

# **Full Digital Contents Distribution to the Home using IPv6**

14<sup>th</sup> Mar 2002

**Munechika Sumikawa**

(sumikawa@ebina.hitachi.co.jp)

Enterprise Server Division

**Hitachi, Ltd.**

# Introduction

---

## ■ Goals:

- Explain key benefits and technologies of IPv6
- Clarify technical issues
- Apply IPv6 benefits
- Case Study for IPv6: “*Full Digital Content Distribution to Homes*”

# Background

---

- One of the expectations of IPv6 network is “Broadband to Home (B to H)”
- The new IP network service, “B to H” model, will be based on IPv6, because of its scalability.
- Such service requires high-speed multicast, QoS and scalable distribution mechanism in the backbone network area.
- Also, this system requires multicast, security and ‘plug and play’ in the home networking area.
- Hitachi, Ltd. and Matsushita Graphic Communication Systems, Inc. are collaborating their R&D efforts in developing this system using IPv6.
- This R&D activity is one of the “Super Internet” project supported by Japanese Government\*.

\* :The Ministry of Public Management, Home Affairs, Posts and Telecommunications

\* :Telecommunications Advancement Organization of Japan

# IPv6 Benefit Categories

---

- IPv6 benefits can be broken down into the following (3) categories
  - Fundamental benefits of the IPv6 specification
  - Improved features for deploying new IPv6 services
    - Exploiting the shortcomings of IPv4
  - Designed to meet the needs of emerging markets for IPv6
    - IPv6 provides large address space for future growth of Internet and new technologies

# Fundamental Benefits of the IPv6 Specification

---

- Address space expansion from 32bit to 128bit
  - Internet for everyone!
  - Hierarchical Address Assignment
    - Reduces routing table size
  - Scope address architecture
    - link-local, site-local, global
- Peer-to-Peer networking
  - Enables 'Always-on' broadband services
- Utilities
  - Plug-and-play
  - Fragment-free
    - No fragmentation by routers = 'Efficient routing'

# IPv6 Features Enabling New IP Services

---

## ■ IPv4 Shortcomings

- Proposed and developed in IPv4
  - ◆ Did not become standardized
  - ◆ Performance/Scalability issues

## ■ IPv6 Features

- Multicast
  - ◆ Developed for commercial use (not experimental)
- Anycast
  - ◆ Service Discovery
- Security
- QoS

# Emerging Markets for IPv6 Addresses

---

- Internet for all devices
  - Mobility
    - phones, cars, PDAs ...
  - Home
    - consumer products, sensors ...
  - Always-on access services
    - xDSL, FTTH ...
  
- Disposal address
  - Tag identifiers for logistic service

# IPv6 Benefits Are Applied to ...

---

## ■ Full digital contents distribution to the home

- High quality movie
  - ◆ 120 minutes MPEG-2 data (approx. 6 Gbyte)
- Large amount of users
  - ◆ 10,000 – 100,000 users

