the professional staff option was dropped. A less troublesome solution was using some past Presidents or retired AdCom members in support roles with a modest stipend. Multiple committees would use that option for administration support. It should be noted that the number of Past Presidents at AdCom meetings sometimes outnumbered the voting AdCom. This was not common for other IEEE societies and provided the MTT with a valuable resource.

Due to the hard times in aerospace defense, membership, and subscriptions decreased, and IMS attendance plateaued. That plus dues were not covering costs of included publications created financial strains for MTT. While initially resisted, this led to an unbundling of publications from dues in 1994 which allowed for lower cost, more attractive dues, and the ability to raise the fees for publications. The non-member subscription rates were also raised.

After a few years, finances improved, helped by an improving economy, new sources of periodical revenue, and significant increases in the stock market in the second half of the 1990's. However, the early 2000s were financially disastrous, a falling stock market and escalating programs and costs at IEEE led to a significant drawdown of the societies' reserves. MTT's reserves would fall from \$6M in 1999 to \$2.5M in 2002. There were 20% IEEE staff cuts and IEEE dues were increased as were MTT to \$10, T-MTT to \$15, and Letters to \$10. MTT dues before unbundling the publications had been \$15. This was a very contentious time between the societies and the IEEE BoD. The first attempt to resolve the financial structure failed in 1999, and much of the early 2000's would be spent addressing the underlying causes.



FIGURE 11. IMS1998 repeat of the popular Baltimore crab feast.

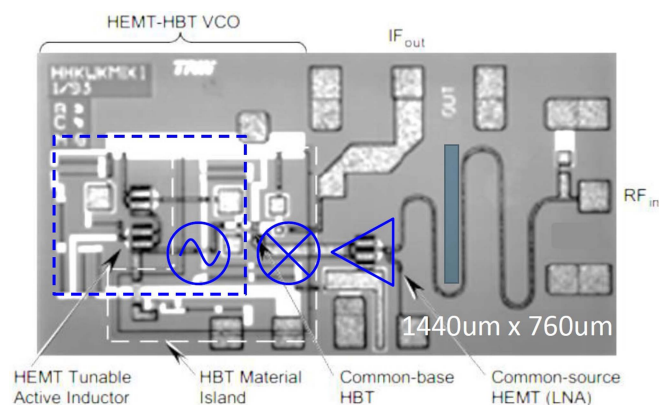


FIGURE 12. 1997 HEMT-HBT Ka-band LNA-mixer-VCO.

While not an MTT action, IEEE refiled in 1993, as a 501(c)3 non-profit for lower mailing cost and was no longer a 501(c)6 member association. This did change IEEE's responsibility to serve more than just its members. USAB could continue lobbying as long it was only a small part of the organization's activities.

And worth noting, MTT and IEEE survived Y2K without incident.

B. IMS, CONFERENCES

The growth of IMS continued albeit at a slower pace. Technical attendance grew from a typical 1700, 10 years earlier to 2400 (IMS2000 Boston, 2848). In the same time frame, submissions grew from 250 to 600, and IMS paper acceptances from 150 to 300. This necessitated increasing the number of parallel tracks from 3 to 4. Workshops grew substantially from 10 to 25 with workshop registration going from 800 to 2500 typically (for IMS2000 it was over 4000). Exhibits grew from 450 to 750. Overall attendance from 8000 to 9500. This was not straight-line growth, there were unusually strong years like IMS2000 and some below-average years. \$500K+ surpluses were common.

As was tradition, each IMS added some notable innovations and firsts:

IMS1992, Albuquerque, introduced the use of computers and videos in the open forum sessions.

IMS1992 and IMS1993, Atlanta, included a Russian Microwave Technologies session.

IMS1993, IMS1994, San Diego, and IMS1995, Orlando, included the collocated National Telesystems Conference. IMS1995 the digest weighed in at 12lbs, 1700 pages.

IMS1996, San Francisco, was the first year of CD-ROM digest, and MicroApps (exhibitor presentations).

IMS1997, Denver, hired a local professional meeting planner and had the first IMS website.

IMS1998, Baltimore, was the first year with a no-Digest registration option (28%) and the first year of electronic registration for advance and on-site, and earlier start on-site registration.

IMS1999, Anaheim, restructured IMS technical sessions to four days to allow for more long papers (following years reverted to 3-days) and the first four-volume digest.

IMS2000, Boston, was the first year of full electronic paper submissions and the first workshop CD-ROM.

IMS2001, Phoenix, had multiple ITAR issues delaying the release of the IMS2001 digest and the hottest "weather-wise" IMS ever.

There were regular discussions about changing the format of IMS as activities grew, increasing the number of days, or spinning off some activities to another event. As the event grew, the site selection became more challenging, and the exhibiting community wanted a greater voice. This brought back the concerns of the exhibition driving the event more so than the technical activities. Exhibitors preferred a few locations with greater exhibit-only attendance opportunities and wanted the technical attendees to spend more time in the exhibition. AdCom felt that locating IMS at a broad variety of sites was good for MTT and its members. However, in discussions about an international IMS, besides the issue of competing with the regional partners, it was clear this would not work well for the exhibition.

MMWMC had been a strong addition to IMS Week and continued to attract 500-600 registrants, but with the decreased defense focus and the increase in commercial activities, it pivoted in 1997 to become Radio Frequency Integrated Circuits (RFIC) Symposium which quickly grew to 881 attendees and 68 presented papers in 2001. RFIC began to focus on CMOS RF IC design for commercial applications, such as cellular phones, W-CDMA systems, wireless LAN, Bluetooth, and GPS plus RF silicon, MEMS, and higher degrees of integration, all hot topics. There were some tensions as RFIC felt constrained in the IMS environment but with time those concerns were worked out and a new MOU in 2000 (and another in 2004) was agreed upon, integrating finances with IMS, and providing more guaranteed freedom for RFIC to pursue topics and organize its event.

Another new addition to IMS was the Microwave Educators forum in 1998 organized by MTT's Education Committee. This was to provide a place to discuss and share best practices for microwave educators and for that home to be MTT/IMS. The first event had 120 participants and continued for several years.



FIGURE 13. MTT 50th anniversary logo.

In 1994, at HH's request, MTT did support the technical program of some topical events: the Technology for Wireless Applications in Turin, Italy, and Vancouver, Canada. These did not perform well. Attendance was weak, some authors did not show up, the exhibits were too large and too far from the technical program, and the digests arrived late. While earning a small surplus, due to the exhibits, it illustrated the difficulties of trying to start a technical event with exhibits from scratch, which is a lesson MTT would relearn again in the future.

MTT continued to sponsor 30 non-conflicting events worldwide at varying levels of sponsorship. More formal sponsorship agreements were created with APMC and IMOC. The first China co-sponsorship event was in 1997. In 2000, MTT agreed to 50% sharing with IEEE Components, Packaging and Manufacturing Technology Society (CPMT, now IEEE Electronics Packaging Society) of EPEP.

MTT's relationship with EuMC/EuMW/EuMA continued to evolve with some ups and downs. In 1998, MTT and EuMA agreed to exchange liaisons and speakers. MTT did provide loans at times for events part of EuMW. EuMW went through a few changes in event management and eventually settled on HH.

MTT did work with other European events, such as Military Microwaves, but eventually, EuMW became the dominant European event and MTT's main partner.

C. PUBLICATIONS

Early in the decade, needing to reduce the backlog, T-MTT had some 3000+ page years, but then settled in at a typical annual 2750 pages, a 25+% increase over the typical 2100-2200 of 10 years earlier. With the backlog, increased submissions, and increasing article page length, help was needed. To address the increased load, three Associate Editors for T-MTT

were added. With the increased submissions, the rejection rate increased to 40% (and this would continue to increase), and led to an increase in the submission to publications (sub-pub) time for a short period.

With the unbundling of both the T-MTT and the Letters, many were concerned there would be a significant drop off in subscriptions. Initially, there was a minimal decrease in Higher Grade members as subscribers, T-MTT was retained by 90%, Letters was retained by 80%, and 95% got at least one publication and a little lower percentage in all areas for students. The subscription rate did erode with time, but MTT fared better than many societies after unbundling. For 2001, T-MTT was #3 among society journals for paid member subscriptions, with 52% higher grade members still subscribing. The increasing availability of institutional Xplore access likely impacted subscriptions for all societies.

The MTT journals were adopting the new electronic communication methods. In 1993, MGWL became the IEEE's first journal to use email for submissions and reviews. T-MTT adopted this in 1994. This improved reviewer response rate and turnaround time and eased the editors' work. In 1999, IEEE introduced Manuscript Central (MC) for electronic submissions and peer review, but the MTT publications did not initially use MC as the editors preferred staying with their custom solutions. The practice was, every three years (an editor's term), there would be a new custom solution used by an MTT journal.

Arguably, the single most significant change in IEEE publications was the development of the IEEE Electronic Library (IEL). As IEEE publications became available in electronic format, IEEE created the IEL as a package available for purchase. Initially, this was a CD-ROM offering and was very popular as library shelf space was a scarce resource and IEL was electronically searchable. Early on, it was clear this would be even more useful online. JOLLY (Journal On-line Launch Year) was developed, and several journals using PDFs went online at the end of 1996, MTT joined soon after the first wave. This eventually became IEEE Xplore. IEL, using Xplore, led to a tremendous increase in access to IEEE and MTT's publications for members and for institutions that purchased access. Those subscriptions would quickly become a substantial revenue source. Lower cost subsets of just the All Society Publication Package (ASPP) or the Conference Proceedings Online Package (POP) were offered for smaller institutions.

This decade saw an increase in T-MTT Special Issues, averaging over 3 topical issues plus 5-6 conference issues annually. Space Terahertz Technology and Microwaves in Space were hot topics, as 1992 was the International Space Year (ISY). With other issues on Terahertz Electronics, these amounted to a total of six special issues. Other topics with multiple issues were Monolithic Microwave and Millimeter-Wave Integrated Circuits, Optical and Quasi Optical techniques, Packaging and Interconnects, Medical/Biological applications, CAD, and modeling issues. Additional special issues were on High-Temperature Superconductivity

applications and emerging commercial applications plus many more traditional topics like high-power amps, filters, and oscillators.

