Advanced Internet Technologies
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Internet Architecture
Opening a new era: issues and requirements

- End-to-End architecture
- Connecting everything, using any-media
- NAT and Firewall
- ID semantics

End-To-End model

- End system works a lot
- End system does not need to know how the network (inside the cloud) is working

‘Peer to Peer’ rendezvous architecture

OSI 7 layer model
Layered Internet

Example of packet processing:
From source end node, relay node (router) to destination end node

Connecting everything, using any-media
- Media independent: Ethernet, Wireless LAN, Optical Fiber, xDSL
- Application independent: WEB, E-mail, File Transfer

Basics of Internet Protocol(1)
- Bucket brigade
- Relay node decrements the TTL (TTL-1) and forwards the packet unless it was sent to the node
- Identification decision is done in network layer

Basics of Internet Protocol(2)
- Best effort communication
- Relay node reports if it discards the packet for some reason – ICMP time exceed

NAT/Private Address

Home Server/Firewall

NAT: Network Address Translation
Global Address Space
Private Address Space

Home server is used as a relay machine to control the home electronics through the Internet. Home electronics addressing and protocols can be different from the Internet Protocol. In this example, if we focus on communication through the Internet, terminal and home server are end nodes.
IP Address (1)

- Identifier of Internet Protocol
  - IPv4: 203.178.143.71
  - IPv4 has 32bit and IPv6 has 128bit address space
  - Identify itself and counterpart (basically unique value)

- notational convention
  - Generally decimal
    - 133.27.4.120 (decimal)
  - binary digit inside computers
    - 10000101 00011011 00000100 01111000 (binary)

IP Address (2)

- Address architecture
  - Network part and host part
    - Example: 192.168.1.12/24
      - Network part (24bit)
      - Host part (8bit)
      - Network address = 192.168.1.0/24
      - 192.168.1.12/24
      - 192.168.1.11/24
      - 192.168.1.13/24

IP Address (3)

- Netmask
  - Administers network in layer
  - Multiple network is administrated by 1 address
  - 192.168.1.128/25
    - Netmask: 255.255.255.128
    - 192.168.1.0/24
      - Netmask: 255.255.255.0

Who is generating the new requirements

- System, Security and Name/ID
  - Operating system requirements
  - Security and Privacy
  - NAME/ID

Identifier: extremely important

- roles
  - Identify an IP address from a Name
  - Identify a Name from an IP address

Identity: should not be mixed with ID

- Issues
  - Intellectual property
  - Intellectual property right versus Operation and Uniqueness
End node solution with sophisticated directory service
- Use DNS to map IP addresses and 'symbols' (=domain names)
- Sophisticated ways to provide 'rendezvous' spaces
  - Multiple convenient spaces on top of a unique domain name space
    - Some are ready; keywords and other directory services

Challenges to deploy new styles of digital communication
Radio Wave, Multicast, and Mobility
- Wireless communication
- Satellite communication
- Multicast
- Mobility

Fixed Wireless Access (FWA)

Satellite communication
- Uni-directional Communication with orbiter
- Some spectrums
  - Ku band (12G-18GHz)
  - Small infrastructure
  - Weak to rain
  - C band (4G-8GHz)
    - Location limitation (same bandwidth with ground wave)
  - Ka band

The C-Band UDLR Network

InternetITS
Separation of Communication and Service
Individual Applications
- Internet
- Car Management
- Car Navigation System
- Probe System
Network Mobility: Applications

- LANs and PANs becoming networks which are mobile
  - in moving vehicles (cars, trains, planes, ships, etc)
  - in moving bodies (humans, animals, equipment, etc)
- Permanently connected to the Internet

Host Mobility vs Network Mobility

- Mobile Network
  - MR + nodes behind the MR:
    - Fixed nodes:
      - Belong to the mobile network
      - sensors, light, GPS
    - Mobile Nodes:
      - Don’t belong to the mobile network
      - Get Internet access via the mobile network
      - E.g. mobile phone, PDA
  - mobility management must be transparent to nodes behind the MR

Scale of the autonomous distributed system
IPv6, Transport and Routing

- 32 bits to 128 bits
- 2.4Kbps to 10Gbps
- Scale of addresses

32 bits to 128 bits

Internet: running 24x7x365 hours/year
Measurement and Operation

- Do we understand the traffic?
- Operation technologies
Course Contents
2 lectures / Topic

• Introduction                jun
• Grid computing              youki
• Reliable Multicast          yamanouchi
• Measurement and Analysis   kjc
• Internet and Satellite      takei
• IPv6 Infrastructure Technology  itojun
• Security                    suguru
• TCP congestion control     nishida
• Closing                     jun