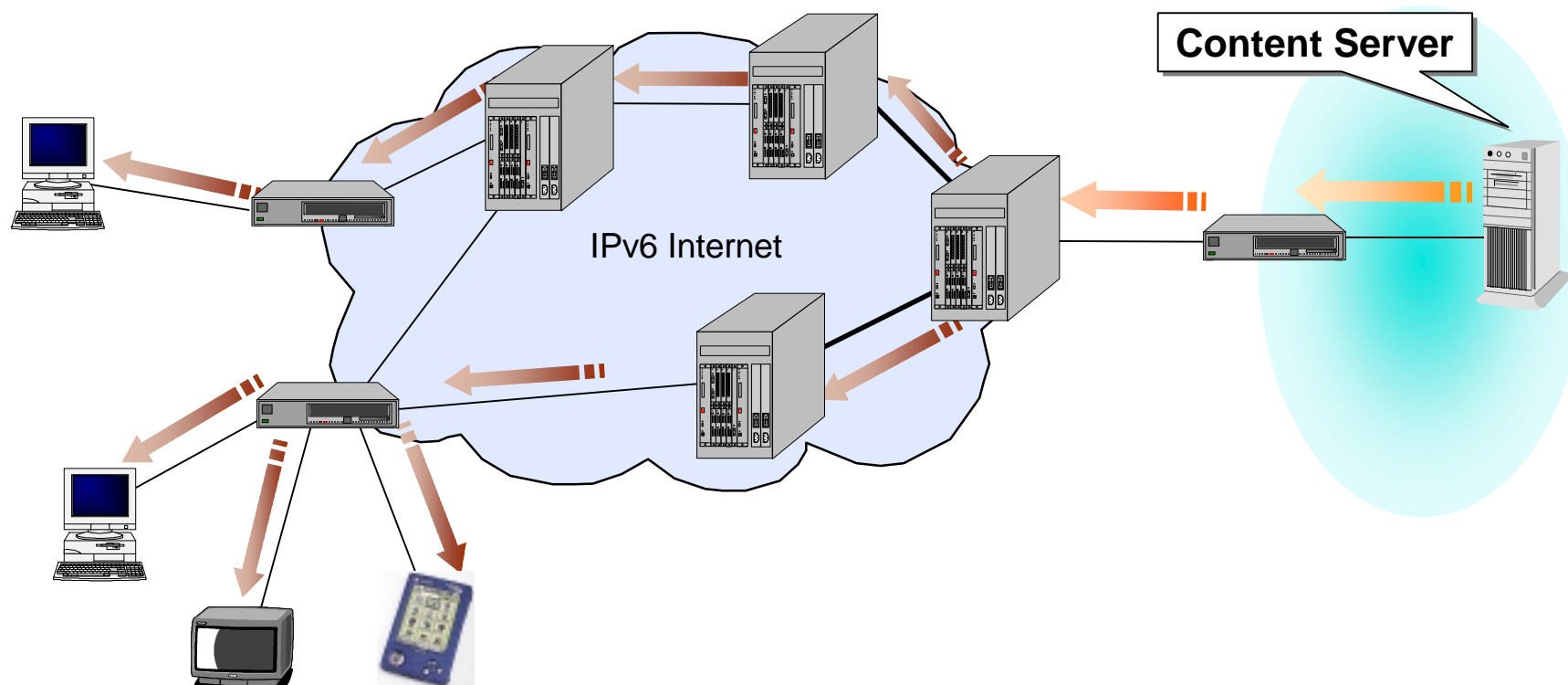
## ■ Two type of network services

- Multicast service (*Push and Select*)
  - ◆ 7Mbps per stream
- On demand service (*Pull*)
  - ◆ Assume 30min for downloading time
  - ◆ 26Mbps per request



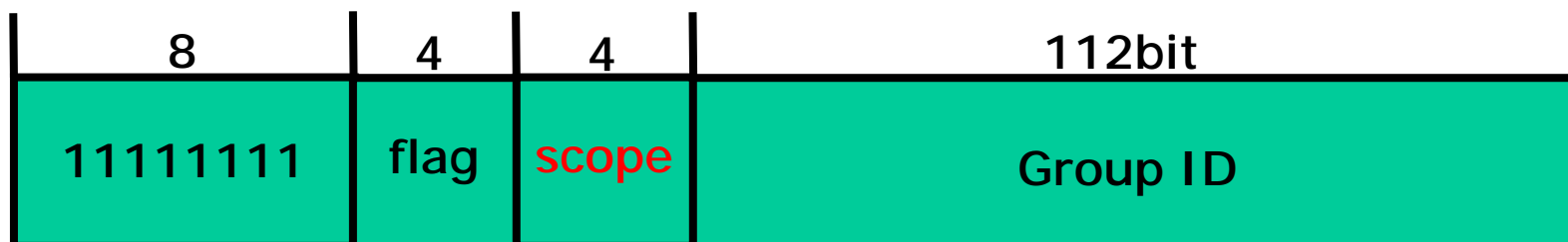
# Multicast Service to the Home

- Bandwidth-conserving technology
- Single data stream is replicated in the network by routers
- Reduces load on content server(s)
- High performance needed on multicast router
  - Traffic = 7Mbps x “number of streams” x “number of interfaces”



