Special Edition on 21st Century Solutions

Network Infrastructure Solutions: Next Generation Core Network

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Abstract

With the transition from the digital revolution to the IT revolution the behavior of companies and individual consumers will also change. Moreover, the network infrastructure which supports these is on the verge of a major structural re-vamping. The business model for network carriers also has begun to shift from the traditional telephone business centered model to information distribution platform business or contents distribution business.[1] Also, at each telecommunications business operator, efforts toward building the next generation network, focused on IP technology, are becoming more vigorous.[2]

In the present paper, we introduce next-generation core network which is suited to the changes in the market environment, changes in user needs, and changes in network services now occurring. We also explain how our company is addressing the future network configurations and demands on network's which will result from these changes.

Trends in Network Services

The ongoing progress of the Internet is changing the style of communication amongst people and companies as well. Business styles are also changing and a new marketplace is being created based on new network-type businesses. (Figure 1.) In pace with this, functions required of network's will change their form from:

- human communication means, primarily the current telephone and e-mail,
  to
- a service infrastructure for the 21st century which supports the network-type economy mainly consisting of B2B and B2C business,
  and to
- a social foundation which supports content-distribution types of communication which will be essential for achieving a rich society, even including C2C business.

These trends will not be short-lived; their will continue to grow.

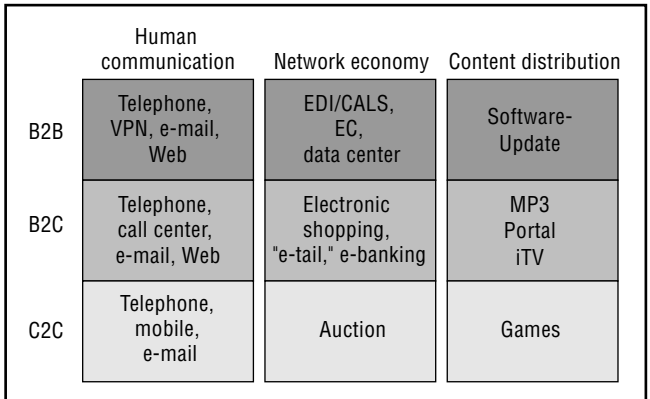

Figure 1: Progress in network services

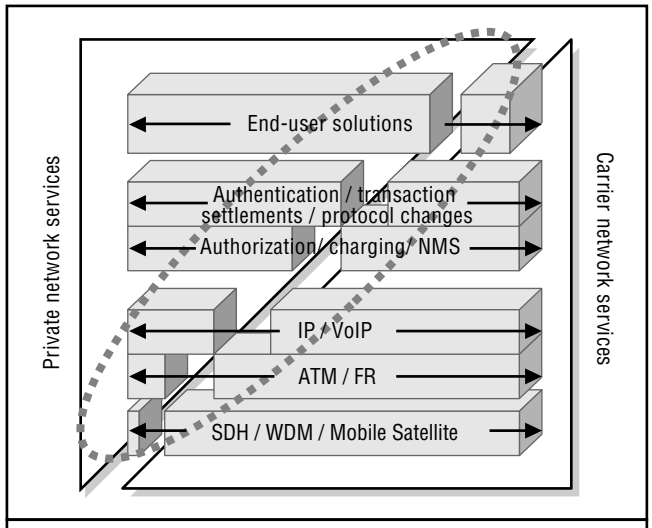

Figure 2: The convergence (melding) of carrier network's and private network's

Changes in the Features Required of Networks

We will briefly describe the changes in the features expected of the next-generation core network's which will be required to respond to the changes in network services. To do that, we will examine three aspects: network functions, traffic, and switching (exchange) architecture.