MGWL was quickly adopted by authors for its faster “sub-to-pub” than T-MTT, with a goal of less than 6 months (which at times was a challenge). MTT submitted a re-titling request for the MGWL as IEEE Microwave and Wireless Technology Letters but due to TAB pushback (too general), this was modified to IEEE Microwave and Wireless Components Letters (MWCL) which was approved in 2001. MWCL was regularly getting 700 submissions, and 722 pages for 2001. The T-MTT monthly patent abstracts were moved to MWCL.

While most seemed to be happy with the Newsletter, as more societies moved to the more glossy magazine format, MTT decided to investigate a magazine. At first, there were thoughts about keeping both, however, the last Newsletter went out in the Summer of 1999 with the 1998 Archive CDROM. The IEEE Microwave Magazine (MM) made its debut as a quarterly publication in 2000 as a publication included in the dues. The Magazine would have multiple longer tutorial articles in each issue, society news, and several general interest columns.

To support IEEE Press (Book) activities, MTT created an MTT IEEE Press editorial board press in 1994. The MTT activities consisted of a Microwave Series of over 10 titles including a 3-volume Microwave Handbook. Other Topics include Electrodynamics, Transmission Line Models, Co-Planar Waveguides, Quasioptics, Health & Safety in EM Fields, and Electromagnetic Simulation Using the FDTD Method. Generally, 8-10 titles were active at any time generating a few thousand dollars in royalties for MTT.

D. CHAPTERS/MEMBER GROWTH

With another set of aerospace and defense sectors cutbacks, membership dropped to 9051 by 1994 but rebounded strongly by 2001 with 13394 members (still an all-time high). Growth in Regions 8 and 10 was a major contributor and membership was now evenly divided between Regions 1-6 and Regions 7-10. Chapters increased to 101 (43 in Region 1-6, 36 in Region 8, and 14 in Region 10) with an average of 123 members per chapter. Japan continued to be the largest chapter at 762 and the United Kingdom, and Germany chapters were each in the mid-400s.

Many things were done to encourage membership. These included the usual discount and free offers at conferences plus mailings to those with IEEE Technical Interest Profiles (TIPs) that might be interested. Chapters were provided with a video to use in membership booths at local events. IEEE introduced GOLD, Graduates of the Last Decade, as a program to focus on younger members, a precursor to Young Professionals. Membership demographics showed that half of the new members left in the first 5 years, and that 10% new members were needed each year to just replace the lapsing members.

Chapter Chair Meetings (CCM) continued to be well attended, with 30-ish chapter chairs regularly attending the meetings at IMS. Regional CCMs were started at APMC,

EuMC, IMOC, and some joint with Division I and IV in Region 8. Since AdCom’s Chapters Liaisons program rarely worked, a short-lived newsletter just for the chapter chairs was tried starting in 1993, the Transceiver.

An MTT member survey in 1996 listed publications as the #1 reason for membership, but for many, the publications were too academic, and they wanted more application content. IEL access provided by their employers would begin to erode the member’s need for individual subscription access. IMS was the #2 reason for membership but only 20% attended and many only if IMS was local. MTT members were multi-disciplinary, as only 25% are just MTT.

Additional activities included a program to recycle members’ back T-MTT issues by sending them to chapters without journal access. DMLs continue to be very popular with chapters, and by 2001 the program had grown to 4 new DMLs annually plus 1 European regional DML, all on three-year terms.

E. INTERSOCIETY

While continuing with prior societal liaisons, MTT added Instrumentation and Measurement (I&M), Sensors (SEN), and Intelligent Transportation Systems (ITS). MTT also added liaisons for two new TAB committees: Health Care Engineering Policy and New Technology Directions (later to be Future Directions). The total formal links reached 15 Intersociety Liaisons and a dozen TAB committees, publications, and council liaisons.

F. TECHNOLOGY FOCUS

The MTT Technical Coordination Committee (TCC) in 2001 re-structured to 21 TCs. The new TCs were: RF MEMs, Wireless Communication, Microwave Technology Business, and Microwave Superconductivity. While other TCs changed their titles: Microwave Lightwave changed to Photonics and Submillimeter changed to Terahertz Techniques.

In the 1990’s, there was expanding application of microwave technology for commercial uses plus research activities exploring new technologies, leading to the growth in submissions to MTT publications and conferences. Commercial applications included satellite systems like the Iridium and Global Positioning Systems (GPS). More earth-bound applications were related to mobile communications: 64QAM, CDMA, 1-chip radio, Wireless Local Area Networks, Bluetooth, Metropolitan/Local Multipoint Distribution Services (MMDS/LMDS), and International Mobile Telecommunications-2000 (IMT-2000). Some other commercial system-related topics were RFIDs, Automotive Radar, Vehicle Communication, Intelligent Vehicle Highway Systems, and Spectrum Policy. Device topics were still hot with LDMOS, Silicon/Silicon Germanium, BiCMOS, In-GaP/InGaAs/GaAs HEMT devices, and modeling/CAD tools.

Two major changes in MTT’s FOI (1993 & 1994) were the addition of “modulation, demodulation, control of microwave signals” and expanding from 1-100 GHZ to 0.2 to 1000 GHZ.

VII. 2002-2011 50TH ANNIVERSARY

50 years later and MTT had established itself as the leading international microwave society, but it was not the time to be complacent.

A. ADCOM

2002 was the 50th anniversary of the founding of MTT. The AdCom had started preparations for celebrating the 50th as far back as 1998. There were many ideas such as a PBS-like documentary (as was done for the Rad Lab anniversary) or a professionally written history of Microwaves, neither of which panned out. A special T-MTT Issue, March 2002, "50th Anniversary Issue" was assembled with 50 invited articles on the history of the society, profession, major technology areas, and outlook for the future. A widely used special 50th Anniversary logo was designed plus a special member pin for the entire membership with different small color inserts recognizing 10-, 20-, 30-, and 40-year members. A virtual (on-line) MTT Museum was created in conjunction with the IEEE History center (but is no longer available). At IMS 2002, there was a special technical session plus a special poster session held in the History Exhibit with some of the T-MTT papers where it was noted Marconi's first transatlantic radio signal transmission occurred 100 years (and 6 months) earlier.

MTT focused on more awards activities as MTT's finances improved. Initially, the undergraduate scholarships were undersubscribed, so eligibility was expanded to entering students and first-year graduates plus more promotion was done. This worked so well that MTT went to ten spring and ten fall scholarship awards. The Fellowship Awards were expanded to eight annually in 2009. There was always the question if this was making a difference but in future years, some awardees would end up on the AdCom or in other MTT leadership roles.

As MTT had added two publications and would be starting a third in 2011, Best Paper awards were created for MWCL (2010), MM (2010), and T-TST (2012). There was some discussion if the Microwave Prize should be limited to T-MTT but it was left as any publication in the MTT FOI although, in reality, it had been just the T-MTT. The best paper awards are considered major awards with an honorarium and plaque plus travel support to the IMS for one awardee.

The Outstanding Young Engineer Award was expanded to one industry and one academia awardee, but in some years, there would be more than one in each category (later formally increase to up to four annually).

Harold Sobol Travel Grant for a student presenting an exceptional IMS paper was instituted in 2005 for \$500 and later increased to \$1000 in 2010. The long-discussed IEEE Microwave Education Fund was finally set up at the IEEE Foundation and received some initial contributions. However, the fundraising was unsuccessful, and it was only once used for a scholarship, so it was repurposed for student travel to IMS until it was exhausted.

MTT played a key role in multiple IEEE Technical Field Awards. MTT continued to co-sponsorship the IEEE

Electromagnetics Award. With the Geosciences and Remote Sensing (GRS) society, MTT endowed the IEEE Kiyo Tomiyasu Field Award, for an outstanding early to mid-career contributor to technologies holding the promise of innovative applications. Kiyo was a long-time MTT contributor, joining the AdCom in 1955, AdCom Chair in 1960-61, and Honorary Life Member in 1978. Additionally, MTT joined other societies to endow the IEEE W.R.G. Baker Award, for an outstanding paper award in an IEEE periodical. MTT also provided \$100K, matched by an MTT member, to preserve Glenlair, the home of James Clerk Maxwell in Scotland.

2002 was still a rough year for IEEE and Society finances. Finally, by the mid-2000's a new stable financial model had evolved. It wasn't without controversy, but the IEEE and Societies eventually settled on a model where central infrastructure costs would be funded by allocations to the major organizational units and later this was handled as a percentage of publication revenues. Fortunately, the success of Xplore and IEL generated enough revenue to make this a workable plan. So, after two decades of financial turmoil, there were to be fewer crises. There continued to be pressure to reduce the overhead infrastructure costs which did happen with time. As revenues increased and financial stability ensued, MTT was able to significantly increase its activities.

There were other key financial changes. First, investment returns could not be used to budget or fund normal operations. However, the use of reserves (accumulated surpluses) could be used to fund initiatives with the understanding those funds could be turned off if needed for fiscal reasons. So, while the economy and equities markets could still have their ups and downs (such as in 2008), the impact on IEEE and MTT operations was greatly diminished. The second change was a new agreement for allocating IEL and other institute-wide publication product revenues to be based principally on downloads, and secondarily on the number of new submissions. The new revenue distribution algorithm turned out to be generally favorable for MTT.

Broadly speaking, MTT earned net surpluses from conferences and periodicals which were used to support committees, awards, projects, administration, and chapters. Dues and individual subscription fees barely covered their expenses or ran a loss.

The use of paid staff to support volunteers continued to be re-raised as it was noted volunteer bandwidth was becoming more limiting than budget constraints. While an executive director was still considered problematic, more committees were making use of a paid administrator, typically staffed by retired volunteers. With time, the number of these separate positions was becoming difficult to manage, so a budget was created to consolidate some of the administrator roles and a group was tasked to find a solution.

