Internet Telephony Jumps off the Wires

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After years of unfulfilled hype, a growing number of service providers have begun offering Internet telephony, in which voice data from phone calls is broken up into packets and sent across the Internet. In response, more individuals and companies have begun using the technology.

As Figure 1 shows, a recent report by the Yankee Group, a market research firm, predicts the US consumer Internet telephony market will explode from 130,000 subscribers at the end of 2003 to 17.5 million subscribers in 2008.

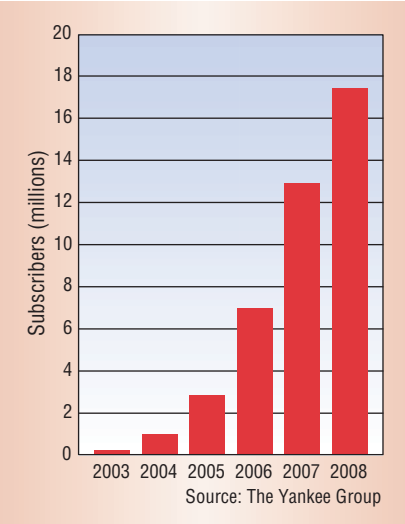
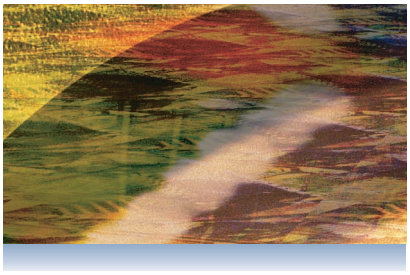


Figure 1. The Yankee Group, a market research firm, predicts rapid growth in the US Internet telephony market.



Now, providers are offering wireless Internet telephony, which adds convenience by letting users make Internet calls from their mobile phones via IEEE 802.11 (Wi-Fi) wireless LAN and third-generation (3G) cellular technologies.

With wireless-phone usage outstripping wired-phone usage, this represents a potentially huge market for developers, explained Mareca Hatler, research director with ON World, a wireless-technology consultancy.

As is the case with its wired Internet telephony, wireless Internet telephony is less expensive than regular mobile telephony because carriers can use the existing Internet, rather than build a new infrastructure, to route calls. In addition, Internet telephony is not subject to the regulation and fees that governments impose on traditional telephony.

Using the Internet enables wireless telephony to offer good reception indoors, which is not always the case with traditional cellular service.

However, despite rosy marketplace-growth projections, Internet telephony faces several important concerns, particularly power usage, security, and quality of service (QoS).

WIRELESS INTERNET TELEPHONY

In many ways, wireless Internet telephony is an adaptation of traditional wireline IP telephony, as the "Internet Telephony 101" sidebar explains.

Wireless IP telephony works primarily with Wi-Fi, which it uses to access the Internet. However, many Internet calls do not travel only over Wi-Fi networks. For example, a call from a user on a Wi-Fi network to someone using a traditional wireline or mobile phone at some point will be routed over the traditional wired or cellular phone network.

Some systems provide wireless service only via Wi-Fi. For example, SpectraLink's system connects its Master Control Unit to Wi-Fi base stations on one end and to a traditional analog or digital PBX on the other, thereby eliminating the need for cellular service.

However, several companies, including Motorola, are developing phones that would use cellular technology for the parts of calls that travel over cellular networks and Wi-Fi for those parts that travel over the Internet.

Wi-Fi

In Wi-Fi Internet telephony, vendors equip a mobile handset with an IEEE 802.11 radio. The phones, when within range of a Wi-Fi access point, use IEEE 802.11 to connect to the Internet, over which they can then transmit voice traffic.

There are several Wi-Fi standards. IEEE 802.11b, the first popular Wi-Fi standard, has a theoretical maximum data rate of 11 Mbits per second using the 2.4-GHz frequency band. IEEE 802.11a has a theoretical maximum rate of 54 Mbps using the 5-GHz band. IEEE 802.11g offers a faster speed and compatiblity with the large installed base of IEEE 802.11b systems because it also uses the 2.4-GHz band.

Wi-Fi works with telephony by providing a wireless channel to the Inter-

net. Wi-Fi converts voice and other data into radio signals that can be transmitted wirelessly. Internet-connected receivers then convert the radio signals into conventional data traffic that can be transmitted via the Internet or another network.

There are a growing number of Wi-Fi-enabled networks and IEEE 802.11 phones from manufacturers such as Cisco Systems and Symbol Technologies, said Allen Nogee, principal analyst for wireless technology with In-Stat/MDR, a market research firm.

