Approach to Next Generation Carrier-Grade IP Transport Networks

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Agenda

- Changes in circumstances surrounding IP networks
- Business strategy for IP networks of NTT Communications
- Next generation carrier-grade IP transport networks
- Issues for GMPLS in carrier-grade network

Changes in circumstances surrounding IP networks

- Scalability
- Reliability
- Robustness
- Economical efficiency

Large-scale and High Speed IP Transport Networks

- ✓ Rapid increase in broadband access users
- ✓ Increase in IP-based applications
- ✓ Development and spread of "*ubiquitous*" technologies
- ✓ Migration to full-IP connectivity

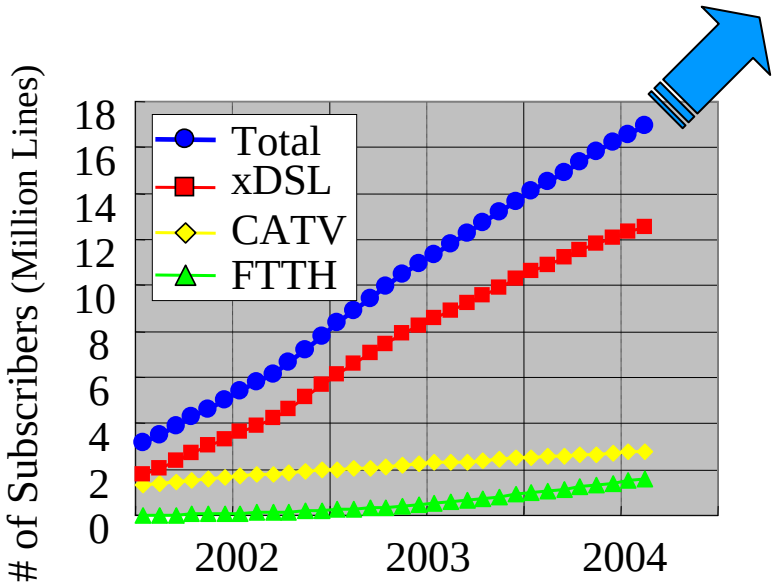


Fig. Trends in the number of broadband users
(Source : Ministry of Internal Affairs and Communications.)

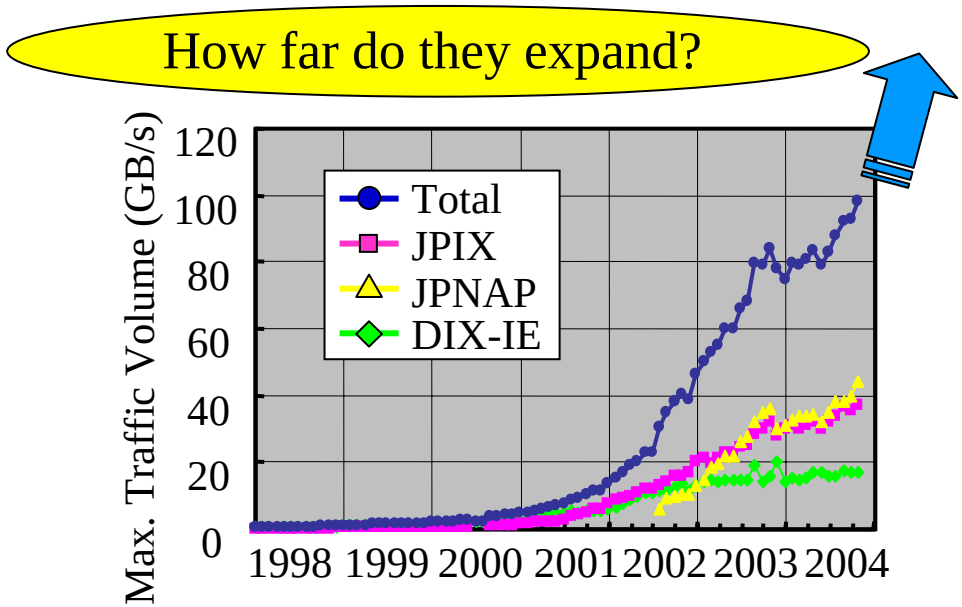
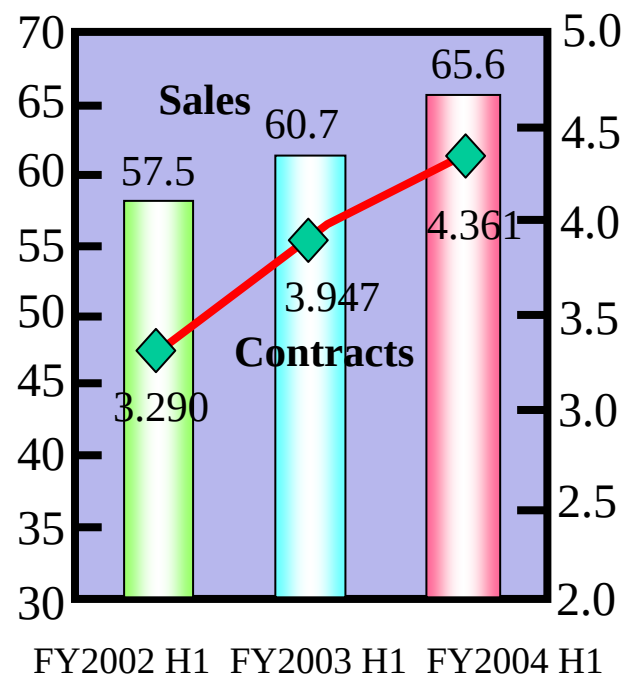