As the face of the membership was changing, becoming more international and more diverse, the AdCom was not changing as much and had been labeled by some as "an old boys' network", and "too inbred." While AdCom



FIGURE 14. Restored Glenlair, the home of James clerk Maxwell in Scotland.

acknowledged that, the preference for those with demonstrated prior committee involvement continued. This led to greater attempts to recruit more a diverse AdCom, chapter, and conference steering committee members. Some steps included more outreach to Region 10, a more formal role for WIE (later Women in Microwave, WIM) on the MTT Membership & Services committee, more inclusion of GOLD (YPs), more student outreach, and modifying governance documents to be gender neutral. The MTT Nominations & Appointments (N&A) Committee was asked to consider diversity in their process and for the member-at-large election positions to have a rotating focus on worldwide, Region 8, and then Region 10 candidates.

The relationship with EuMA/EuMW continued to improve, with strong cross-representation on governing bodies and regular communication. After working out details on copyrights, EuMC Proceedings, back to 1969, were included in Xplore in 2010. MTT continued to provide Technical Co-sponsorship of EuMC, EuMIC, and EuRAD and to financially co-sponsor ECWT until it was absorbed into EuMC in 2011. MTT agreed to share its Technical Program Management System (TPMS) with EuMW. EuMA would provide annually 10000 € to fund MTT Region 8 chapters' activities using the proceeds from their very successful EuMW.

While continuing Region 8 outreach, MTT initiated more Region 10 activities. While there had been earlier visits by MTT to China and India and a 2002 AdCom meeting in Japan, it was felt more outreach was needed. In 2007, MTT held an AdCom meeting in Shanghai, and then a smaller delegation toured China meeting with academic and government leaders to find out what MTT could do. There was strong interest in Chinese language materials, help in getting their work published (better understanding of IEEE requirements), materials for local chapters, and resolving issues with dues and travel costs. Then in 2008, a similar delegation toured India, and MTT followed up in 2012 with an AdCom meeting in New Delhi. India microwave leaders wanted help in meeting IEEE publishing standards, lower dues, and the ability to pay in

local currency, tutorial materials, speakers, and making the conference approval process simpler. Both countries encouraged MTT to sustain this outreach. There were significant increases in membership after these visits.

MTT increased its engagement with APMC by adding past conference proceedings to Xplore in 2005 and signing a formal MOU in 2008. MTT regularly technically co-sponsors APMC and provided financial sponsorship when requested.

In response to the feedback, in 2008, MTT funded translations of MM articles into Chinese, and for Region 9 (Latin America), Spanish and Portuguese. By 2011, 60 articles were translated into simplified & traditional Chinese, 27 articles into Spanish, and 5 articles into Portuguese. In 2011 alone, there were nearly 90000 downloads from MTT.org, and 85% of these were for Chinese articles.

Increasing outreach, the Education Committee had several activities going on such as the MultiMedia RF and Microwave April 2003 special issue with CDROM of T-MTT, the ongoing IMS RF and Microwave Education Forums, and annual Scholarship and Fellowships awards. Another major effort was ExpertNow, a 2005 TAB/Educational Activities Board (EAB) program for professionally produced online tutorial courses authored by "Subject Matter Experts" (SMEs). These would be sold to corporations, academic institutions, and individuals (reduced prices for IEEE members) and the societies would receive the revenue. MTT would get one "free" module and the rest would cost MTT \$20K to be paid back from revenues. Five additional MTT modules were released, four more were in development, and seven more had been committed when the program closed in 2009. The revenue model was failing, and most societies did not participate.

B. IMS, CONFERENCES

IMS appears to have peaked in early 2000. By 2011 numbers were weakening, as IMS registration slid to 2000, RFIC to 735, and workshop registrations were slightly lower to 2075 with a total technical registration of 2600. IMS paper submissions were mixed with a strong first half of 2000's with a couple of 1000+ submissions years and then a downward trend, but a few bright spots brought the average for the second half to 868. RFIC was averaging 265 submissions but with some year-to-year variation. Parallel technical sessions increased to seven on some days. Fortunately, exhibit booth sales increased to 810 on average (840 excluding Hawaii). Some of the declines may have been due to other conferences increasing their numbers and some may have been due to economic conditions. Another proposed explanation was that, with the T-MTT getting stricter on the need for new content over the IMS submission and the sub-to-pub for T-MTT being similar to the timeline for the IMS digest, led some to skip the conference submission path.

With advice from the IEEE, and with the retirement of some key HH personnel, MTT went through a yearlong competitive bid process for IMS exhibition management. After 32 years of HH managing IMS exhibits, MTT selected MP Associates (MPA) as IMS2009 Exhibit Manager. The transition went well



FIGURE 15. 2010 Cairo AdCom meeting.

and MPA was extended until 2014. HH continued to play a key role in promoting IMS.

IMS steering committees had historically reported to the MTT Meeting & Symposia Committee (M&SC). Given the size of IMS and the need to better coordinate year-to-year activities, a new Ad Hoc Committee on IMS Co-ordination was created in 2002. Later it became a standing committee, the IMS Executive Committee (IMSEC, 2004), to address issues of common interest and to create more continuity among IMS years. The Site Inspection & Negotiating Committee (SINC) became an IMSEC subcommittee.

With the IMSEC in place, it became a forum for creating and managing multi-year activities and contracts removing the need for individual steering committees to redo this each year. This included multi-year discounted audio-visual contracts, digest and publication production contracts, a shared website template, a common chart of accounts, and retaining a professional treasurer. IMSEC also handled the exhibit manager contact and started a discussion about retaining a multi-year event planner. Annual events would evolve IMS from being an annual start-up to more of a franchise model. Continuity was improved as significant changes would require three years of IMS Chairs to agree.

One major activity IMSEC became involved in was the Technical Program Management System (TPMS). TPMS was developed by a volunteer for IMS2005 after commercial systems were found deficient for IMS' needs. TPMS was regularly enhanced and became the mainstay for MTT conferences and a few technical co-sponsored events for over 10 years.

SINC increased IMS site selections to eight years out to get desirable dates but for Boston and San Francisco it was necessary to go out even further and placed no costs holds (first right of refusal) for 10 and 20 years out. Boston and San Francisco were categorized as "strategic" cities for IMS and would not go through a competitive process if SINC felt the bid was reasonable.

As was tradition, each IMS added some notable innovations and firsts:

IMS2002, Seattle, was the last year of 35mm presentations, the pilot year for electronic presentations, and the first using a professional meeting planner.

IMS2003, Philadelphia, had the Call for Papers in multiple languages, the first year of IEEE doing event planning, with free Wi-Fi for attendees and used a 3rd party paper submission service.

IMS2004, Ft. Worth, had the first uApps CD and required pre-registration for a printed digest.

IMS2005, Long Beach, dropped the paper digest, added the first Student Design Contest, and made the first >\$1M surplus.

IMS2006, San Francisco, had a daily Abstract Book, Print-on-Demand, and Exhibitor Press Event, and used IEEE staff to negotiate hotel contracts.

IMS2007, Honolulu, offered Short Courses with IEEE Continuing Education Unit (CEUs) credits, a dress code of "Business Aloha", another ITAR incident, and provided MTT GOLD members incentives to attend. There was exhibitor resistance to Hawaii, but it received a very high number of paper submissions.

IMS2008, Atlanta, introduced the MTT GOLD Pavilion and International Exhibition Pavilion plus it was the last year of HH as exhibit manager, and a tornado damaged the hotel the month before.

IMS2009, Boston, introduced a new registration option (SuperPass, Early Bird-3 tier fees), free Wednesday exhibits, evening reception on the Exhibit Floor, promotional IMS Insider newsletter, and MPA became Exhibit Manager.

IMS2010, Anaheim, added an Emerging Technology TPRC Committee, linked publishing of the Program and Digest with the TPMS Database, STEM program, Badge Cash, and used USB drives for Digest distribution.

IMS2011, Baltimore, introduced double-blind reviewing, a smartphone App, the Graduate Student Challenge, μ Apps Panel Session, and a Closing Ceremony.

There had long been a concern that MTT was too dependent on a single major overloaded conference. It was thought that perhaps a solution would be to offload some subjects to another event while creating a second significant source of conference revenue. Unrelated in 1996, a new event called the Wireless Communications Conference was started and later became the MTT-supported IEEE Radio and Wireless Conference (RAWCON) but after a few years it began to struggle. It was re-branded as a second symposium for MTT, as the IEEE Radio Wireless Symposium (RWS). It would be structured like IMS, at a convention center with exhibits, but in January at a warm weather location. The IMS TPC and MTT AdCom meetings would be collocated at RWS to provide a source of attendees.

The first RWS was in 2006 and collocated with Power Amplifiers for Wireless Communications (PAW) and The Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF). RWS2006 has some success as a technical event with 750 technical attendees and nearly 300 presentations but

the 155 booth exhibitors were discouraged by the smaller-than-expected audience and felt the technical sessions were located too far away from the exhibits, so exhibit traffic was light. In 2007, the exhibitors were disappointed again and the idea for a large exhibition was dropped going forward. Attendance held up for a couple of years and then started fading.

In 2010 and 2011 the event was reimagined as Radio Wireless Week (RWW) with multiple emerging technology events; RWS, SiRF, Power Amplifiers for Radio and Wireless Applications (PAWR), Wireless Sensors and Sensor Networks (WiSNet) and Biomedical Wireless Technologies, Networks, and Sensing Systems (BioWireleSS). Attendance settled in at 400+ and 200+ presentations.

By 2011, MTT was sponsoring over 50, mostly repeat conferences and workshops, and its International Microwave Workshop Series (IMWS). IMWS was a series of workshops started in 2009 and presented around the world by MTT on leading topics. MTT 100% financially sponsors eight conferences: IMS, RFIC, RWS, PAWR, BioWireleSS, WiSNet, SiRF, and WAMICON. Plus, MTT partially financially co-sponsored additional conferences and workshops, such as ARFTG, EPEP, International Conference on Ubiquitous Wireless Broadband (ICUWB), International Conference on Wireless Information Technology and Systems (ICWITS), International Symposium on Radio-Frequency Integration Technology (RFIT), MIKON and European Conference on Wireless Technology (ECWT). MTT also was supporting all the major regional microwave events: EuMW, APMC, and IMOC. There were many additional technical co-sponsored and occasionally financially supporting events, and as the number of events grew, ADCOM delegated the oversight of technical sponsorship to the MTT M&SC. Some long-time events were moved to a three-year review cycle. The TCs aided M&SC in reviewing conferences for content and MTT involvement.