# IPv6 Multicast Technology

- Similar to IPv4
  - Adds scope architecture
    - ◆ E.g. Site, local, and Multicast addresses
      - Site boundary routers drops the scoped multicast packets
    - ◆ More sophisticated than IPv4 TTL



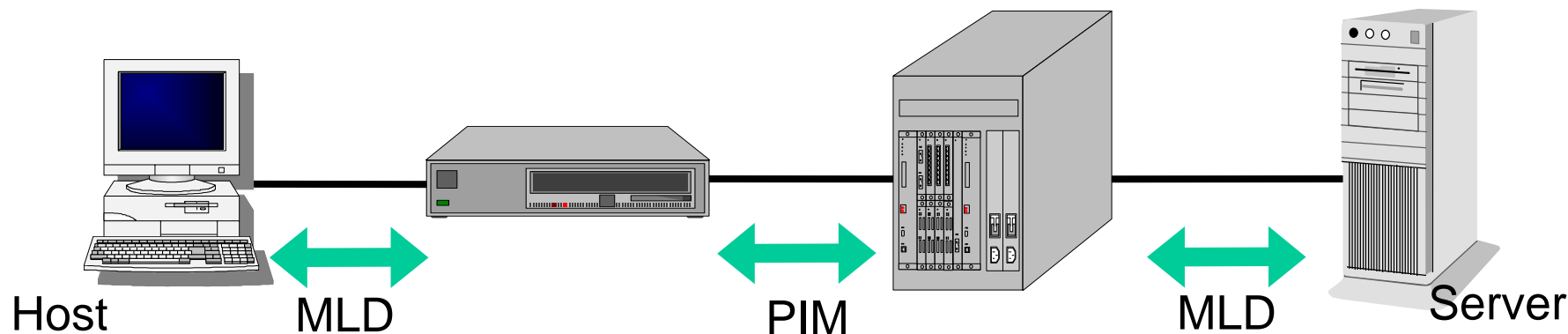
# Multicast Routing Protocol

## ■ Host-Router Protocol

- MLDv1
  - ◆ Multicast Listener Discovery