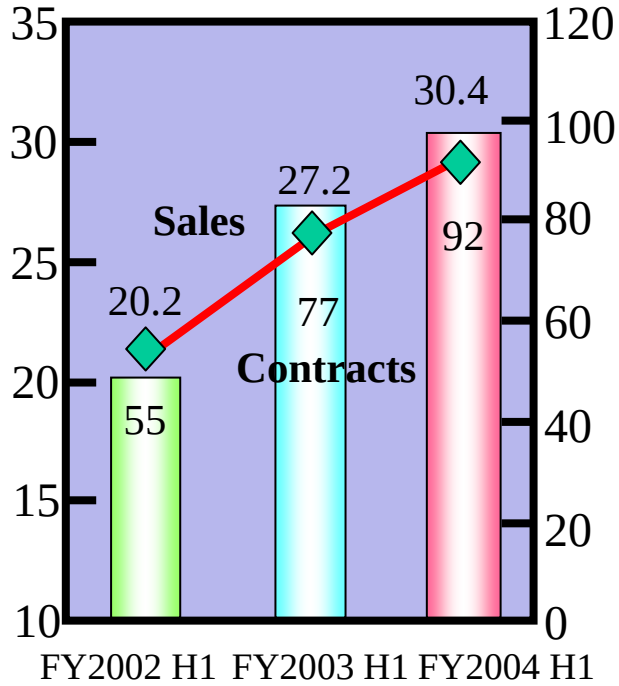
Fig. Trends in IP traffic volume of major IXs
(Source : Traffic volume data reported by JPIX, JPNAP and DIX-IE(WIDE).)

OCN, IP-VPN and Wide-Area Ethernet Services

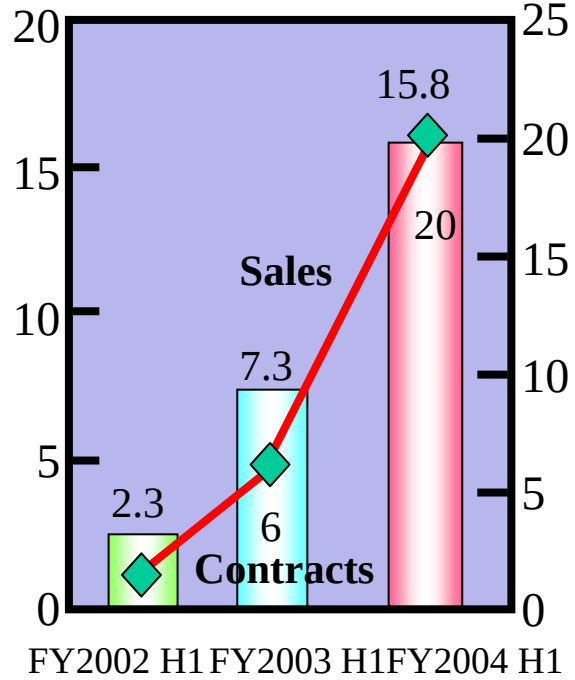
OCN Sales and Contracts



IP-VPN Sales and Contracts



Wide-Area Ethernet (e-VLAN, etc.) Sales and Contracts



Source : NTT Communications' Financial Results Outline for Fiscal Half Year Ended Sept. 30, 2004.

Reliable and Robust Networks

- Increase in IP-based enterprise networks
  (Migration from leased line to IP-VPN service)
- Increase in applications that need a quality (VoIP, Video, etc.)
- Migration from existing fixed line telephones to IP telephones
- Support of security
- Support of rapid network recovery scheme

IP networks as a social infrastructure and a lifeline

Reliable and Robust Networks (Cont.)

Lessons learned from large-scale disasters
(e.g., Niigata-ken Chuetsu earthquake (Oct 23, 2004))

- Need of various network recovery schemes
- Robust facilities
- Rapid responses to disaster
- Remote control of network equipments at the disaster area
- Automated provisioning process

