

IBM Research has had a long history of significant contributions in the field of communications and networking. Our invention of trellis-coded modulation in IBM Research paved the way for reliable transmission over telephone channels. We have also contributed to successful IBM products, such as Token Ring, a local area communication network, which also became an international standard. In the area of analysis of communication systems, members of IBM Research developed the Convolution algorithm and Mean Value Analysis (MVA) techniques for analyzing queueing networks. These techniques are widely used in the performance study of communication networks. Our current research focus is to advance the state-of-the-art in communication technologies as well as in Internet infrastructure and services.

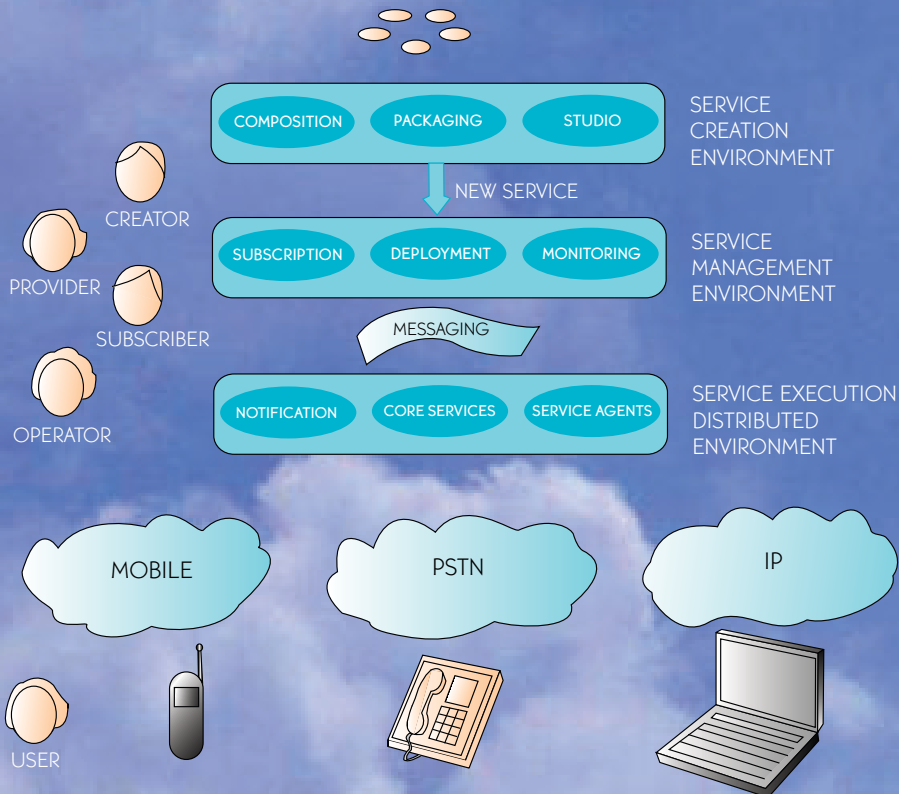
### Pervasive Networking and Wireless Internet

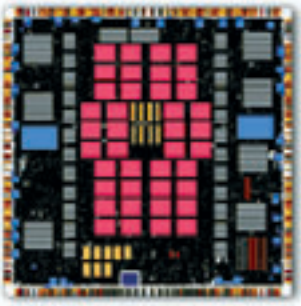
We are seeking to enable mobile, personal computing devices to offer value-added networked services. The challenge is to extend today's Internet-enabled services to pervasive computing devices and to create new wireless Internet middleware and services, such as location-based services and wireless content distribution.

Furthermore, we are investigating Internet infrastructure components (such as servers, gateways, and proxies) that enable dynamic adaptive and personalized services for wireless connected devices and users. Among our research projects that target the next generation wireless Internet are mobile and wireless content distribution, mobile e-commerce infrastructure, secure wireless Internet service access and delivery, and Bluetooth™ wireless technology.

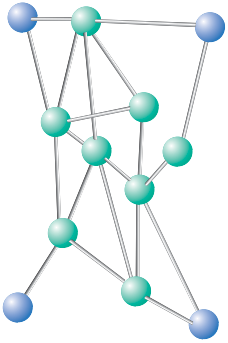
### Intelligent Service Architectures

Content distribution networks currently being deployed use edge servers located at major Internet Service Provider (ISP) access and network exchange points to improve the response time of Internet applications by offloading the delivery of bandwidth-intensive objects, such as images and video clips.





We are developing an intelligent Internet infrastructure that improves the performance and scalability of distributed applications by moving computation to the edge of the network. Applications are split into two components: one that can be executed at edge servers closer to the users, and one that cannot. For easy management and operational convenience, the nodes constituting the distribution network are designed to be as self-configuring, self-managing, and self-diagnosing as possible.



### Rapid Service Creation

We are introducing technologies for the engineering of hybrid services that exploit the convergence toward IP as the universal network infrastructure to combine Web and telecommunications services. Our service architecture comprises three environments: creation, management, and execution. A service is created using components from various domains such as telephony, mobility, and web services. The created logic, combined with other modules dealing with service data and dialog presentation, forms a service package. This, in turn, is deployed, and functions such as subscription and management are activated. Upon user invocation, the service logic executes in a distributed environment and interacts with resources through standard Java interfaces.

### Quality of Service (QoS), Policy-Based Networking, and Optimal Multimedia Delivery

With the rapid growth of IP-based networks, managing the performance of networked applications has become a key requirement. We are exploring different methods for managing the performance of IP-based applications, including identification of performance bottlenecks in existing protocols, implementation of end-server QoS techniques, and exploitation of an intelligent services architecture.

We have taken a composite approach that exploits the knowledge and capabilities of end-stations, particularly high-volume servers, to provide enhanced QoS features. We have developed policy-based techniques to simplify network QoS and security management. A network policy is an administrator-defined criterion for network operation that is specified in simple, intuitive terms. The initial primary application of these performance management techniques is in the domain of optimal multimedia delivery, exploiting peer-to-peer networking, as well as content distribution networks.

### Communications Technology Systems

Our research in this area is focused on communication devices and subsystems for the OEM market; in particular, switching, network processor, short-range and cellular wireless technologies, and magnetic recording channel electronics. We invented high-speed address lookup methods that are optimized for data structure density and update performance. Currently, we are contributing to a PowerPC-centric Network Processor (NP) architecture. On the software side, we are working on a distributed IP control point architecture and have demonstrated advanced NP applications for traffic engineering and intrusion prevention. We are also contributing software to the PowerNP™ reference platform to demonstrate the QoS strength of our NPs.