  - ◆ Host specify joined group
- MLDv2
  - ◆ Host specify joined group and source
  - ◆ Broadcast service oriented

## ■ Router-Router Protocol

- PIM-SM, PIM-DM
  - ◆ N-N communication
- PIM-SSM
  - ◆ 1-N communication
  - ◆ Broadcast service oriented



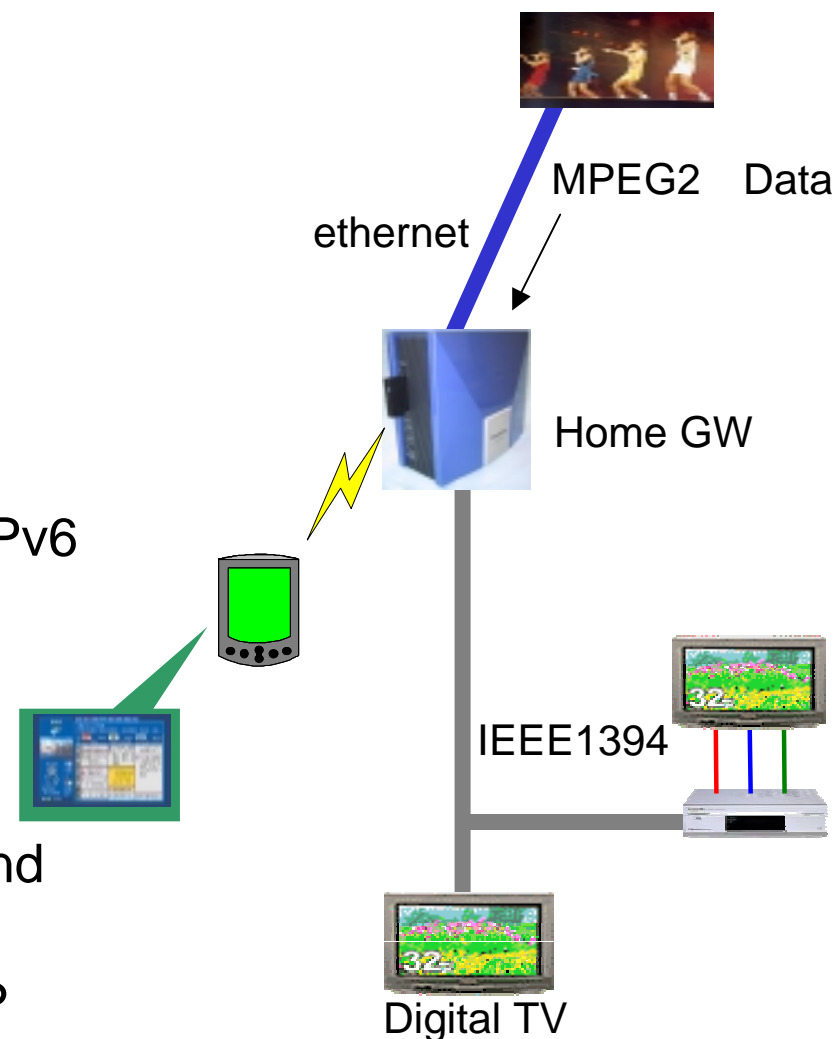
# Multicast Requirements for Commercial Use