Importance of network recovery scheme with maneuverability and robustness

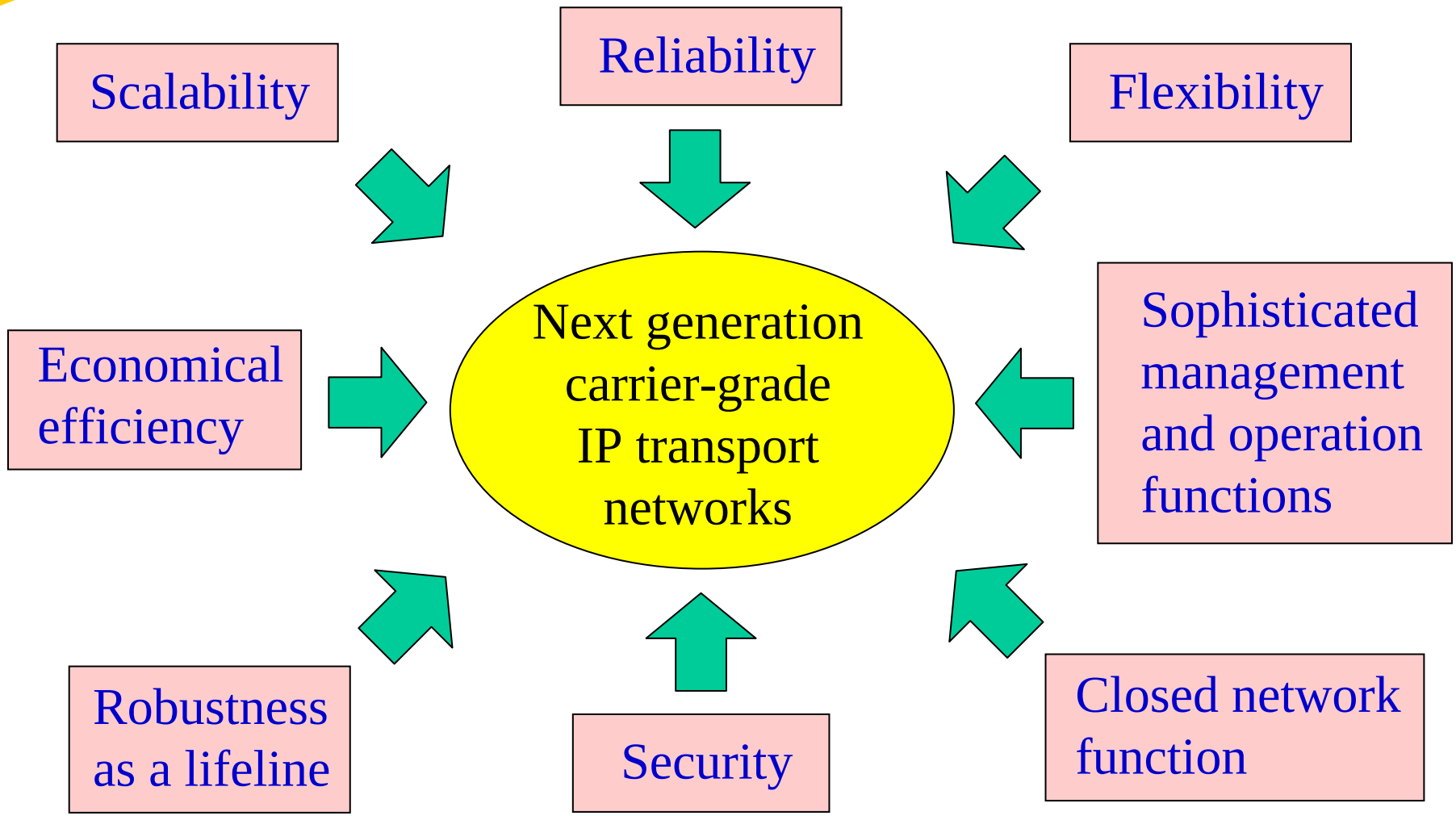
Carrier-Grade IP Transport Networks

In addition to scalability, reliability and robustness ;

- Rapid service delivery
- Flexibility for various demands and services
- Reduction of CAPEX and OPEX
- Sophisticated network operation and management