C. PUBLICATIONS

The trend of increased paper submissions continued for both T-MTT and MWCL. T-MTT published 30% more pages in these 10 years than in the previous 10 years. MWCL had a 55% increase. Even with increased budgeted page counts, there needed to be multiple mid-year supplemental page budget increases. This created a strain on the editorial team and for very a brief period, sub-to-pub slipped but by the second half of this MTT decade, both journals were below the IEEE desired nine-month sub-to-pub, even with this huge paper increase. The pool of Associate Editors for both journals expanded to support the editors. The quality standard stayed high with 30-40% acceptance rates. By 2011, T-MTT was 3900 pages annually and would continue to rise. MWCL, which was predominantly international submissions, was running 825 pages.

Impact Factor, which had been an obscure metric for years (first used in 1975), became more important in the mid-2000s as some institutions set a minimum required impact



FIGURE 16. IMS2011 magnetron display history exhibit, Baltimore.

factor when selecting journals for submissions. While it can be noisy, varies between subject areas and disciplines, and potentially can be manipulated, it nevertheless became a single indicator of a publication's "quality" and "importance". For 2005 (released in 2007) T-MTT had an impact factor of 2.27 with a cited half-life of 7.7 years. This ranked T-MTT, 15th and 16th respectively, among the 208 publications in its category, Electrotechnology, which included 78 other IEEE journals. This was regarded as an excellent result for T-MTT which was a clear #1 among journals in the microwave subject area. MWCL had an impact factor of 1.4 and a half-life of 2.7 years, 34th and 70th among those 208 publications, and very high among Letters. T-MTT's IF stayed above 2.0 and MWCL started to breach 2.0 by the 2011 publication year.

Another sign of the high quality of the MTT journals was the new metric of downloads from Xplore. T-MTT was regularly #2 of all IEEE periodicals (roughly 100 journals) with J-SSC #1. MWC was generally in the high 30's, and 4th among IEEE Letters journals. Not only was this a sign of quality but as downloads determined revenue sharing, it had a very positive financial impact on the MTT.

Paper submission processing for MTT publications had long used custom solutions, and different ones depending on the Editor. However, this approach was becoming dated and not as manageable as the number of submissions increased. IEEE had been encouraging the use of the third-party Manuscript Central (MC), but it had been resisted by MTT partly due to expense and lack of customization. However, in 2006, MWCL and then MM started the process of switching to MC, targeting the 2008 publication year. Later, T-MTT made the move and was operational by 2010. MC was renamed ScholarOne in 2010.

Open Access (OA), meaning, making research data, results, and peer-reviewed articles accessible by all for free, without subscription fees or paywalls, started to be a hot topic in the early 2000's. Outside of the philosophical issue, the "free"

part was a potential threat to IEEE's IEL and subscription model revenues which allowed the IEEE and societies to fund much of their activities. The National Institute of Health (NIH) was the first major funding agency to talk about OA mandates. NIH funding was a small part of IEEE articles with nearly none for MTT. A poll of MTT authors showed little interest in OA, however, if the NIH mandate was adopted by other funders (which did occur later), it would become a bigger issue. If revenues did fall, it raised the questions of how to support the peer review process, article editorial processing, and repositories like IEL. An added factor was the appearance of Google Scholar which could find copies of the author's work on their website. There was little resolution of these issues at that time and there was more to come.

With many papers being submitted to MTT publications written by non-native English speakers, at times, a great paper was hurt due to poor grammar. An initiative of the MTT Publication Committee and MTT editors was to provide, at MTT's cost, a third-party Grammar Assistance Program to the authors to help improve their submission's readability. In the first year, 2009, 28 papers were referred to this service.

IEEE Microwave Magazine made its debut as a quarterly publication in 2000, then bimonthly in 2006 plus a special issue for IMS (and a regular issue for RWW). Starting in 2009, it was provided to every IMS technical attendee as the official IMS Show issue. The editorial content was high-quality peer-reviewed tutorials with TCs supplying technology overviews periodically. There were regular columns on society operations and columns of general interest to the professional community. The Magazine won multiple awards for its cover art and a "best in show" at a technical publication competition. By 2011 it was running 1000-1100 pages annually with 800-900 editorial pages and the rest ads. The Magazine, at times, had more advertising than IEEE Spectrum (albeit at lower rates due to lower circulation).

Two proposals for new MTT journals were bought forward to the AdCom. One was to cover sub-millimeter wave and terahertz technology and systems, extending MTT's scope to 10 THz. This moved quickly through TAB and in late 2011, the first issue of the "IEEE Transactions on Terahertz Science and Technology" (T-TST) as a bimonthly appeared with 27 invited articles, and 336 pages and was a tremendous success. For 2011 and 2012, all MTT members would receive T-TST for free to help build interest and awareness. Also, any individual could receive a free issue by completing a survey.

The second area was RFIC, and this was more controversial due to the number of other societies interested. The eventual compromise was a virtual compendium journal with selected articles from T-CAS, J-SSC, and T-MTT that would be called the IEEE RFIC Virtual Journal (VJ-RFIC). It became available in late 2012. Not all on the AdCom were pleased by this solution.

The number of special topical T-MTT issues continued at three a year and additionally, there were also some special issues for MWCL and MM (such as Homeland Security). The most frequent T-MTT topics were UWB Technology (four

issues), and multiple special issue topics were on Microwave Photonics (including a joint LEOS issue), Terahertz (including one joint with AP), Multimedia Tutorials, RF & MW ICs, BioMed, and Microwave CAD. Some new topics were Radio Frequency Nanoelectronics and Radio Frequency Identification (RFID). T-MTT also had 3-4 conference special issues annually and MWCL had a few smaller event special issues.

D. CHAPTERS/MEMBER GROWTH

By 2011, MTT had 158 chapters (including 15 student chapters) compared to 101 Chapters in 2001. But membership had dropped from 13394 to 12129. Much of the membership drop occurred in the early 2000's but there was a continued general membership decrease in all regions except Region 10 which grew from 2112 in 2001 to 2,711 by 2011. Region 9 saw a major drop off in student memberships and Region 1-6 had a drop of 1500 members to 5468. The recession of 2001-2003 with its "jobless recovery" did impact many industrial members. Region 1-6 now was 46% of MTT membership after holding steady at 50-ish% for years. Much of these decreases were attributed to a lack of membership value, especially with Xplore access widely available from employers. The increases in Region 10 were driven by the MTT outreach (like the Region 8 efforts in the 1990's), India had the largest increase in membership and chapters, particularly for students. As other societies had seen similar declines, MTT remained the 5th largest technical society within IEEE, as it was in 2001.

AdCom took multiple steps to address the membership declines. Chapters were encouraged to provide more local activities and were provided increased funding to support those activities. Unfortunately, often only 30% of the chapters regularly submitted requests. AdCom created an "Outstanding Chapter Award" with increasing cash awards and offered cash incentives for the greatest increase in membership. While MTT had higher retention rates than most other societies, the rate was still just in the lower 80%.

Other targets for retention efforts were students and GOLD members which typically had a high drop-off when hit with the full IEEE member and society dues. Surveys revealed travel support to IMS was a need, so multiple student travel support programs were created.

AdCom started a Google Ad campaign, and by 2006 there were 300 clicks per month and 100K impressions. By 2007, this grew to almost 1000 clicks a month and 500K impressions. By 2009, 25% of visits to mtt.org were from Google.

DMLs were always a strong attraction for chapters. MTT ramped up to four new DMLs annually, each with three-year terms, increased the travel budget and added a part-time administrator. Region 8 DMLs were increased as the demand was high, but MTT was still lacking a Region 10 DML. The Speaker's Bureau increased to 60 speakers from the 24 TCs.

E. INTERSOCIETY

MTT continued working with many prior organizations of previous years, particularly EuMA, APMC, IMOC, IEICE, and key IEEE societies such as AP, and ED. The relationship

with the IEEE Electromagnetic Compatibility Society (EMC) was refreshed. The main mechanism for IEEE intersocietal relations was changing to Councils and Technical Committee where subjects of common interest between societies were handled. MTT supported multiple Technical Councils: Biometrics Council, Council on Electronic Design Automation, Nanotechnology Council, Sensors Council, Council on Superconductivity, Systems Council, and the Technical Committee on RFID (later to become a council). MTT is still engaged with all of these today. There were a dozen or so other technical IEEE and TAB Committees on a variety of topics where MTT was less engaged.

F. TECHNOLOGY FOCUS

By 2002, it was getting difficult to write an FOI that covered all the specific technologies that MTT was involved in, so a shorter and more conceptual FOI was developed, dropping specific frequency ranges, or society overlaps. It then read as

The field of interest of the society shall be microwave theory, techniques, and applications of rf, microwave, guided wave, and wireless technologies, as they relate to components, devices, circuits, transmission lines, and systems involving the generation, modulation, demodulation, control, transmission, detection and effects of electromagnetic signals. It shall include scientific, technical, and industrial activities.

Microwave theory and techniques applies physical and mathematical principles to analyze structures with dimensions representing a significant fraction of a wavelength or when propagation effects need to be considered.

The TCC was restructured again in 2002, and soon added TC-22 for Signal Generation and Frequency Conversion, and then TC-23 for RFIC. Then in 2008, TCC added TC-24 RFID, and in 2010, TC-25 Nanotechnology and TC-26 Wireless Energy Transfer and Conversion. TC-13 was renamed from Ferrites to “Microwave Materials.” TCs over the years had taken on additional duties including organizing workshops, panels, IMS student design contests, and supporting other MTT conferences. Plus providing a technology update for the Magazine every 3 years and a TC-specific website providing resources for their areas. The TCC organized the Winter Technical meeting before the start of the IMS Technical Program Review Committee (TPRC – the new name for the IMS TPC).

