

# Software Engineering for Internet Computing Internetworks and Beyond

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**THE INTERNET**, once a network of networks, has become not just the platform of choice for delivering services to increasingly mobile users but also the connective tissue among people, information, and things. The newest and most popular computing and application paradigms have been born on the Internet, or at least motivated by it, such as Web 2.0, social networking, mobile Internet, cloud computing, the Internet of Things, and big data.

### An Open, Dynamic, Evolving Environment

The open, dynamic, and evolving environment of Internet computing continues to demand new software technologies. Such technologies should be context aware, adaptable,

cultural differences. So, new programming and life-cycle paradigms, such as Internetware,<sup>1,2</sup> are inevitable. Example research topics for this area include, but aren't limited to,

- programming models and platforms for dominant and emerging Internet-based systems such as cloud computing,<sup>3</sup> service computing,<sup>4</sup> social computing,<sup>5</sup> mobile Internet,<sup>6</sup> the Internet of Things,<sup>7</sup> and cyber-physical systems;<sup>8</sup>
- platforms and application frameworks for Internet-based software, such as Web-based integration (for example, REST [representational state transfer] and JSON [JavaScript Object Notation]), infrastructure

example, cloud-based development environments);<sup>11</sup>

- technology and human-interaction models and techniques in the development of Internet-based software;
- migration or integration of legacy software into Internet-based software;<sup>11</sup> and
- case studies and experience reports on one or more of the previous aspects in industry practices.

### This Special Issue

This issue includes the following exciting and representative research.

In “Debugging the Internet of Things: The Case of Wireless Sensor Networks,” Patrick Eugster and his colleagues relate their experiences developing debugging tools for wireless sensor networks, enablers of perception in the Internet of Things.

In “Automated Synthesis of Service Choreographies,” Marco Autili and his colleagues describe a tool for creating service choreographies. A choreography is a form of decentralized service composition that describes peer-to-peer message exchanges among participant services from a global perspective.

In “Stigmergy-Based Construction of Internetware Artifacts,” Wei Zhang and his colleagues present an approach that enables the continual construction and evolution of model-based Internetware artifacts by the collective of software stakeholders connected by the Internet.

In “Diagnosing Energy Efficiency and Performance for Mobile Internetware Applications,” Yepang Liu and his colleagues describe the characteristics of energy and performance bugs in smartphone applications. They discuss challenges

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and able to evolve to effectively deal with rapid changes in user requirements and run-time environments. The Internet-based software ecosystem increasingly impacts software engineers by redefining their roles and patterns for collaboration, innovation, and value creation, particularly in global distributed environments.

Software engineering for Internet computing involves the architecting, development, deployment, management, and quality assurance of software supporting Internet-based systems. It also addresses global-development issues such as communication complexity, distributed control, governance policies, and

provisioning and deployment (for example, OpenStack and Capistrano), and Web-scale data analytics and content handling (for example, MongoDB and Hadoop);


- quality-assurance approaches and security-and-trust aspects<sup>9</sup> in the engineering of Internet-based software;
- software design models for Internet-based software, such as UML, BPM (Business Process Management),<sup>10</sup> and Petri nets;
- software development processes and tools for the Internet (for example, agile development for Internet-based software) or with the Internet (for



and techniques in diagnosing them, and study tool usage for analyzing smartphone applications and software development kits.

In “A Tail-Tolerant Cloud API Wrapper,” Qinghua Lu and her colleagues explore the characteristics of cloud APIs, using Amazon EC2 (Elastic Compute Cloud) as a test-bed. They also present mechanisms to improve cloud API performance.

In “Multitier Diversification in Web-Based Software Applications,” Simon Allier and his colleagues introduce an approach that extends software diversification beyond the OS level, as a step toward breaking Internet application monoculture.

Finally, to look at what’s “beyond” Internetwork, seven outstanding researchers in the field (Jian Lü, David Rosenblum, Tefvik Bultan, Valerie Issarny, Schahram Dustdar, Margaret-Anne Storey, and Dongmei Zhang) share their views on the future of software engineering for Internet computing. 

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