Appropriate balance
between serviceability and cost

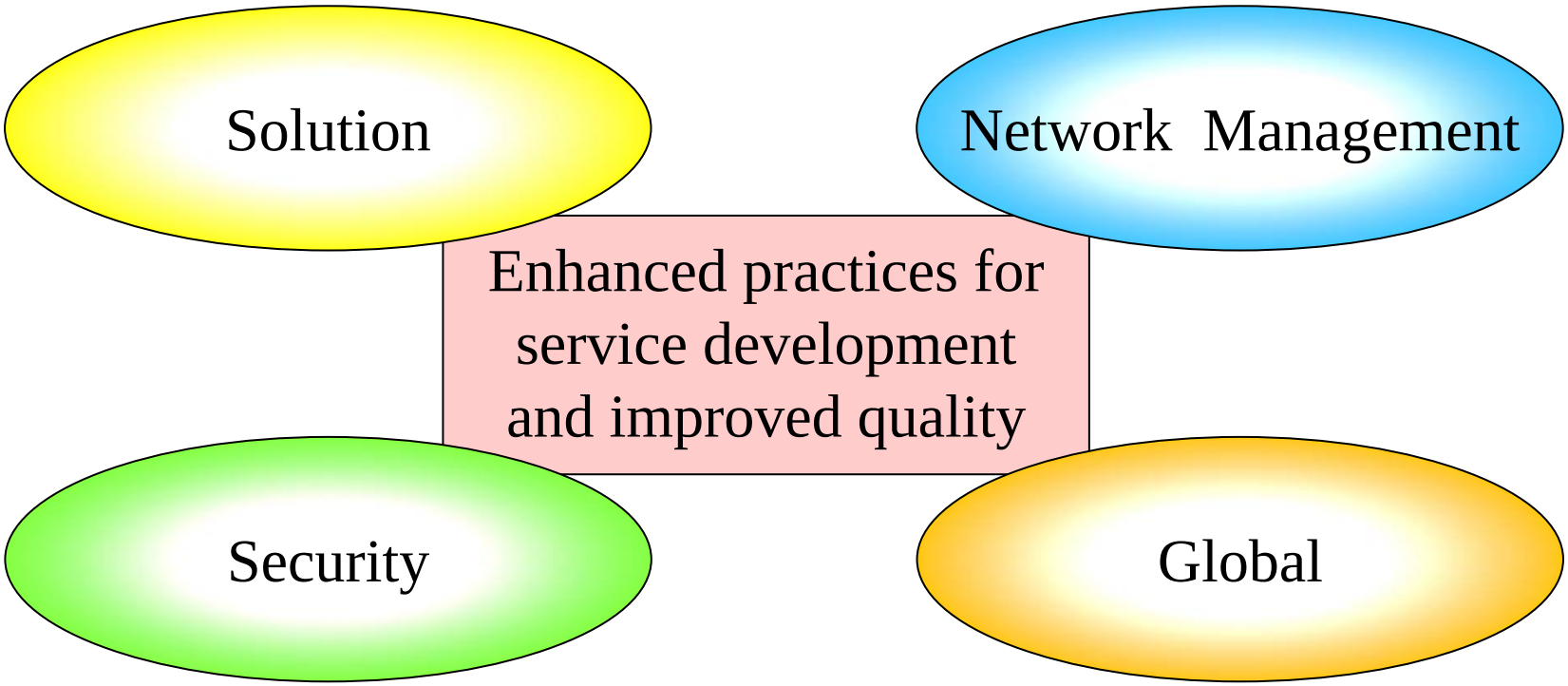
Requirements for Future IP Transport Networks



Business Strategy
for IP Networks of NTT Communications

Four Core Business Domains for NTT Com's Growth Model

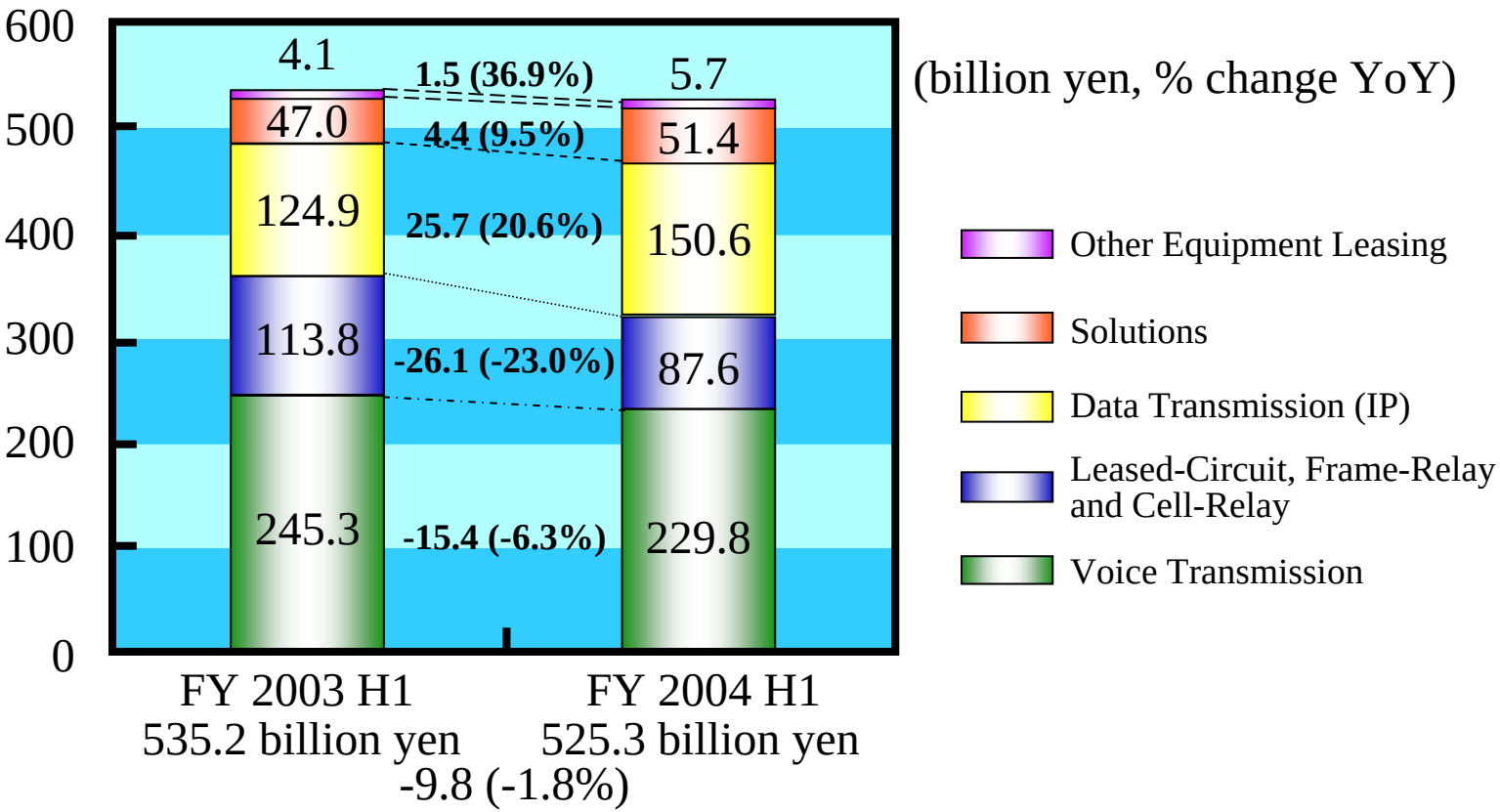
Global services that fully leverage the Internet to meet customers' IT needs