Some of the emerging subjects for this time period were: SiGe, GaN, GaN MMICs, UWB, MEMS, metamaterials, RF nanomaterials technology, Doherty PAs, amplifier linearization, digital linearization, wireless power, energy harvesting, energy scavenging, intra-vehicular communications, software-defined radio, digital receivers, direct conversion receivers, reconfigurable filters, system on a chip (SOC), microwave generation by optical techniques, WiMAX, 3G (first service 2001), 4G (2009), signal integrity and many others.

VIII. 2012–2021 KEEPING UP WITH A CHANGING WORLD

As MTT entered its seventh decade, it was expanding its operations in all dimensions, in conferences, in publications,



FIGURE 17. Improved MTT logo and tagline.

in supporting the community, and in ways to exchange ideas, in all parts of the world, to better serve its more diverse community. In addition to the traditional methods, MTT would start making more use of the web and electronic methods. This would serendipitously prepare MTT for the most disruptive world event in some time, COVID-19.

A. ADCOM

With the changing technologies and flat numbers on membership, conference submissions, attendance, and more competition, MTT Adcom decided it was time to put more focus on MTT’s branding and having a clearer message. One of the first steps in 2015 was to clean up the MTT logo, create a new crisper digital version, and re-registering the trademark. And after multiple discussions, in 2017, AdCom approved the tagline “MHz to THz Community” (reusing MTT) making it clear that MTT includes RF to THz. The MTT Strategic Plan - 2021 version was updated and each AdCom committee updated their goals and action plans to support MTT’s Big Audacious Goal: “Be the indispensable global, collaborative, multidisciplinary community for MHz-to-THz RF technology for the benefit of humanity.”

A key element of the plan was “MTT-S’s expanded influence will continue to move well beyond its historical component focus into systems and applications.” This and the recognition that a substantial amount of systems work was already being done, led the society to change its name after 70 years to IEEE Microwave Theory and Technology Society (MTT-S) in 2021 which was formally ratified by IEEE BoD in November 2021.

In staying with the times, MTT took a hard look at its web presence and saw many deficiencies. MTT had taken its website off of the IEEE servers as there were too many restrictions on volunteers maintaining the content. This put more responsibilities and costs on MTT but allowed more control (a choice other societies also made). One step in 2012 was getting a more common look for all MTT sites, whether MTT.org, conferences, committees, or for other uses. This also allowed a simpler transition to making all the sites smartphone friendly. The continuing issue was getting new content and frequently updating the sites.

The first MTT mobile app was developed for IMS2014 and then expanded for other events. These web enhancements all increased MTT's web presence but came at a heavy price tag. Fortunately, some members had these skill sets and the willingness to volunteer to take over much of the site maintenance from paid professionals resulting in reduced costs with improved responsiveness. The MTT.org website had expanded to become the hub for many MTT activities. MTT's web presence was recognized by the TAB Society Review process in 2014 for its quality.

As early as 2012, MTT began venturing into social media to promote MTT activities. This grew over the years to MTT having a presence on LinkedIn, Twitter, Facebook, Instagram, YouTube, and others. There is an active group following each of these sites and posting updates.

Much of the website and social media activities have been taken over by MTT's Young Professionals (YPs). [IEEE first used "GOLD" for these younger members and switched to YP in 2014. MTT AdCom had a GOLD subcommittee of the AdCom Member & Geographical Activities (MGA) Committee back in 2007 and many of those early GOLD subcommittee members went on to hold senior MTT/IMS roles.] MTT had long focused on students but somewhat lost contact once they graduated. By now actively involving YPs, they have become a tremendous asset to MTT. By 2017 YPs were active in multiple AdCom committees and conference steering committees (especially IMS2017 and those since).

With the YPs' involvement expanding in 2017, they started planning their networking activities at multiple MTT conferences, a strong desire amongst early career professionals. By 2020, MTT's YPs received recognition from IEEE MGA Board for their exceptional activities and outreach. In 2020, YPs created multiple webinars for other YPs, MTT LIVE TALK, showcasing inspirational leaders, such as astronaut, Robert Thirsk. In 2021, three YPs were appointed voting ex-officio AdCom members, and the YP subcommittee, led by YPs, was raised to a full AdHoc Committee. Every AdCom committee had at least one YP and the TCs had on average 20% YP members or affiliates. While the YPs continued to hold networking events at all MTT conferences, they have expanded to other activities, such as a regular MM YP column. MTT's YPs have been ambassadors of MTT to undergraduates and other YPs around the world.

Women In Microwave (WIM) is a group that had been underutilized and underrepresented in MTT for a long time. AdCom did provide a \$5K grant to IEEE Women in Engineering (WIE) as early as 1995 and IMS has annually held a networking reception for WIE since at least 1996, renamed WIM reception in 2007. The AdCom MGA committee created a WIE position in 2012 (renamed WIM in 2015). But generally, the WIMs were left to organize their events, which they did.

In 2014, WIM receptions and sessions were also organized at EuMW and RWW and a link on MTT.org highlighting WIM was added. Also, in 2014, MTT WIM began participating in external events like "Geek Girl" and the new IEEE

WIE Leadership Conference. WIM started using the web for Live Chats and webinars. WIM quickly increased its activities of receptions, sessions, and panels at additional MTT conferences. By 2018 WIM was regularly placing articles in MM and this would turn into a monthly WIM column. There were two MM special issues, February and March 2022, on "Research by Women in Microwave." During COVID, WIM produced multiple virtual events, such as the WIM Colloquium Session in India in 2021 attended by more than 500 global participants.

A Task Force on Mentoring, Diversity & Inclusion was formed in 2021 and provided multiple recommendations which AdCom endorsed. One, also suggested by TAB, was the creation of a Diversity, Equity & Inclusion (DEI) position on all standing committees including conference steering committees to enhance appropriate representation in committees and events. In 2021, AdCom formally adopted the WIE Pledge.

The outreach to Region 10 continued with the creation of two new regional conferences, one in India, the International Microwave and RF Conference (IMaRC), and the other in China, the International Wireless Symposium (IWS). A key goal was to develop stronger ties with their national professional bodies (more in their respective sections later). The translated paper program continued to be popular and Chinese articles were increased to 94 papers. An MTT Chinese language multi-volume tutorial/review e-book was developed, but distribution issues are still being worked on.

After the successful outreaches to Europe and Asia, MTT initiated Region 9 (Latin America) outreach activities in 2013. This included the development, with strong local support, of the Latin American Microwave Conference (LAMC) which had a successful debut in 2016 alternating every two years with SBMO's IMOC. The conference included many features found at other MTT events. LAMC2020 faced the same COVID issues as other 2020 events and was delayed and rescheduled for 2021 as a virtual event. Regions 9 also participated in the RF & Microwave Lab Kits initiative sponsored by the MTT Education Committee, which were distributed to India, Sri Lanka, Peru, and Mexico.

Two other new initiatives by the MTT Education Committee were webinars and the MTT Resource Center. Monthly microwave technology webinars started in 2016 with commercial sponsorships to cover costs. These were very popular (one had 1400 attendees and many others in the high triple digits) and increased to 18 in 2020 in response to COVID. As a bonus, the MTT Resource Center was turned on in August 2020 and all the MTT webinars were loaded along with some IMS2020 content and some DML content. By end of 2021, there were over 300 items in the Resource Center including 122 webinars. This was the type of content members needed during COVID lockdowns.

MTT had long struggled to provide administrative support for certain committees but there were continuing concerns about hiring a society executive director. Since 2003, individual IMS steering committees had contracted with IEEE

for event planner support and many committees contracted with a senior retired volunteer for support. In 2013, MTT entered into a multi-year support agreement with the IEEE for providing event planning for IMS and RWW plus Ad-Com/President and IMSEC support. A separate agreement in 2011 was arranged for handling the IMS Treasurer role by the IEEE Boston Section. In 2018, the IEEE agreement was expanded to cover the MTT Awards and the MTT M&SC. Other committees began using YPs and only the MTT Marketing & Communications (MarCom) Committee had paid outside specialist support. For publication editor support, there was a separate agreement with a non-IEEE provider.

MTT developed a relationship with Microwaves101.com in 2013. This was an attractive opportunity as Microwaves101 is extensively used by industry practitioners and could provide a path for MTT to better connect with that part of the microwave community. MTT was to review the existing content and add new content to Microwaves101. Additionally, MTT would help in supporting some website enhancements. As the MOU has expired, the future of this is unclear.

COVID (2020-2021) impacted MTT in many ways. No one expected it to last so long. In-person meetings were canceled or rescheduled as virtual events. Virtual events provided opportunities for those that normally were not able to travel to attend but many felt that the lack of in-person networking and side discussions was a loss. It also negatively impacted the exhibition portion of conferences. Chapter meetings and local workshops were likewise impacted. Conference organizers showed great ingenuity in coming up with ways to continue with combinations of live streaming, on-demand recordings, and some hybrid options. Conferences experimented with new software packages to overcome these issues. But as in-person events began returning in late 2021 and 2022, most seem to be glad to get back to the old ways. While many feared severe economic impacts on MTT, the reduction of activity expenses and travel more than compensated for revenue impacts.

AdCom made a few key governance changes. In 2012, the Bylaws and Procedures were revised to be gender-neutral. In 2017, the Best Paper Awards process was modified to remove the AdCom from the approval process to allow the AdCom members' teams eligibility for the awards. In 2019, the At-Large election was increased to two positions annually and the AdCom-selected positions were reduced to five. The N&A candidate selection process was adjusted to provide more opportunities for underrepresented groups.

And no history would be complete without mentioning the tragic, unexpected death of 2018 MTT President Tom Brazil on 13 April 2018. It was a shock to the microwave community and his many MTT friends.

B. IMS, CONFERENCES

By 2021, MTT 100% owned conferences were IMS, RFIC, and RWW (RWS, PAWR, SIRF, WISNET, and SHARC) plus ICMIM, IMaRC, International Microwave Biomedical Conference (IMBIOC), IMWS series, IWS, LAMC, International Conference On Numerical Electromagnetic and



Connecting Minds. Exchanging Ideas.

FIGURE 18. IMS logo.