---

- High-speed IPv6 multicast packet forwarding
  - Hardware technology needed for commercial services
  - Hitachi Gigabit Router “GR2000” provides IP Multicast in hardware
- High-speed encryption/decryption between servers and clients
  - IPsec
  - “Pay per View”
- Security for multicast routing protocol
  - Hitachi R&D is currently developing technology

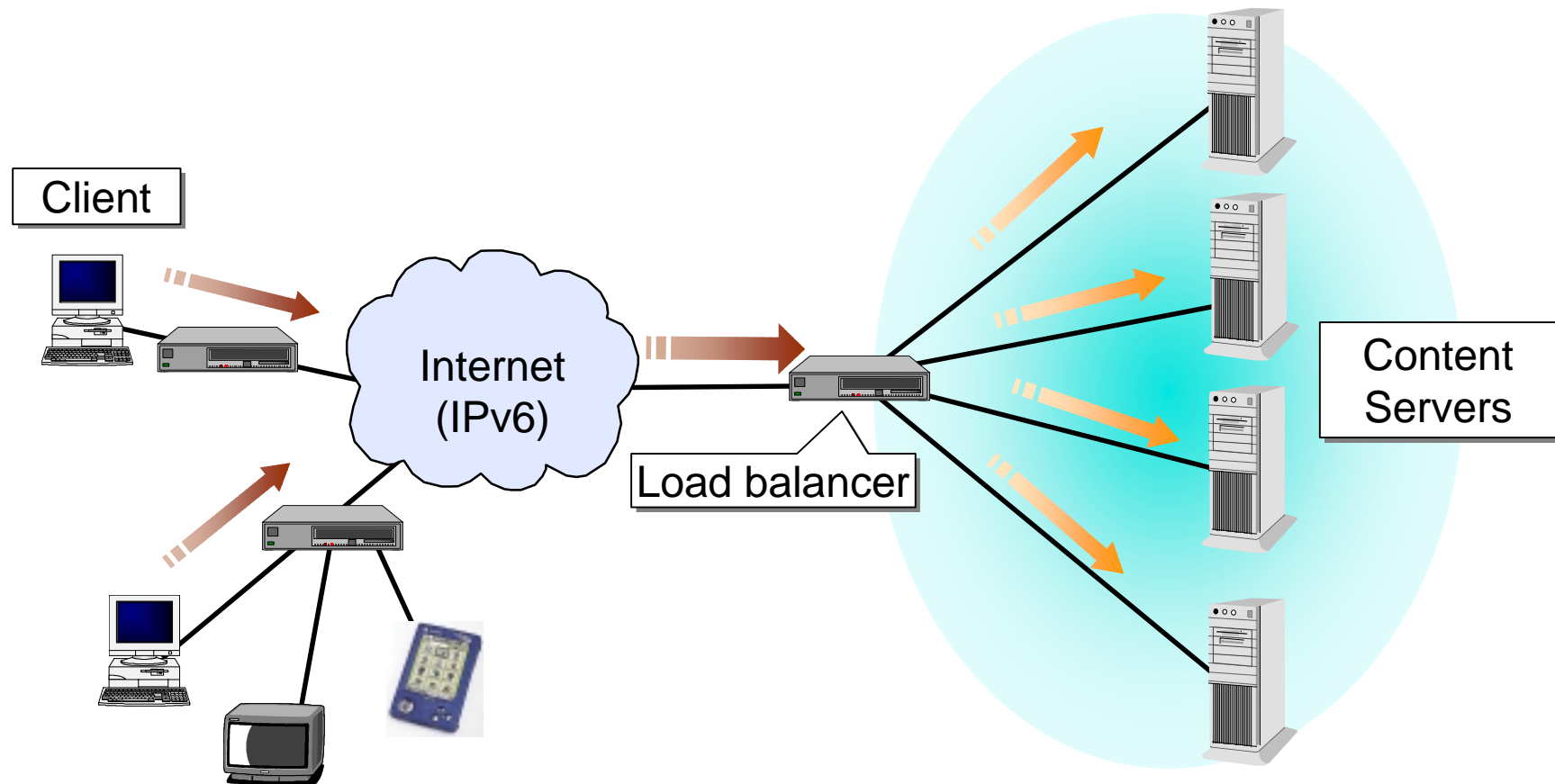
# How to Select “Video Program”