Business Domains for New Growth

Operating Revenues

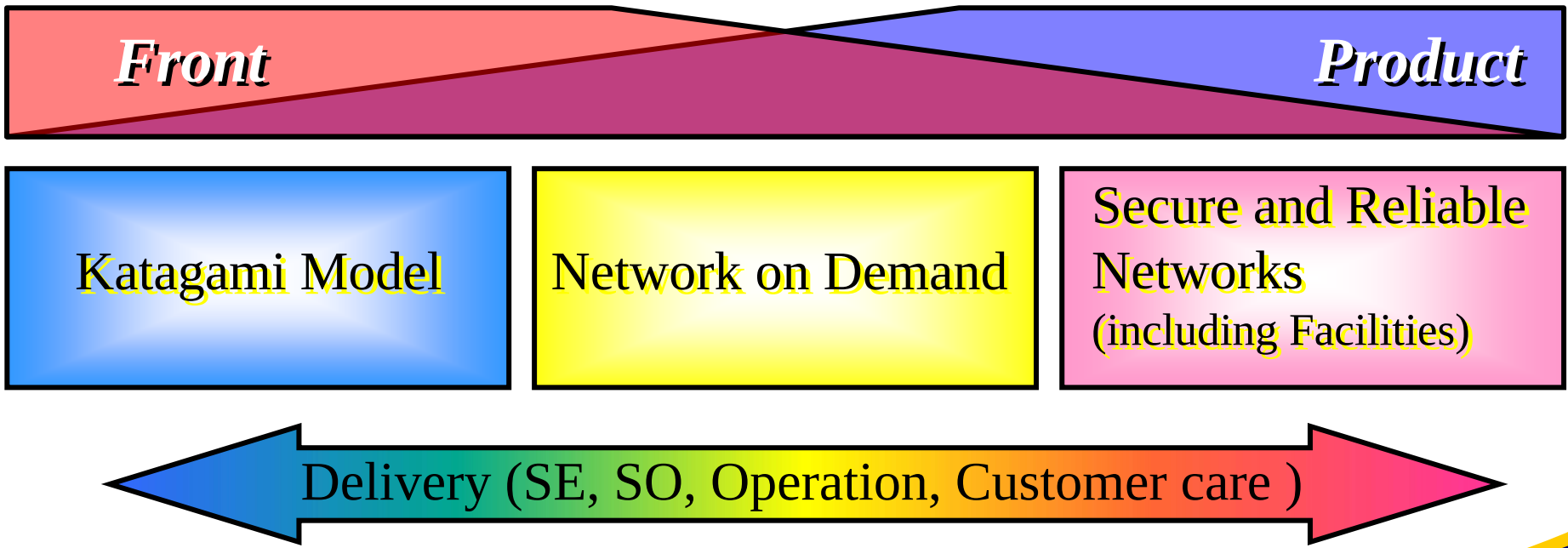
Data transmission (IP) and solution service revenues increased.



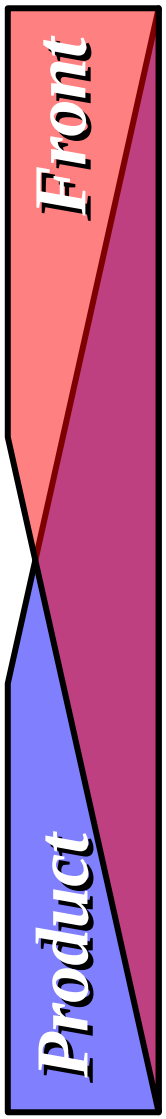
Source : NTT Communications' Financial Results Outline for Fiscal Half Year Ended Sept. 30, 2004.

Strategy for Network Management

Strengthened sales and product development/delivery for business model focused on customers' needs, usage patterns and effectiveness.



Strategy for Network Management (Cont.)



Katagami Model

"Katagami" is a Japanese word meaning "pattern".