1. Changes in network functions
   The first change is the "convergence of carrier network's and private network's." The functions and technology of

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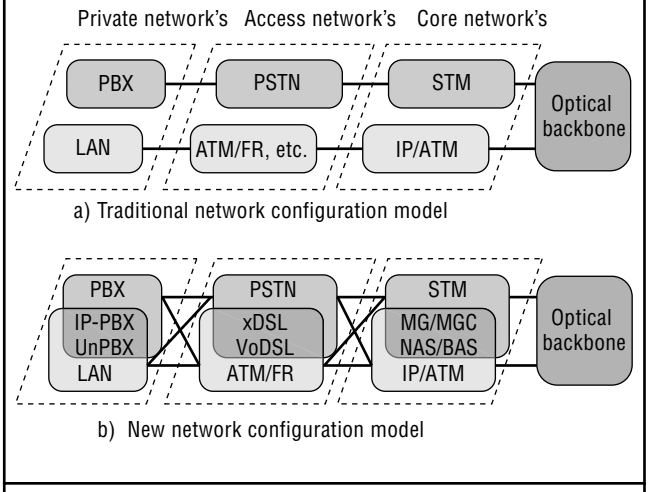

Figure 3: The convergence of telecom network's and datacom network's

types of carrier network businesses are being created. In the future also, it can be expected that for functions such as network outsourcing, server hosting / housing, etc., private network's will be the source of models for new carrier network businesses. (Figure 2.)

The second change in network functions is the "convergence of telecommunications and data communications." With private network's and carrier network's (access and core), the two applications of telecom network's and datacom network's have developed independently, responding to the traffic characteristics and service attributes required of each of them. Nevertheless, convergence of the is steadily progressing. In private network's, products like IP-PBX and UnPBX, and in carrier network's, products like xDSL (Digital Subscriber Lines), MG (Media Gateways), MGC (Media Gateway Controllers), NAS/BAS (Narrowband / Broadband Access Servers)—in other words, products which are in this "converged region," have begun to create new network equipment markets. (Figure 3.)

2. Changes in communication traffic
   The change in communication forms, from B2B to B2C and C2C, along with the rise of netwoek business, have caused changes in communication traffic. As for traffic attributes, streaming-type, transaction-type, and burst-type can be considered. (Figure 4.) In addition, the dispersion or concentration of traffic can occur dynamically, and extreme bursts of data can also occur. In the next-generation core network's that will support this kind of diverse traffic, the functions which will be required are detailed QoS control, route control, and dynamic network management. Next-generation core network's will make good use of these functions, and it will be important for them to establish flexible communication path dynamically and in real time and use network resources efficiently.

	Burst	Transaction	Stream
QoS	Best-effort	Guaranteed	Guaranteed
-loss	-less	-extremely less	-less
-delay	-N/A	-less	-extremely less
-jitter	-N/A	-less	-extremely less

Figure 4: Diversity of traffic attributes

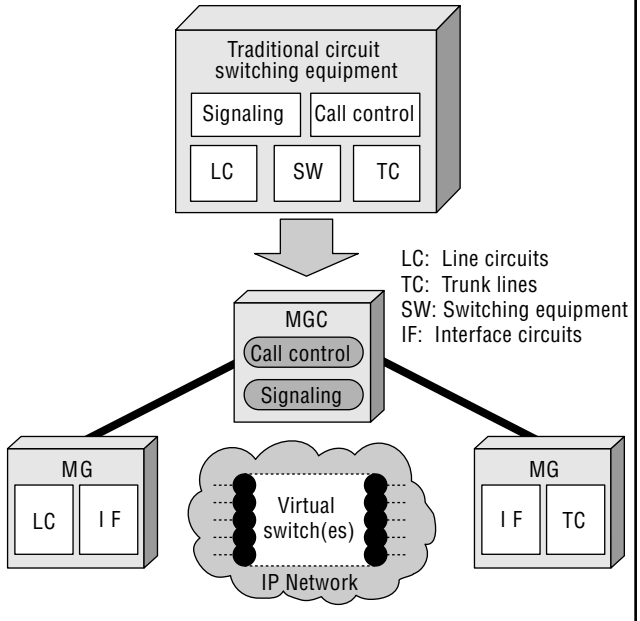

Figure 5: Changes in switching equipment architecture

3. Changes in switching architecture
   The third major change is in the architecture of switching equipment. Standardization of Decomposed Gateway Architecture is being promoted because it offers an alternative to traditional circuit switches. (Figure 5.) To make it possible to support multimedia services, which are expected to grow in the future, while changing the network infrastructure as little as possible, IP networks can be used as virtual switches. This is a configuration whereby the MG, which corresponds to an "edge," is controlled by software running on a multi-purpose server. In other words, this represents a down-sizing of the network-wide switching function through introduction of a new computer architecture. In addition, recently, evaluation of the possible application of an open API called JAIN (Java[*1] API's for Integrated Networks), Parlay is being actively pursued.