Multiphysics Modeling and Optimization (NEMO), RFIT, WAMICON and Wireless Power Technology Conference and Expo (WPTCE). This is a total of 14 events plus there are five events with partial or occasional financial sponsorship APMC, ARFTG, EPEP, IMWS-5G, IMOC, and in development, the Africa-located International Microwave & Antennas Symposium (IMAS2023). MTT also technically co-sponsors 23 additional events. The present list can be found at MTT-S Sponsored Conferences.

1) IMS

With the help of a few strong sites, the pre-COVID 2012-2019 IMS attendance saw a mild increase (4-5%) increase in average technical attendance for IMS, RFIC, workshops, and total technical (respectively 2100, 800, 2130, and 2700) compared to 2002-2011. Paper submission continued their slight downward trend offset by a couple of strong years for a pre-COVID average of 926 for IMS and 204 for RFIC. However, submissions for the three last pre-COVID events, all at traditionally strong locations, were respectively 817 and 184, so definitely a concerning trend, and then COVID hit. Paid exhibits continued to grow moderately, increasing to an average of 840 10x10s (880 excluding Hawaii).

These disappointing trends led to multiple activities to re-invigorate IMS Week. One was a decision to invest in some formal marketing. The first step, taken in 2012, was to determine what image MTT wanted to project for IMS Week, and that was "Only IMS allows me to directly collaborate with the largest global concentration of RF/MW experts and solution providers for design, integration, and manufacturing." The next step in 2014 was creating a standard, supporting IMS logo with the tagline "Connecting Minds. Exchanging Ideas." These two concepts would be guides for the promotion and branding of IMS. Simple in concept but much harder in execution.

A second decision was to change the site selection to a five-year rotation with four key locals (Boston/San Francisco/Southern California/Mid-Atlantic) and one at-large selection. This would focus on locations with a strong history of attendance. As most locations could not locally support

an IMS every 5 years, the steering committees would need to draw from the entire MTT population, and an IMS Leadership training program was developed. This was formally adopted in 2017 but as sites and teams had already been selected, the first site and team under this new system would not be until IMS2026 in Boston.

The legacy paper management system, TPMS, was retired in 2016, and replaced by a new Electronic Paper Management System (EPMS) developed, to IMS's specifications, by MPA, the IMS exhibit manager at that time. EDAS was separately selected for smaller non-IMS/RWW events.

In 2019, it was time to again put out a competitive bid selection for the IMS exhibit event manager (EEM). This time a marketing function managed by the EEM was added to the requirements. Horizon House (HH) was selected as the EEM starting with IMS2021. HH had previously been the IMS EEM until 2008.

As was tradition, each IMS added some notable innovations and firsts:

IMS2012, Montreal, for MTT's 60th anniversary, was the 2nd Canadian IMS with a record number of 1225 papers submitted including 351 student papers. Strong international presence and participation aided by a less difficult visa process. Mobile application for smartphones was updated with a more searchable program book and personalized schedule.

IMS2013, Seattle, had Wireless Industry Day (82 local industry leaders), a new daily Program Book format, and ramped up Social Media activities including IMS INSIDER.

IMS2014, Tampa, introduced a STEM program and IMS Connect, an outreach for developing interests in RF/wireless and encouraging graduate school amongst junior/senior-level undergraduates from minority groups.

IMS2015, Phoenix, added the RF Boot Camp, the "Bring a Friend" discount, and company bulk registration discounts for IMS and RFIC.

IMS2016, San Francisco, debuted the new EPMS submission system, LED Monitors for Interactive Forum, a practical workshop on Designing a Digital Radio, the Best Industry/Advance Practice Paper Competitions, a Workshop on Entrepreneurship, and the IoS Panel Session.

IMS2017, Honolulu, had a joint MTT & ComSoc 5G Summit/Exec Forum, the 3 Minute Thesis (3MT) competition, Exhibitor Workshops, the IMS Hackathon, the IoS/IoT/5G Pavilion, Exhibitor Workshops, and a Steering Committee with ~60% YPs and Students, with most key subcommittee positions chaired by YPs.

IMS2018, Philadelphia, created a Society Pavilion for MTT's IEEE partners in the exhibit hall, technical session signage using 55" monitors, IMS video content on monitors, a digital video wall (16 ft X 10 ft) in the Exhibition Hall, and an exhibitor thank you outreach trialed.

IMS2019, Boston, featured a Start-up Pavilion, a YP lounge, a 5G Summit Co-Sponsored with ComSoc, an

interactive forum using a 60-second video pitch, and expanded the exhibitor outreach.

IMS2020, Los Angeles, the original focus was on practitioners, systems, and "Connectivity Matters", with Keynotes on aerospace, 5G, and automotive.

Due to COVID, IMS2020 pivoted to a virtual event with free access for MTT members, and a single, reduced fee for all events for all others including authors. Some live stream events with mostly pre-recorded "On Demand" talks that had an average of 65 views per talk. Total Technical registration was 6124. The was a virtual exhibit but with mixed results.

IMS2021, Atlanta, was a hybrid event. The in-person event followed COVID protocols with masks and social distancing. There were 284 technical attendees, 14 technical sessions, 359 paid booths, and an Automotive Exhibition Pavilion.

The virtual event was 2 weeks later, with 289 IMS and 61 RFIC papers, 20 IMS and 12 RFIC workshops, and a Connected Summit Forum. For the virtual event, technical registration was 1500 and had registration fees. IMS2021 inaugurated the MWCL's "Top 50 Papers" IMS Initiative.

2) RWW

RWW had successfully made the reimagined transition to a multi-topical event. It typically was 4 or 5 topical 1-day or 1 1/2-day events in parallel. In 2012, it was the same group of events as in 2011, RWS, PAWR, WiSNet, and BioWireless, with technical co-sponsorship by multiple IEEE societies: ComSoc, AP, and EMB. It generally drew 300-400 attendance with 175-225 presented papers and a small 15-20 tabletop exhibition. RWW occurred in mid-January in the southern part of the USA: Austin, New Orleans, Southern California, Phoenix, Orlando, ...

In 2017 BioWireless left to become an independent conference (combined with IMWS-Bio) as IMBioC. This was not unexpected as that was a partial purpose of RWW to incubate new events that might set off on their own. It was replaced with the Topical Workshop on The Internet of Space (TWIoS). In 2018, RWW began regularly hosting the multi-society Internet of Things (IoT) Summit. In 2019, ARFTG joined the week and added more attendees and a few more exhibitors. In 2020, just before COVID, the IEEE Space Hardware and Radio Conference (SHaRC) joined. AP and IEEE Aerospace & Electronic Systems (AES) Society began regular technical co-sponsors, and GRS joined in 2022. In 2021, RWW went virtual like nearly everyone else.

3) IWS/IMARC

The International Wireless Symposium (IWS/China) and the International Microwave and RF Conference (IMARC/India) events were started in 2013 as major country/regional events owned and operated by the local MTT chapters and the MTT AdCom. These were targeted at potential high technology and membership areas that were not well served by other events.

IWS, from the start, was a challenging adventure. Partially being a new entrant, partially being viewed as an outsider not

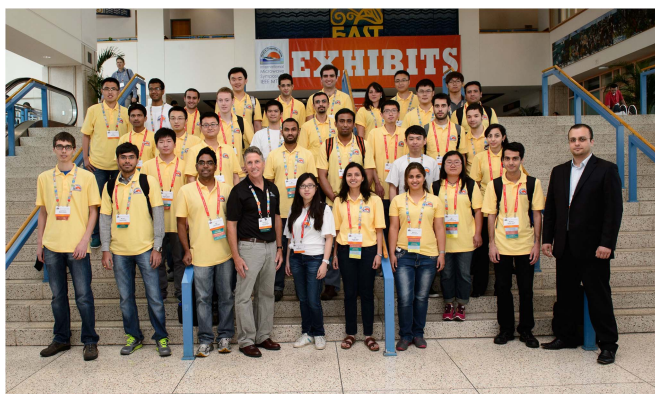


FIGURE 19. 2014 IMS and RFIC Ph.D. sponsorship initiative, Tampa.

understanding the environment, and partially as others were also discovering this new opportunity, the event fell short of desired outcomes. MTT was initially unable to partner with the Chinese Microwave Society (CMS, part of the Chinese Institute of Engineering, CIE). The inaugural event had good attendance, 375, a large turnout for the free workshops (1200), and reasonable paper submissions (335) but exhibits were weak.

Succeeding symposiums, which moved to a variety of cities, struggled despite an infusion of MTT support and funding. They were moderately successful technically, but not financially, as other events were getting the exhibitors. New partners were found in 2015, and attendance increased but finances still struggled.

There was no IWS in 2017 to allow for a re-grouping. IWS returned in 2018, collocated with other events as part of the China Microwave Week. An arrangement was reached with CIE-CMS where MTT delegated the handling of the conference and financial risks to CMS. A portion of the surplus would support MTT activities in China. IWS2020 was a virtual event after being postponed and IWS2021 was an in-person event with 246 accepted papers but limited in-person access for non-China residents.

With support from the Indian Institution of Electronics and Telecommunication Engineers (IETE), the first IMaRC in 2013 was a modest event with 220 registrations, 65 podium papers, 40 posters, 4 workshops, and a modest net loss. IMaRC2014 again had 220 attendees, 109 total papers, 12 exhibitors, and an Education Forum and was breakeven financially. IMaRC2015 took place in Hyderabad, India, with 400 attendees including 96 presented papers, and a Ph.D. Student Initiative, with 29 exhibitors. IMaRC continued at a steady pace and IMaRC2019's attendance was 385, with 153 accepted papers, and 25 Exhibitors.

IMaRC2020 was canceled due to COVID and IMaRC2021 was a hybrid event, with 300 participants from all over the world virtually attending, and about 70 attendees present in person at the IIT Kanpur campus. Events included a Ph.D. Student Initiative, a Student Design Competition, with Best Paper Awards for student-authored papers, both WIM and YP events, and a virtual exhibition.

For 2022, it was decided to merge MTT's IMaRC with AP's Indian Conference on Antennas and Propagation (InCAP) as Microwave, Antennas, and Propagation Conference (MAP-CON).