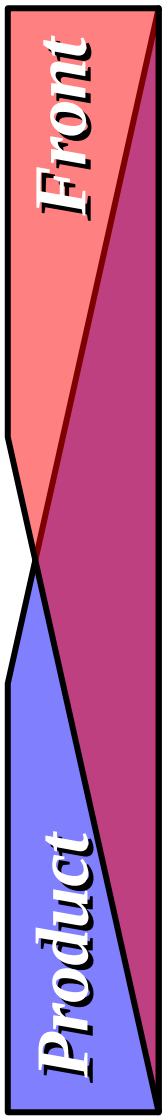
Network on Demand

Secure and Reliable Networks
(including Facilities)

Patternized service menu for customers and/or usage

- ✓ Suitable service provision based on customer demand
- ✓ Rearrangement of relevance between products and technology
- ✓ Efficient development based on Katagami Model

Strategy for Network Management (Cont.)



Katagami Model

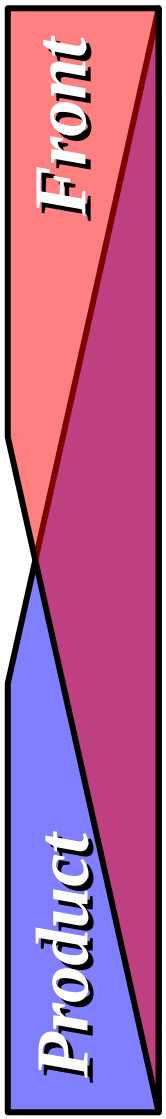
Network on Demand

Secure and Reliable Networks
(including Facilities)

Rapid Delivery of Various Services

- ✓ Reconstruction of delivery process
- ✓ Rearrangement of network services
- ✓ New service creation for ubiquitous networks

Strategy for Network Management (Cont.)



Katagami Model

Network on Demand

Secure and Reliable Networks
(including Facilities)

Security and Reliability that meet customer's requirements

- ✓ Development of network services with security
- ✓ Quality control based on SLA
- ✓ Facilities and networks with robustness

Strategy for Network Management (Cont.)

Missions:

- Rapid and suitable service provision for customer's requirements.
- Development of IP transport networks as infrastructure with high reliability and scalability for customer's satisfactions.

Next Generation Carrier-Grade IP Transport Networks

Development Strategy for Next-Gen. Network Architecture

Step-by-step approach for sophisticated and simple network architecture

	Step 1	Step 2	Step 3
Archi-tecture	Networks for each service	L2/L3 MPLS-VPN	GMPLS (IP + Photonic)
Service	Basic connectivity	IP over MPLS Ethernet over MPLS ATM/FR over MPLS HSD over MPLS	Large scale and high speed transport Multi-layer TE Automated provisioning over network layers
Optional function		QoS, Multicast, IPv6, etc. MPLS OAM	Optical VPN On-demand path provisioning Burst traffic forwarding

Enhancement of networking features

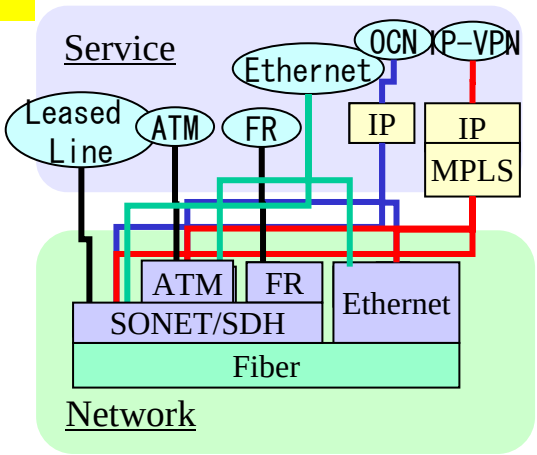
Development Strategy for Next-Gen. Network Architecture

Step-by-step approach for sophisticated and simple network architecture

Step 1 → Step 2 → Step 3

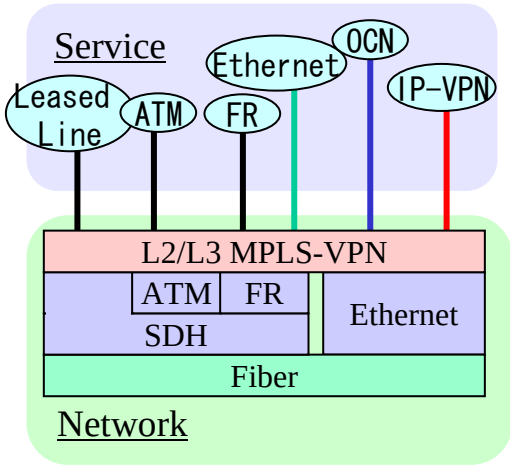
Archi-tecture

Networks for each service



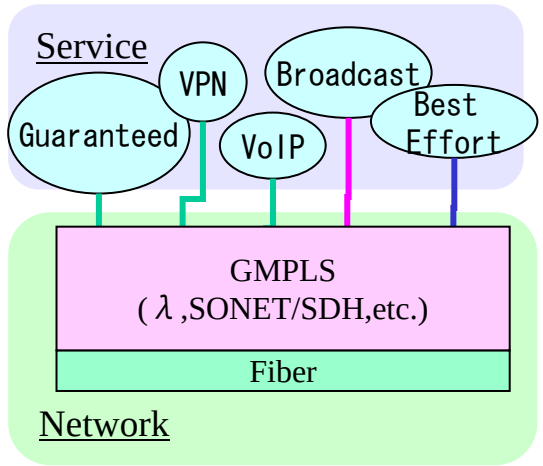
Complex network

L2/L3 MPLS-VPN



Partial service integration

GMPLS (IP + Photonic)

