Network and Service Management for the Future Internet

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Network/Service Management: 3rd Class Citizen ?

- Forwarding Plane and Control Plane
  - The Internet: Forwarding + Control Plane combined
  - NGN: Forwarding and Control Plane separated
  - Future Internet: ???
  - Very active in Research, Development, Commercialization, and Standardization

- Management Plane
  - The Internet: device-oriented, service provider controlled
  - NGN: service-oriented, customer requested
  - Future Internet: ??? more harsh requirements at least
  - Mostly treated as 3rd class citizen during development cycle and standardization activity
  - Usually said that it is very important but unfortunately set aside until last moment

- Traditional FCAPS
  - Fault Management (root cause analysis, event correlation, ...)
  - Configuration Management (Topology, Inventory, ...)
  - Accounting Management (Usage collection, ...)
  - Performance Management (Traffic monitoring, ...)
  - Security Management (Access control list, key management, ...)

- Improved Management Capabilities
  - Policy-based management
  - Web-based management
  - SLA management
  - Business management (accounting, charging & billing, ...)

Service Provider Centric / Device Oriented

Network and Service Management

- Fast
- Ubiquitous
- Huge number of service objects (users, various smart devices, applications, sensors, etc.)
- QoS, especially QoE become norm
- SLAs among various entities (customers and providers)
- Venerability to the anomalous attacks will increase due to the complexity of the infrastructure

Unmanaged → Managed → Reactive → Proactive → Autonomic

**Customer Centric / Service Oriented
Network and Service Management**

Research Efforts in Europe

- **EuroNGI WP.JRA.1.5 Network Management: New trends and Architectures**

  - D.WP.JRA.1.5.1 State of the art in Location Management procedures
    - Network Management introduction
    - Policy based Management
    - Mobility and Location Management
  - D.WP.JRA.1.5.2 Study of mobility behavior of new Internet mobile users (IMUs)
    - Mobility models
  - D.JRA.1.5.3: Contribution to new *LU* schemes and new *SDB* architecture under new the behaviors of new *IMU*s with respect to mobility and traffic patterns.
  - D.JRA.1.5.4: Document describing the achievements on network management and its architecture within the NoE.
  - D.JRA.1.5.5: Contribution to standardization bodies (3GPP, ETSI, etc).

Research Efforts in Europe

- Special Joint Specific Research Project (JRA.S.06): Design and Evaluation of Distributed, Self-Organized QoS Monitoring for Autonomous Network Operation (AutoMon)

  - Specification of a distributed, self-organizing and autonomic IP QoS monitoring framework which is based on Distributed Hash Tables
  - Evaluation of the performance of the peer-to-peer mechanisms for maintaining the monitoring overlay
  - Analysis of applicability and accuracy of generic end-to-end performance metrics with regard to user-perceived Quality of Service.
  - Implementation of a concept demonstrator by the participating SME

- **E**uropean network on **MAN**agement solutions for the **I**nternet and **C**omplex **S**ervices (EMANICS)
  - 14 partners
  - Integration / Dissemination
  - Joint Research
    - Scalable Management
    - Economic Management
    - Autonomic Management
  - More information: http://www.emanics.org/
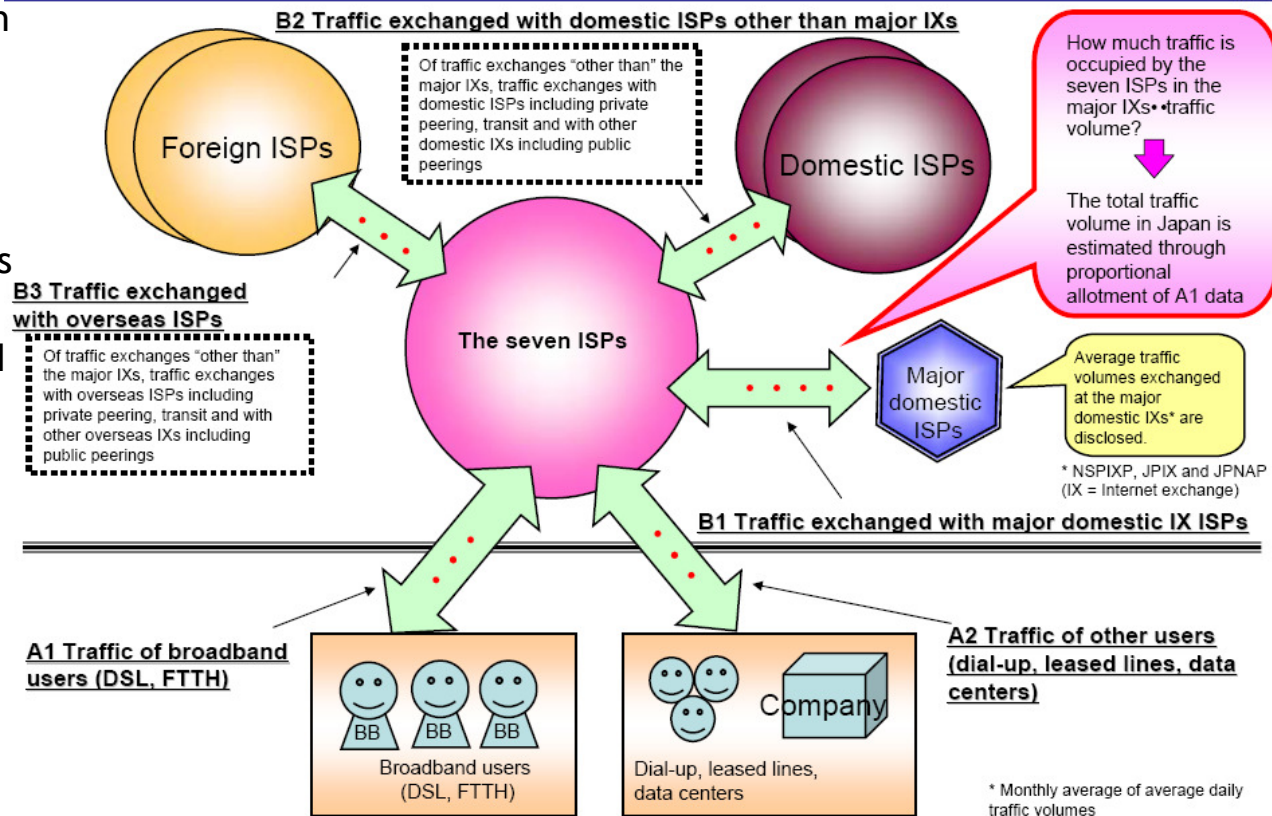
Research Efforts in the US