While space does not allow for in-depth coverage of the other 8 financially sponsored MTT events or the 5 partially sponsored or the 23 technical co-sponsored events, MTT was involved nearly weekly with events around the world supporting the microwave community getting together for "Connecting Minds, Exchanging Ideas." More detail about these other important events will need to wait for another day.

C. PUBLICATIONS

By 2021, MTT's portfolio of journals had increased. In addition to the legacy T-MTT, MWCL, and MM, T-TST was added in 2011 and the Open Access Journal of Microwaves (J-MW) was added in 2021. Plus, there was a significant expansion in MTT co-sponsored journals.

Before 2012, MTT co-sponsored just the J-LT (1983) but then MTT started adding multiple open-access co-sponsored journals: IEEE Journal on Multiscale and Multiphysics Computational Techniques (J-MMCT 2016), IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology (J-ERM 2017), and IEEE Transactions on Quantum Engineering (T-QE 2020). There were two more OA journal co-sponsorships agreed to but not published until 2022/2023: IEEE Transactions on Signal and Power Integrity (T-SPI 2022) and IEEE Transactions on Radar Systems (T-RS 2023). These co-sponsorships, with a variety of societies, demonstrated the degree of multi-disciplinary areas in which MTT was active. Additionally, a unique compendium called the RFIC Virtual Journal (VJ-RFIC 2012) was created as multiple societies felt RFIC was a core focus area. An up-to-date listing and topic area details can be found at MTT Publications Overview.

Even with these additional journals, the MTT legacy journals continued to have significant increases in submissions. T-MTT published 40% more pages in this decade versus the prior decade and was regularly publishing 5500 pages annually. MWCL was running 25% more than the prior decade with about 1100 pages annually plus an additional boast of 200 pages starting in 2021 due to the Top 50 IMS/RFIC paper initiative being published in MWCL without additional content expansion. T-TST was running over 800 pages annually although showing some impacts of external competition.

MM also saw a large page increase of 50% over the prior decade. MM went to 12 issues from 7 in 2015 but returned to 7 for 2017-2018 as it worked on content acquisition and low ad revenue. It returned to 12 issues in 2019 and was running 1350 pages annually but with continued ad revenue issues. MTT made MM available electronically to all IEEE members for free to raise its subscription base and increase ad revenues, but that did not increase subscriptions as much as hoped.

With the increased submissions, the workload on all the MTT journal editors was reaching the breaking point. T-MTT, as far back as 2006, had co-EICs, but the IEEE did not

like that and suggested breaking the journal into Part A and Part B with separate Editors as other societies had done. In 2018 MTT approved the creation of Track editors with the Associate Editors reporting to the Track Editor who reported to the Editor-in-Chief. By 2021, T-MTT had 3 track editors (increasing to 6 in 2022), MWCL had 4 and T-TST had 3.

Impact on reviewers was also a concern with the increasing submission rates. Responsive reviews were important in maintaining the high quality of the MTT journals but also equally important to support the shorter submission-to-decision timelines. The editors' felt strongly MTT needed some form of thanks for reviewers. T-TST started this with a reviewers' reception at the 2012 Infrared, Millimeter, and Terahertz Waves Conference (IRMMWTHz). This was also a way to recruit new reviewers for the new T-TST. In 2016, a reception for reviewers at IMS was started. While expensive, these reviewer receptions have been appreciated and well attended.

MTT journals' Impact Factors continue to be metric closely followed by the editors as the IF of their journal could influence an author's selection of journal to publish in. The MTT journals' impact factors rose steadily through the decade but so did the other peer journals. Overall, the MTT journals stayed relatively stable among their peers. For 2021 T-MTT's IF was 4.38, MWCL was 2.72, T-TST was 3.47 and MM was 3.06. The other MTT publications were either too new or just establishing their numbers. For tracking, IEEE Xplore posts the most recent IF for an IEEE journal which is 18-24 months in the past. Another factor of importance to authors is the time from submission to decision and from submission to posting, and MTT journals also do well here. T-MTT is on average 50-60 days to decision with a 30% acceptance, MWCL's average is 30-40 days also with a 30% acceptance although it has been below 25% at times and T-TST's average to first decision is 48 days with a 34% acceptance. The decision to e-publication can take another 10-12 weeks. The MTT journals are fairly comparable and competitive.

The impact of OA increased over this decade. The IEEE/TAB decided that all new journals would be OA and all the newer MTT journals are OA. "Plan S"/"cOAlition S" was a 2018 initiative to require European government-funded researchers to only publish in OA journals by 2021. Starting in 2021, USA federal funders were to create an OA policy without any embargo or delay after publication. Many other worldwide funders are going in the same direction. It is possible to do OA with all MTT journals, but some may prefer OA-only journals. So far, these mandates have not had a major impact on the legacy MTT journals, but MTT is positioned to serve both the OA (with article processing charge) or traditional (with subscription fees) publishing researcher. However, long-term this could financially impact IEEE and MTT unless alternative revenue sources are developed.

One consequence of OA was increasing dissatisfaction with over-length page charges (OPC). This was principally a T-MTT issue as MWCL has a hard page limit of 3 that was increased with an extra page for references in 2020. And for the various OA, non-print journals, page length was not an

issue. OPC generated significant revenue for MTT, but it was becoming increasingly anachronistic, especially as MTT's page limit was lower than most IEEE print publications. In 2021, MTT changed the number of free-of-charge pages for the T-MTT from 7 pages to 11 pages with discounts for MTT-S members.

The cost of print subscriptions, as other subscribers dropped print, was becoming increasingly expensive but still desired by some. In 2017 only 1115 MTT members took any MTT publication in print, just 10% of the membership. MTT decided to set the print price for T-MTT, MWCL, and T-TST at the cost of printing and mailing with a discount for MTT students and retirees with a higher rate for non-MTT IEEE members.

A separate e-mail newsletter has been an on-and-off thing for MTT. The MM has an e-newsletter from 2016 to 2018 promoting MM content. A society e-newsletter re-started in 2019, highlighting upcoming conferences, selected articles from MTT publications, society news, and an occasional message from the MTT-S President with some commercial advertising to cover costs and included an opt-out. A separate quarterly Student e-Newsletter was started in 2021 to highlight MTT student, YP, and WIM activities including scholarship announcements. These are also accessible on MTT.org.

In 2017, T-MTT started a Journal-within-a-Journal on Microwave Systems and Applications, as both T-MTT and MWCL reported 30-40% of their papers were systems-related (and RFIC was the #2 topic). This is more than a doubling of system papers compared to 10 years ago. This was a supporting factor for the society's name change to Microwave Theory and Technology Society in 2021. Also, in 2021, MTT requested TAB to change MWCL to Microwave and Wireless Technology Letters (MWTL). This change was approved and will take effect with the 2023 publication year.

D. CHAPTERS/MEMBER GROWTH

Regular member (professional) chapters began to level off at 150, with a few changes each year. Student Branch Chapters continued to increase to over 60. Membership continued to slowly decline to just below 11000 in 2018 and then start to slowly rise to 11109 in 2021 but still below 2011 numbers. Student membership had declined for years and recovered some in 2021. There were increases in females and YPs as discussed earlier. Region 1-6 by 2021 was holding steady at 45% of the membership with Region 10 at 26%, Region 8 at 24%, Region 7 at 3%, and Region 9 at 2%. MTT was the 7th largest IEEE society (but there are 6 others between 10000 to 11000). These declining membership trends were common for other societies.

Member dues stayed flat at \$17 until 2017 when they were raised to \$24 but with re-bundled free electronic access to MTT-owned publications T-MTT, MWCL, and T-TST, the MM was already included. Student dues were raised to \$10 but also included the same electronic publication access. In 2022, Student dues were reduced to \$1. Other promos to increase membership were a free magazine issue for contact

info, half-price first-year membership, reduced registration for MTT members at MTT-sponsored conferences, and reduced overlength changes for members.

DMLs continued to be popular and the number of DMLs increased to 17 in 2014 but the expenses became an issue and slowly were reduced back to 8. By 2021, MTT was again able to increase the number to 10 and again increased to 14 by 2022. The DMLs were providing 100+ talks most years, with a peak of 153 in 2015. There was a mix of DMLs from multiple regions, principally 1-6, 8, and 10, addressing a long need for broader representation. COVID did bring new issues, but the DML program continued with 77 talks in 2021 via virtual presentations. The present DMLs can be found at MTT-S DMLs.

To encourage chapters to increase activities, MTT restarted chapter awards for the top 5% of chapters in 2012. They received a plaque and travel expenses to the presentation. In 2017, this was changed to a \$1500 award to the chapter. The change was delayed to 2019 due to the need to get TAB approval. Also, in 2012, chapters could request multiple \$200 grants for workshops and more on special request.

CCMs continue to be held at multiple conferences but in 2012 travel reimbursement was modified to rotate among chapter officers and limited repeat grants to the same person. The meetings went virtual for COVID with attendance of up to 200 but it was unclear if the experience was as valuable.

E. INTERSOCIETY

Given increasingly overlapping zones in technologies, MTT reached out to several IEEE societies creating Sister Society/MOU agreements to strengthen cross-society interaction. These agreements were to cooperate on some projects and offer some cross-society member benefits. They generally included membership booths at each other's conferences, to encourage chapters to develop joint local activities, the sharing of mailing lists for conferences, and considering potential joint publications. A new panel series for IMS, the InterSociety Technology Panels (ISTP), was kicked off at IMS2021, with MTT's intersociety partners participating.

Some other tangible outcomes were publication co-sponsorships: J-ERM with AP, EMBS, and Sensors; J-MMCT with AP, EMC; VJ-RFIC with CAS, SSC; and the coming T-RS with eight societies. MTT worked with AP and EMC on the TAB Hardware Initiative (2017). Various societies participated in MTT's webinars. AP, AES, and EMC regularly technically co-sponsored RWW and other MTT conferences. Another intersocietal activity was the inaugural Wireless Power Week (WPW) in 2018 in cooperation with IEEE Power Electronics (PEL) Society, IEEE MEMS Technical Community, and later AP.