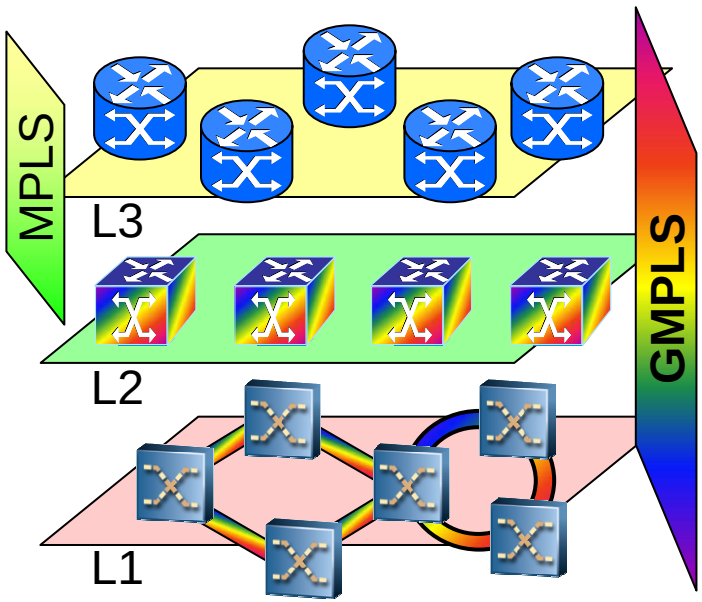


Subjective service integration
Simple network structure

Simple network architecture

Advantageous Effect of GMPLS in Carrier Networks

Integrated and transparent network control by GMPLS



- Autonomous network control including non packet-based forwarding planes
  - Rapid network operation
  - Rapid recovery from network failure
  - OPEX reduction
- Interoperability in multi-vendor network
  - Best network construction by “best of breed”
  - Effective utilization of existing facilities
  - CAPEX reduction
- Traffic engineering over multiple switching layers that is suitable for various traffic
  - Flexible path provisioning according to QoS
  - Burst traffic forwarding