Companies such as Agere Systems, Broadcom, and Texas Instruments (TI) are beginning to release Wi-Fi-based Internet telephony chips, which have embedded functionality formerly provided by both software and hardware, said Allen.

For example, TI's TNETV1600 system-on-chip platform consists of a voice-over-IP application processor, an IEEE 802.11b and IEEE 802.11g media-access-control baseband processor, and a radio transceiver.

Originally, Wi-Fi worked only within a wireless LAN. In recent years, though, individuals and companies have established Wi-Fi hot spots, which are nodes that provide laptops, cellular phones, and other mobile devices within the technology's range of 100 meters indoors and 400 meters outdoors with Internet connections. Many hot spots are close to one another, which gives cellular-phone users widespread Internet access.

In-Stat/MDR predicts that sales of business-class Wi-Fi-based Internet phones will increase about 120 percent from 2003 to this year, while the Wi-Fi Internet telephony market will grow from $16.5 million in 2002 to $500 million by 2007.

3G cellular

Verizon is building a $1 billion wireless broadband network that's fast enough to enable high-quality Internet telephony and cellular service. The network's 1xRTT (single-carrier radio transmission technology) carries Internet voice traffic at speeds of up to 144 Kbps. Its evolution-data-optimized (EV-DO) technology carries data at a theoretical maximum rate of 2.4 Mbps and an average real-world rate of about 500 Kbps.

Verizon's BroadbandAccess system is available in about 20 US metropolitan areas.

In the future, evolution-data-and-voice (EV-DV) cellular technology will combine EV-DO and 1xRTT and thus could carry telephony traffic at 3 to 5 Mbps.

Meanwhile, TI and other manufacturers have recently developed or are developing Internet telephony chips for cellular systems.

Wi-Fi and cellular work together

Some equipment vendors are working on ways to better enable Wi-Fi and cellular technologies to work together in Internet telephony. This would let callers switch seamlessly between the two technologies, passing, for example, from one office's Wi-Fi network to a user's cellular infrastructure and then to another office's Wi-Fi system.

ON World's Hatler said Internet telephony that works with both Wi-Fi and cellular would be useful for the many stores, warehouses, hospitals, and other organizations that use or plan to use both technologies for various purposes. This creates a large potential market for dual-use Internet phones.

Kineto Wireless has developed an IP-network controller that an organization can install between an IP network and its cellular or PBX system. Users could then connect Wi-Fi access points to their IP networks. This would

Internet Telephony 101

Internet telephony systems send voice information in packetized, digital form and use the Internet Protocol rather than the circuit-switching protocols of traditional systems.

Users of traditional IP telephony can make and receive calls via PCs, laptops, or phones. IP telephony calls travel either completely over the Internet, if both parties are using Internet phone systems, or over both the Internet and traditional phone networks, if one party is using a traditional phone.

IP telephony systems that work with traditional phones include gateways that translate the transmissions to and from data formats appropriate for the phones and those appropriate for the Internet.

Gatekeepers provide centralized call-management functions, such as accepting or rejecting calls because of voice-quality or bandwidth problems, bandwidth management, or authentication.

Internet telephony uses the Real-Time Protocol to ensure the timely delivery of packets, a necessity for voice traffic. RTP doesn't guarantee real-time delivery, but it streams data and thus lets clients process the information on a steady, sequential basis as it arrives. Otherwise, it's difficult to guarantee quality of service (QoS) using public networks, on which voice packets must compete with data and other traffic types.

With the RTP Control Protocol, both senders and receivers periodically transmit RTCP packets to each participant in an RTP session. A real-time application uses the information in the packets to monitor the session's quality for events such as jitter and packet loss.

Over the Internet, the Resource Reservation Protocol can help provide QoS for voice transmissions. Using RSVP, an application can reserve resources along a route from source to destination. RSVP-enabled routers then schedule and prioritize packets to fulfill the reservations.

extend the wireless-telephony services to the Internet.

If cellular users are indoors and near a Wi-Fi access point, their phone's software would sense the stronger, more reliable Wi-Fi signal. The software would then tell the controller to route incoming calls over the Internet, via the access point, to the handset's IEEE 802.11 equipment.

No commercial dual Wi-Fi/cellular phones exist yet, In-Stat/MDR's Nogee noted, although manufacturers Motorola, Nokia, and Samsung are testing new models, each with a single chip that would provide the dual functionality.

According to a recent In-Stat/MDR report, combination Wi-Fi/cellular handsets will begin significant adoption in 2007 or 2008, as Wi-Fi chips continue to become smaller, less expensive, and more power efficient. Company analyst Norm Bogen predicted the number of Wi-Fi/cellular handsets used globally will grow from about 1 million in 2005 to more than 100 million in 2008.