- Select IPv6 Multicast address
  - Example
    - ◆ Movie Channel 1 => ffee::1
    - ◆ Movie Channel 2 => ffee::2
- Matsushita Graphic Communication Systems, Inc. developed (as R&D activities):
  - Movie Distribution Server using IPv6 Multicast
  - IPv6 Home Gateway to connect IEEE1394
  - Digital TV with IEEE1394
  - Electric Program Guide Server and Client (= Program Selector)
  - Contact: [info@v6.mgcs.co.jp](mailto:info@v6.mgcs.co.jp)



# IPv6 Video on Demand

- Large amount of traffic “requests” sent to servers
- Load balancing system is required
  - Access bandwidth = 26Mbps x “number of requests”



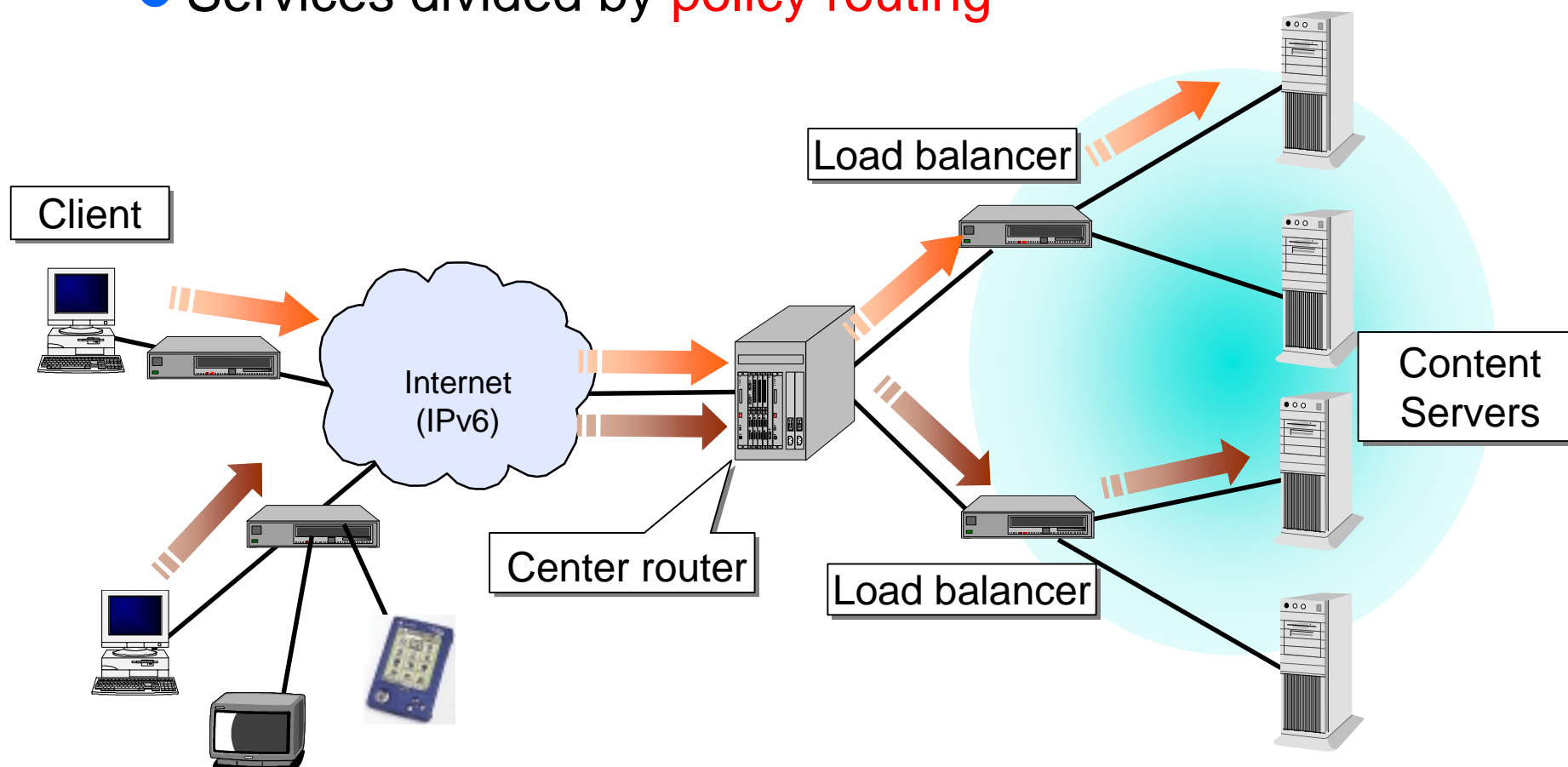
## Current Load Balancing System

---

- Load balancer and several servers
  - Distributes each request to servers impartially
    - ◆ LSNAT(Global address -> Private address converter)
    - ◆ L4/L7 Switch
- Predicted growth in traffic...
  - 26Mbps x 1000 simultaneous requests = 26Gbps
  - Results in large amount of overhead in the load balancer
    - ◆ Many servers and many requests
- **System bottleneck will be at “load balancer”, instead of servers and networks !**

# New Proposal: Hierarchical Load Balancing

- Router load balance(L3,L4) to L7 load balancers
  - Traffics divided by **multi-path routing** by flow
  - Services divided by **policy routing**