[*1] Java is the registered trademark (in the US and other countries) of the US firm, Sun Microsystems.

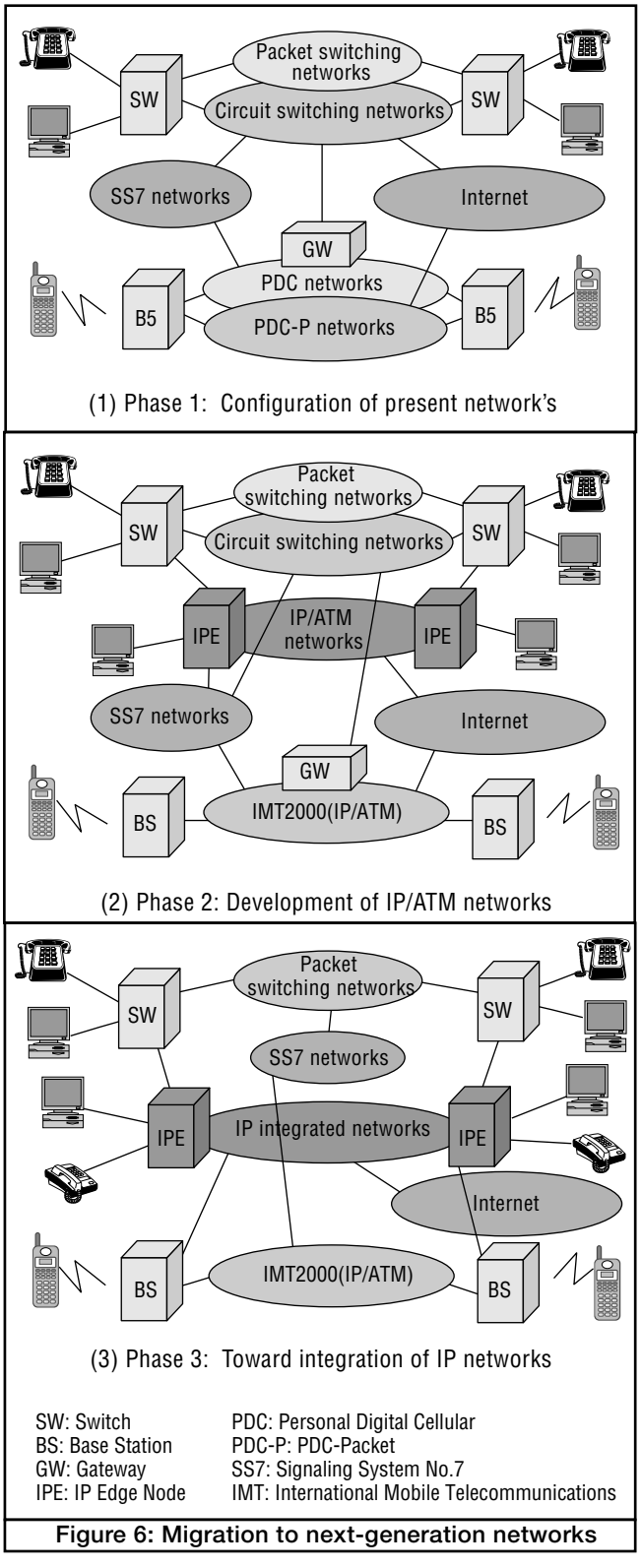

Figure 6: Migration to next-generation networks

Migration of core network's and next-generation network architecture

To explain how core network's will evolve, under the impact of the changing requirements on network's explained in the previous section, this can be described in terms of three phases, as shown in Figure 6[3)]