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- Two FIND Projects

- Towards Complexity-Oblivious Network Management
  - *Operationally independent, self bootstrapping* management plane
  - A *single, simple management interface* for all data plane protocols
  - *High-level, goal-directed specification* of network properties and policies

- Design for Manageability in the Next Generation Internet
  - Automated Management
  - Intrinsic Management Support
  - Real-time Change Detection
  - Pervasive Data Sharing
  - Network Management Evaluation Test-bed and Methodology

- WIDE(Widely Integrated Distributed Environment)
  - Japan's Internet Research Consortium
  - Has been 20 years
  - Hundreds organizations and around 600 researchers and engineers participating
  - Funded mostly by SPs and vendors
  - Major facilities managed by WIDE
    - International links, IXes, Root Name servers, etc.

1. Types of traffic statistics*

MIC

B2 Traffic exchanged with domestic ISPs other than major IXs

Of traffic exchanges "other than" the major IXs, traffic exchanges with domestic ISPs including private peering, transit and with other domestic IXs including public peerings

Foreign ISPs

Domestic ISPs

How much traffic is occupied by the seven ISPs in the major IXs•·traffic volume?

The total traffic volume in Japan is estimated through proportional allotment of A1 data

B3 Traffic exchanged with overseas ISPs

Of traffic exchanges "other than" the major IXs, traffic exchanges with overseas ISPs including private peering, transit and with other overseas IXs including public peerings

The seven ISPs

Major domestic ISPs

Average traffic volumes exchanged at the major domestic IXs* are disclosed.

* NSPIXP, JPIX and JPNAP (IX = Internet exchange)

B1 Traffic exchanged with major domestic IX ISPs

A1 Traffic of broadband users (DSL, FTTH)

BB BB BB

Broadband users (DSL, FTTH)

Company

Dial-up, leased lines, data centers

A2 Traffic of other users (dial-up, leased lines, data centers)

* Monthly average of average daily traffic volumes

What about us ?

- Has highly advanced Internet/NGN Infrastructures
  - World top Broadband Internet Access Penetration Ratio
    - xDSL, FTTH, WIFI, …
  - Mobile Internet
    - CDMA, HSDPA/HSUPA, WiBro, WCDMA
  - BcN (Broadband Convergence Network) for NGN
  - High speed Research and Development Networks
    - KOREN, KREONET, APII, BcN Testbed, etc.

- Best place for finding wide range of the Internet Applications
  - P2P, Web disks
  - Multimedia Streaming
    - IPTV, Private P2P Broadcasting (Afreeca), VoIP (Skype)
  - Business
    - Best on-line transaction apps (on-line banking, HTS, etc.)
  - On-line games
    - Lineage, Starcraft…
  - Social nets
    - Cyworld, various Blogs, UCC portals, etc.

Research Efforts in Korea

- There are some but not as systematic or organized as others
- Major Obstacles
  - Limited funding especially from service providers and vendors
  - Not sufficient government leadership in the area of network and service management
    - Government thinks it is Provider's role and Provider's focuses on imminent business-oriented issues only. Research issues, especially longer-term ones, were treated as lower priority items
  - Providers' reluctance on providing management information
    - Appropriate screening is definitely needed but major portion of information can be shared for research purpose without harming the business
- However, we have enough research resources, especially excellent network and human resources
- Currently, several efforts to establish network and service management projects for BcN and Future Internet are underway

Our Straw man Proposal

- Autonomic Traffic Measurement and Analysis for the Future Internet

- Objective
  - Establishing Infrastructure and framework for the research of national scale Traffic Measurement and Analysis over the Internet, BcN, and the Future Internet
  - Organize a group of experts from various sectors
  - Establishing infrastructure for real-time traffic characterization of national scale broadband Internet users
  - Establishing infrastructure for current Internet Traffic Characterization for the major ISPs and inter-ISPs
  - Research and development of hardware and software for automatic traffic measurement and analysis for high speed and ubiquitous network environment
  - Development of educational program
  - Development of dissemination program for the obtained results