However, ON World's Hatler said, many cellular service providers may not want to cooperate out of fear they will lose revenue to Wi-Fi carriers.

LocustWorld and mesh networks

Wireless broadband vendor LocustWorld's freely downloadable MeshAP software configures a group of wireless access points into a coherent mesh network. Each device on a mesh network acts as a node and receives and transmits its own traffic, while acting as a router for other devices. Intelligence in each device lets it configure an efficient network and adjust for problems, such as unavailable nodes.

LocustWorld also sells MeshBoxes, small appliances that run MeshAP and act as mesh-network nodes and routers.

The company has added hardware and software support for the Session Initiation Protocol to its mesh-networking equipment.

The Internet Engineering Task Force introduced SIP as a signaling protocol that simplifies and allows interoperability in interactive online multimedia sessions, including those involving Internet telephony, for which the protocol initiates call setup, routing, authentication, and other services.

SIP support thus turns the company's MeshBoxes into wireless Internet telephony switches.

LocustWorld director Richard Lander said the company's Internet telephony system works with wireless and wired IP networks and can interoperate with cellular technology.

Internet telephony concerns include power usage, security, and quality of service.

Skype and P2P wireless Internet telephony

Skype for Pocket PC, available as a free download, is a peer-to-peer (P2P) wireless Internet telephony technology that works with Wi-Fi-enabled PDAs running Microsoft's Pocket PC operating system. Callers can connect with users running Skype's other applications, including those for traditional Internet telephony. They can also utilize the SkypeOut service for calls to people who don't use Skype.

Skype for Pocket PC uses proprietary P2P software to intelligently route calls directly between users' PDAs without using a centralized device. This differs from most Internet telephony applications, which require routers or other centralized network devices to connect to both IP and traditional cellular or wired networks.

Because the client handles most of the complex computation and routing tasks, it needs more processing power—at least 400 MHz—than most PDAs have, according to Skype spokesperson Dan Twigg.

INTERNET TELEPHONY CONCERNS

Despite its promise, wireless Internet telephony raises several important concerns. For example, the relatively new Wi-Fi Internet phones can be quite expensive. However, Nogee noted, prices are dropping.

Also, Wi-Fi Internet phones use considerable power for their radio transmissions. This requires bigger phones to accommodate more or larger batteries at a time when the demand is for smaller phones.

Security

As with any wireless technology, Internet telephony raises security concerns. For example, authentication approaches, which determine whether people trying to access a system are who they say they are, must be improved and standardized, said Nogee. Without standardization, competing technologies from vendors could cause system incompatibilities.

Meanwhile, wireless security itself is only now overcoming some early problems. Many users complained that the Wired Equivalent Privacy Protocol, used in early Wi-Fi applications, was not strong enough. The industry has since evolved to Wi-Fi Protected Access and now WPA2, based on the IEEE 802.11i wireless-security standard, which uses the new Advanced Encryption Standard.

Regardless, wireless Internet telephony security will require the exchange of additional information between senders and receivers and thus slow data transmissions, which will affect voice quality, explained ON World's Hatler.

Quality of service

QoS is a key issue for Internet telephony. IP networks must prioritize telephony traffic because, unlike other data traffic with which it shares the Internet, voice data must be transmitted in real time. If not, voice quality degrades and latency becomes a problem.

Currently, several approaches, mostly proprietary, provide some QoS for Internet telephony.

According to Nogee, the proposed IEEE 802.11e standard would provide

a way to address Wi-Fi-based QoS. The standard, currently under consideration, would accomplish this by prioritizing packets based on traffic type, enabling access points to schedule resources based on transmission rates and latencies, and otherwise improving bandwidth efficiency.

According to an In-Stat/MDR survey, many businesses are looking into Wi-Fi-based Internet telephony. The survey of business Internet telephony users found that 10 percent of respondents are already working with the wireless technology, and 48 percent are considering implementing it.

Currently, the biggest Internet telephony opportunities are in businesses such as healthcare, education, retail warehousing and distribution, and manufacturing, which already have established Wi-Fi networks over which they could run Internet telephony, explained In-Stat/MDR's Bogen.

The real commercial value, ON World's Hatler added, will come when wireless Internet phones can integrate with PBX systems and thus become more useful to companies.

However, she added, the usefulness of voice over Wi-Fi technology will depend on the continued growth of the wireless LAN infrastructure—including access points, gateways, routers, and clients such as laptops, PDAs, and phones—in the enterprise and residences. ■

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