1. Phase 1: Present network configuration
   Phase 1 is the network configuration which has existed before any changes in the demands placed on network's. It consists of two independent kinds of network's: circuit switching networks and packet switching nets (i.e. fixed network's) on the one hand and mobile MW's, such as PDC nets and PDC-P nets, on the other. Therefore, on each type of network, services such as dial up connection, Internet connection, etc. are provided, separately tailored to that type of network.
2. Phase 2: Development of IP/ATM networks
   For both fixed networks and mobile networks, the introduction of packet-based network (exemplified by IP/ATM) is progressing, as a means for achieving IP data communication more efficiently. Traffic for dial up connections is also accommodated in this packet network also. In other words, as changes in traffic and the ongoing convergence of telecom and datacom become more pronounced, network's must evolve in accordance with these changes.

   Specifically, with fixed networks, medium to high speed access means, such as xDSL, PDS (Passive Double Star), etc., have appeared, as services integrating speech and data. Also, for IPE's (IP Edge Nodes) to handle dial-up and always-on connected Internet users, telecom / datacom integrated products, such as the previously mentioned NAS and BAS, have appeared in the market. Also in the case of mobile networks, as a third-generation broadband (integrated voice and data type) service, IMT2000 has come into being, based on IP/ATM networks.

   With the growth of always-on connected type Internet access means, network-type economies have made good advances and the increase in traffic and the trend toward greater variety in attributes has progressed. Optical WDM rings for backbone network's and multi-service rings for access-type network's make their appearance in this phase.
3. Phase 3: Integration into an IP network
   In this phase, in addition to the convergence of telecom and datacom and the changes in traffic, there will be progress in the areas of integration of private network's and carrier network's and change in the architecture of switching equipment. Specifically, an integrated IP network will be provided, usable for both fixed networks and mobile networks. As a result it will become easy to achieve integration of fixed service and mobile service (Internet access through the same address, etc.)

   Under such drastic changes, IP-based voice services (VoIP: Voice over IP), whose introduction from the private network side has been making progress in the area of fixed nets, will be provided to carrier network's also, through the "interworking"

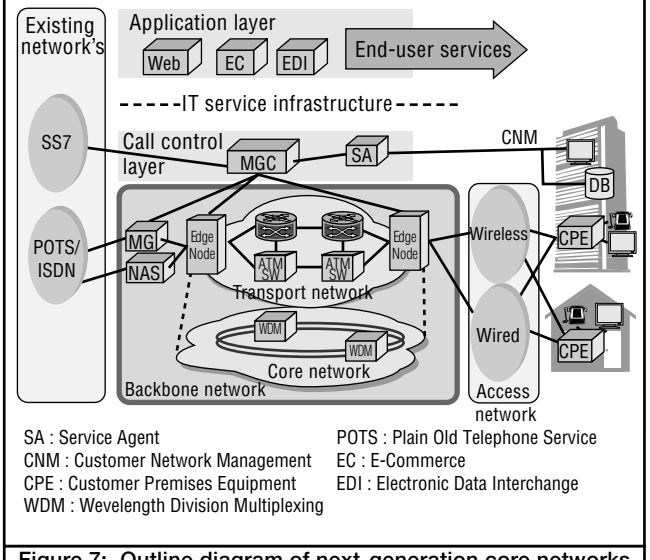

Figure 7: Outline diagram of next-generation core networks

of IP integrated networks and circuit switching networks. MGs and MGCs, enabled by the above mentioned Decomposed Gateway Architecture, and IP edge nodes offering a mobile IP function will be specified as IPE's. Moreover, traditional telephone switching equipment will migrate to server-type switches, such as MGs and MGCs. It is even forecasted that conventional telephone switching equipment will eventually disappear. In this case, the configuration will be such that each function—bearer forwarding, call control, service control-is layered and control is done, dispersed over each MG, MGC, and SA (Service Agent.)

Figure 7 shows an outline of the next-generation network based on the kind of migration described above.

How Oki Electric is Tackling the Issue of Next-Generation Core network's

At present, we are proceeding with development of key components based on the migration to next-generation core network's. Here, from among those, we will explain the basics of two major systems.