# Multi-path Load Balancing Solution

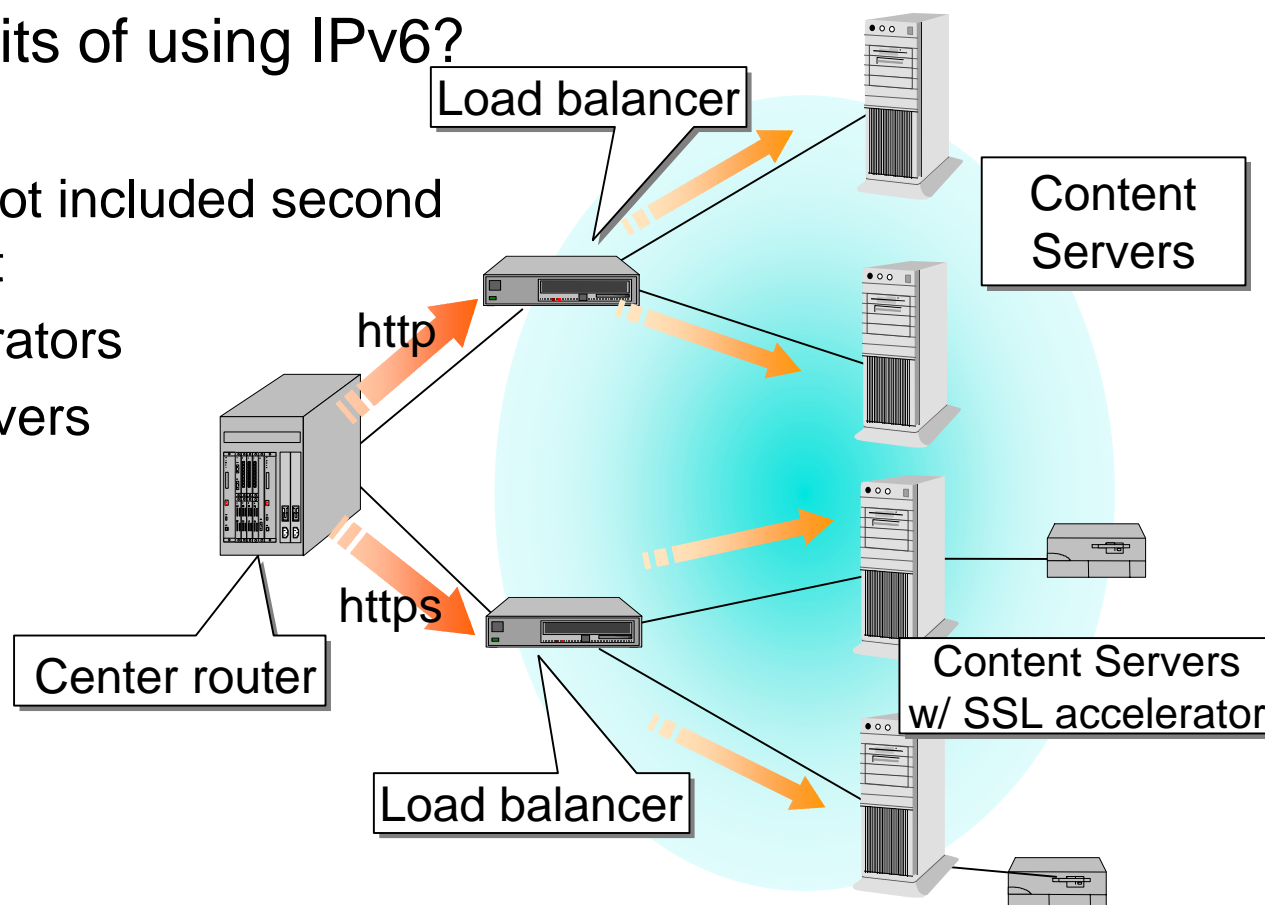
---

- Divides IP flows by Center Router
  - Hash value by source and destination address (L3)
  - Hitachi Gigabit Router “GR2000” provides a solution using Multi-path Load Balancing
- What are the benefits of using IPv6 for this system?
  - Load balancer needs virtual address
    - ◆ Link-local address can be used
      - Next-hop determination
      - Replaces private address
    - ◆ Relatively more simple in IPv6 than IPv4
      - IPv4 assigns private addresses

# Policy Routing Load Balancing

- Redirect secure connections to servers with SSL accelerator
  - L7SW checked URL before
- What are the benefits of using IPv6?

- **Fragment-less**
- L4 information is not included second fragmented packet
- Install SSL accelerators only for part of servers
- Cost-effective



# Conclusion

---

- IPv6 key benefits are discussed with case study:  
“Full Digital Contents Distribution System”
  - ◆ IPv6 Multicast
- Hitachi develops IPv6 hardware solution and scalable technologies
  - High-speed IPv6 multicast router (GR2000)
  - Hierarchical Load Balancing System using the GR2000
- Special Thanks to:  
Junichi Sakai (Matsushita Graphic Communication Systems, Inc.)

Thank you!

**HITACHI**  
Inspire the Next