As of 2021, Sister Society MOUs existed with AP, EMC, GRS, PELs, and SSC (to be signed). The IEEE data on society membership showed MTT members in 2021 were also commonly members of these societies: AP 38%, SSC 16%, ComSoc, CAS, and ED all 12%. The most popular joint

chapter society affiliations were: AP (74 of 150), ED (27), EMC (15), ComSoc (7), and AES (6).

At the TAB level, MTT participated in all seven TAB Councils. Sensors Council had 1000 MTT members in 2021 and even the newest Biometrics Council (2020) had 230 MTT members. TAB also had a series of initiatives that had many MTT interested members: IEEE Future Networks Initiative (247), IEEE IoT Initiative (338), IEEE Quantum Initiative (42), and New Space/Internet Of Space Initiative.

MTT continued its long relationship with other related non-IEEE societies including EuMA, IEICE, SBMO, CIE/CMS, and IETE offering member rates at their events and access to IEEE's Xplore digital repository for their proceedings and some publications.

F. TECHNOLOGY FOCUS

As reflected in the MTT journals and conferences, while still having a strong component focus, MTT was the home for an increasing microwave systems community. The journal editors were reporting 1/4 to 1/3 of their papers were systems-related and similar trends were noted for conferences. This was reflected in a restructuring of the MTT TCC into 16 Core Technologies and Techniques TCs and 9 Systems and Applications TCs in 2019 with a 10th systems TC, Microwave Aerospace Systems, added in 2020. This restructuring was done by combining a few of the original TCs and renaming some others. There was no intention of removing or de-emphasizing any of the prior areas but rather acknowledging some of the new focus areas. The present list of TCs can be found at MTT-S Technical Committees.

MTT formed an AdHoc Future Directions Committee (FDC) in 2017 as an outcome of strategic planning to guide future growth and new technology capture (first started in 2014) for MTT. FDC was combined with the Technical Coordinating Committee (TCC) and renamed the Technical Coordination & Future Directions Committee (TCFDC) in 2019 and FDC continues as a TCFDC subcommittee. FDC worked with other IEEE groups including the IEEE FDC on the 5G Initiative (renamed Future Networks Initiative), Internet of Space (IoS), Smart Hardware Initiative, Internet of Things and Wearables, Connected Vehicles, Wireless Power Transfer Initiative, Quantum Initiative, and others. FDC led the MTT-Sat CubeSat program which funded multiple student groups to develop CubeSat payloads resulting in three finalists being selected for launch possibly in 2024.

A goal for TCs was to expand their worldwide inclusion and starting in 2015 TCC meetings were added at EuMW, APMC, and RWW, in addition to the traditional IMS meetings. Another major TCC goal was increasing the representation of YPs on TCs with either full or affiliate members. By later 2021, there were just over 20% YPs on the TCs. To retain the knowledge of long-time/retiring members, a non-voting of TC Emeriti position was developed.

The MTT FOI had grown difficult to read due to all the specific additions. Multiple revisions were made to shorten and make it more succinct, with the latest in 2021:



FIGURE 20. AdCom 2022, not your AdCom of yesteryear.

The field of interest of the society shall be theory, techniques and applications of guided wave and wireless technologies spanning the electromagnetic spectrum from RF/microwave through millimeterwaves and terahertz, including the aspects of materials, components, devices, circuits, modules, and systems which involve the generation, modulation, demodulation, control, transmission, sensing and effects of electromagnetic signals.

See MTT-S Field of Interest Statement for the latest version and supporting details.

IX. 2022 MICROWAVE TECHNIQUES & TECHNOLOGY AND THE FUTURE

2022 was the 70th anniversary of the founding of MTT and the start of the eighth decade. Much has changed and much has remained the same. MTT was formed to provide opportunities for like-minded individuals to share and exchange information in MTT's FOI. MTT has done this from the start with its conferences, its publications, and its outreach to the worldwide microwave community. And MTT continues to do so. The FOI and technologies included have changed. The formats of the conferences and publications have changed. While MTT started as a USA domestic-based organization, it is now active around the world, with conferences in all major regions, authors from all parts of the world, and clearly the worldwide leader in the microwave community. Five of the ten MTT Presidents between 2012 and 2021 were not based in IEEE Region 1-6/USA (as also the 2023 President). The membership and leadership are more diverse and more representative of the expanded community.

To commemorate the 70th anniversary, there will be multiple articles in MTT's Microwave Magazine and Journal of Microwaves taking a historic look at MTT and its technology as well as a more forward look at the microwave community. These articles will be published in 2022 and 2023, and a listing of the 2022 articles can be found in the References and Sources section of this paper.

Activities in 2022 illustrate that MTT still has a bright future. MTT was able to re-start IMS2022 in Denver as an in-person event with a full range of activities. Attendance and exhibitions were at 75% or more of pre-COVID numbers. It is expected IMS2023 (San Diego) will be even closer to pre-COVID levels. While COVID isn't gone, MTT has been

able to adapt and move forward despite it. Other conferences, chapter meetings, and AdCom meetings have returned to their former in-person levels, but MTT learned that web-based material has an audience. Another encouraging sign is MTT has returned to over 12000 members, with 12099 at the end of 2022.

Looking to the future, MTT is expanding its focus on systems and has a new name, Microwave Theory and Technology Society, but still MTT. Systems were highlighted at IMS2022 with the System Forum Days and there will be an increasing focus on systems in MTT publications and conferences. There are new activities planned, such as International Microwave & Antennas Symposium (IMAS2023) in Africa joint with AP and the MTT co-sponsored IEEE Transactions on Radar Systems (2023).

MTT is financially sound and in 2022, AdCom approved funding for several new and continuing initiatives including participating in the IEEE's Public Safety Technology Initiative and continuing to participate in IEEE's Future Networks Initiative, working with MTT's intersociety partners to form an Inter-Society Distinguished Lecturer (ISDL) Program, continuing the Distinguished Microwave Instructors (DMI) program, creating an MTT Student Ambassador Program, starting two Multilingual Video Competitions (MVC) for student and addressing the recommendations from the 2021 Task Force on Mentoring, Diversity & Inclusion.

The future is bright.

X. STANDING ON THE SHOULDERS OF GIANTS

Today's MTT is very different but, in many ways, very similar to the MTT of 50, 60, and 70 years ago. Very different technologies, but the same very engaged volunteer base. It was a great disappointment not to have been able to enumerate in this article all the major contributors to MTT over the years. There have been 500+ major awardees, thousands of certificates of appreciation, over 250 AdCom members, 65 IMS chairs, 50+ EICs, 100+ DMLs, thousands of chapter chairs, multi-thousand TCC/TPC/journal reviewers, and thousands of others who contributed papers to MTT conferences or publications and many others who have supported the profession by supporting MTT. Additionally, many MTT members have been leaders or supporters of other IEEE activities. The MTT community has had an outsized impact on the IEEE.

Our profession, our community, and the MTT have benefited from the contributions of a very large active community of giants.

As a small effort to recognize a portion of these individuals, see:

Past MTT-S Awardees
 MTT-S AdCom Past Presidents and Chairs
 Transactions Past Editors - MTT-S
 Past M-Magazine EICs
 Letters Past Editors - MTT-S

Terahertz Science & Technology Past Editors
MTT-S Honorary Life Members
MTT-S Distinguished Microwave Lecturers
MTT-S Distinguished Microwave Lecturers Emeritus

Additional info
MTT-S Chapter Web Sites
Past and Future MTT-S IMS sites

XI. SOURCES/REFERENCES

The primary sources for this article were:

AdCom minutes with presentations from 1952-2022 meetings, there were 260 AdCom meetings for which 258 sets of minutes survive. Available from IEEE.

IMS final reports (MTT IMS archives), T-MTT articles on individual IMS through 2002 (typical December or following January issue), then moved to MM for future years, a total of 66 reports.

MTT newsletters 1968-1999

MTT-S History Collection photos

XII. ADDITIONAL READING

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D. T-MTT 50TH ANNIVERSARY ISSUE – MARCH 2002

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ACKNOWLEDGMENT

Ted Saad was an original MTT member for 59 years and joined the MTT AdCom in 1953. Served as T-MTT Editor 1954–1956, MTT-S AdCom Chair (1958–59), and for many years as Historian of MTT-S. In 1973, he was elected as an Honorary Life Member of the Society. And more relevant to this article, he was the keeper of the records. He maintained copies of the minutes (without which this article could not exist), was a keeper of the early T-MTT issues, and wrote multiple articles on the early history of the society.

Charlie Jackson led the project to scan and digitize the early issues of T-MTT and other materials Ted had saved. Because of that, all that early material was saved and eventually posted on Xplore. Additionally, Charlie started the IMS Archive project.

Steve Stilzer oversees the MTT-S History Collection which provided multiple photos.

Unfortunately, many activities MTT AdCom activities and many co-own or sponsored activities could not be covered due to time and space, this is not to diminish their contribution, or importance but just the limitations of space and the author.



JOHN BARR (Life Fellow, IEEE) retired from Agilent Technologies/Hewlett Packard in 2008 having served in various engineering R&D roles, including as the R&D Manager/Director for Agilent's Wireless Semiconductor Test Solutions. He has been involved in the development and design of RF and microwave component measurement systems. His activities include the design of RF down-converters, IF detectors, and automation of these systems. That later evolved into the area of vector error correction, time domain conversion, and

multi-parameter measurement systems. Before retiring, he concentrated on the development of high-throughput manufacturing semiconductor test systems for RFICs and wireless communications ICs. This work in conventional and six-port network analyzers led to five patents and ten published papers. He is active in the Microwave Theory & Technology Society (MTT-S) as an Honorary Life Member of the MTT-S AdCom and was the President in 2002, Vice President, and Treasurer. He was the General Chair of the 2006 IEEE MTT-S International Microwave Symposium and the 2012 IEEE Radio & Wireless Week General Chair. At the IEEE institute level, he was an IEEE Director and Treasurer on the IEEE Board of Directors in 2013–2014 and was the IEEE Technical Activities Board Treasurer, Finance Chair of the Publication Services and Products Board (PSPB), Member of the IEEE Finance Committee and Chair of the PSPB/TAB Products & Services Committee. He is the 2023 Chair of the IEEE New Initiatives Committee.