1. IP edge node: APRON

   APRON (Active and Programmable IP Node for Multiservice IP Network) is an IP edge node which has adopted leading technology—such as network processors, the newest IP protocols (mobile IP, IPv6, etc.), programmable and active networks, etc.-ahead of the competition. It can be applied to medium and high speed IP services (for which demand is expected to increase in the future), to next generation mobile communications (mobile IP), etc.[4] In Figure 8 we show the APRON system architecture which is now being considered.

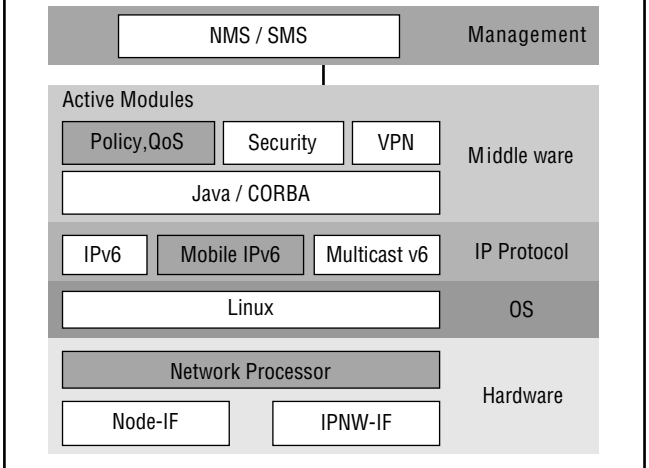

Figure 8: APRON architecture

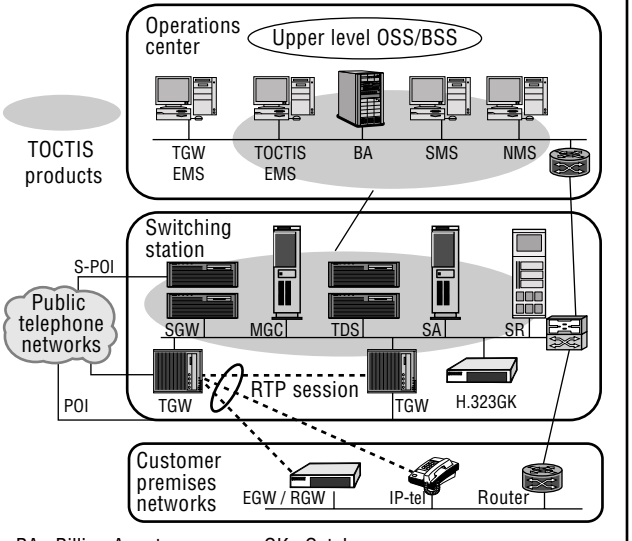

Figure 9: TOCTIS product line

2. TOCTIS

   Oki Electric, while contributing to standardization of Decomposed Gateway Architecture, offers TOCTIS (Tailored Open Components for Telephony and IP Services) as a component product. TOCTIS is a core controller and applications server which provides, in addition to toll bypass, UMS (Unified Messaging System) and a voice service linked to a WWW server. It utilizes MGCP (Media Gateway Control Protocol) and H.323 protocols. The TOCTIS product, in the form of a set of control software

running on a multi-purpose server, is shown in Figure 9.

Here we have introduced APRON and TOCTIS, as examples of work Oki Electric has done, aimed at next generation core networks to support 21st century information distribution society. However, in the future we plan many more solution products based on next-generation core network configurations which we will successively introduce to the market, as well as providing them to the global partners with whom we have alliances.

References

1. Suzuki: NTT's R & D aimed at achieving information distribution, NTT Technical Journal, Vol. 12, No. 1, pgs. 25-29, 2000.
2. For example, Japan Telecom HP: http://www.japan-telecom.co.jp/prism/eg/prism_indexe.html
3. Miyake: Directions for creating the next-generation, the 5489th JPI Special Research Forum, 2000.
4. K. Kato, et al.: Active Policy Networking, WTC, T6, 2000.