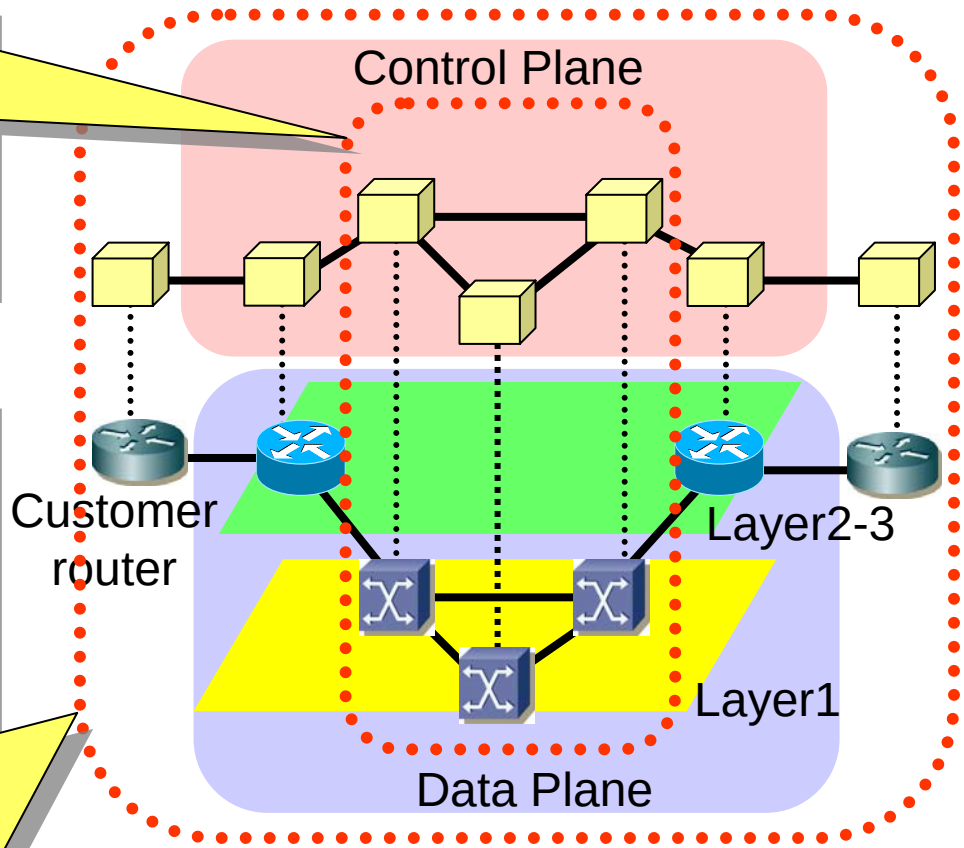
Applicable Domain of GMPLS

Advanced IP transport NW

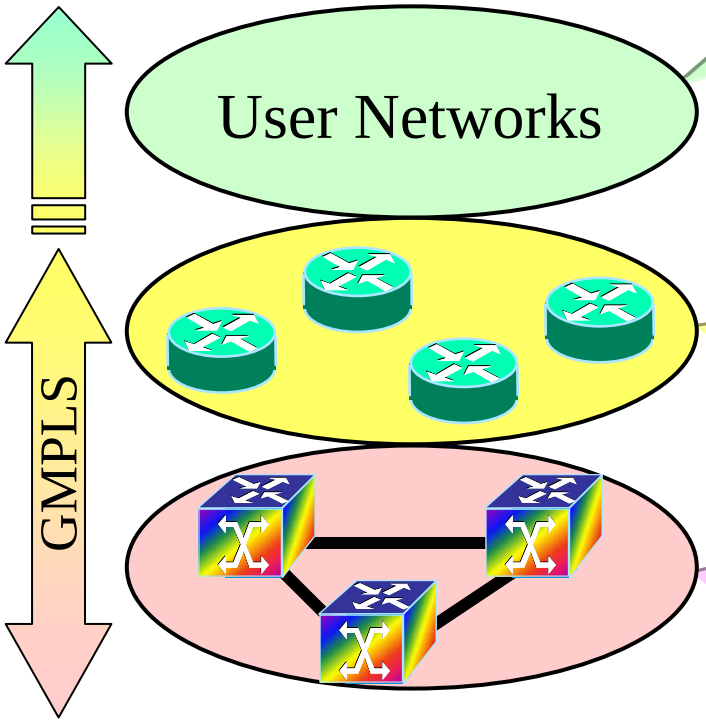
- Autonomous control of path routes
  - high reliability
  - high efficiency of NW resource

Integrated control of multilayer NW

- Unification of NW operation
  - reduction of operation cost
  - automated provisioning/ failure handing (rapid responses to recovery)
- Innovative service creation
  - cooperation with customer router



Strategy for Next Generation IP Transport Networks



User networks

- On-demand service (QoS, burst traffic, etc.)
- Rapid service delivery

Advanced Edge Networks

- Packet forwarding according to the flow/traffic measurement
- Path selection based on GMPLS

Intelligent Core Networks

- Integrated management over multiple network layers
- Automated path provisioning that cooperate with edge networks (user, IP flow, QoS, burst traffic, etc)

Application of GMPLS to Carrier Networks

- Protection / restoration running on multiple switching types
  (additional function for TDM, lambda and fiber (port) switching)
  - Rapid and flexible network recovery by automated path provisioning mechanism
  - Efficient use of network resource by shared mesh protection / restoration
  - Improvement of network reliability
  - Reduction of operation cost
- Provision of on-demand service
  - Rapid service delivery
  - Timely path provisioning suitable for demand

Applicable Area of GMPLS

Area	Application	Issue
Metro	- On-demand service - Flexible add/drop - Traffic engineering	- Security - ROADM control by GMPLS - Cooperation with NMS
Backbone	- Protection/restoration - Automated path provisioning (Multiple network layers)	- Analysis of economic effect - Rapid failure detection - Cooperation with NMS - Inter-domain connection - Scalability

Issues for GMPLS

Issues for GMPLS in Carrier-Grade Network

- Building of control plane suitable for carrier's network operation
  - Scalability, reliability and cost
- Interoperability in multi-vendor network
  - Appropriate (unified) interpretation of GMPLS protocol
    - Liaison between IETF, ITU-T and OIF
    - Interoperability test at PIL, ISOCORE, IOL(UNH), etc.

      (PIL : Photonic Internet Lab., IOL : InterOperability Laboratory)
- Scalability of GMPLS network
  - Inter-AS GMPLS networking mechanism
  - Scalability of control plane network (RSVP-TE and OSPF-TE)

Issues for GMPLS in Carrier-Grade Network (Cont.)

Management of GMPLS networks

- Operation and management mechanism of LSP (TE-link)
  - ⇨ Network management and accounting
- Interaction of management plane and control plane
- Clarification of notification and localization mechanism of failure
  (LMP or SNMP,…)

Specific Initiatives (Global)

First Asian carrier named "Best Global Carrier" at World Communication Awards 2004

WCA 2004 WINNER
Best Global Carrier
Best New Service

Awards ceremony, London, October 11, 2004

The World Communication Awards, sponsored by Total Telecom/Terrapinn Limited, is the premier global awards event in the telecommunications industry.

Also received Best New Service Award, as well as Best Global Carrier Award

NTT Communications

Global IP Solution Company

Thank You