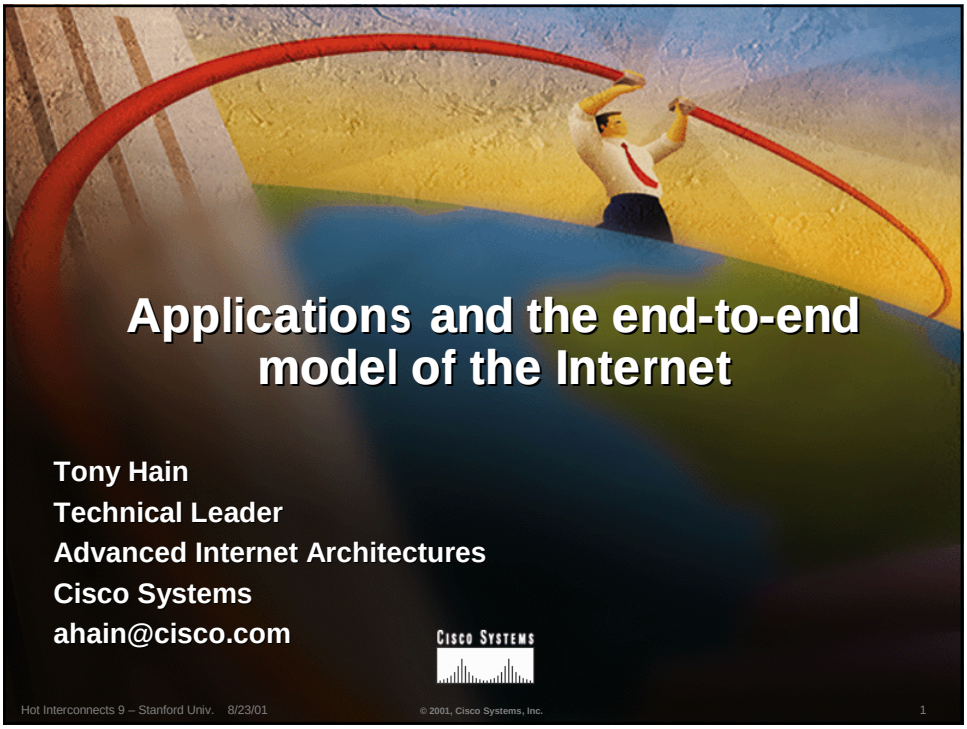

# Applications and the end-to-end model of the Internet

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## Abstract

In the early years of the Internet virtually all nodes hosted services, and the applications took advantage of direct path between the peer nodes. With the massive infusion of consumers during the commercialization of the mid-1990's, that capability was sacrificed in the name of rapid deployment simplicity. This infusion also consumed sufficient address space to cause spot shortages, driving deployments of NAT to accommodate the growing number of nodes. Unfortunately these NAT deployments are precluding the subsequent distribution of services and new applications. IPv6 extends the address space to return the routing infrastructure to an end-to-end model, which will support the simple deployment of these services and the concept commonly called peer-to-peer.


http://www.cisco.com/ipv6

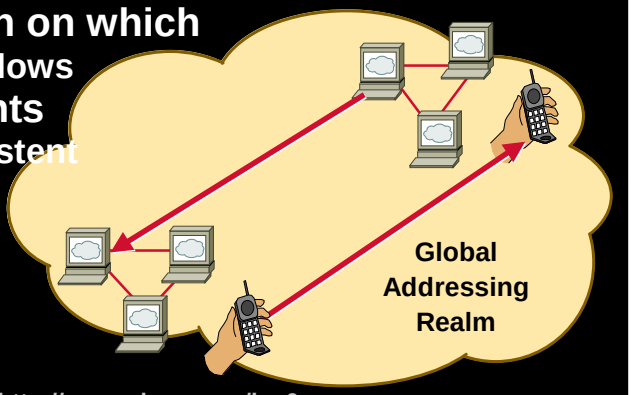
## Overview

- peer-to-peer
- current Internet environment
- games
- collaboration / real-time interpersonal communication
- personal file server
- summary



## Peer-to-Peer

- Virtually all nodes host a service
  - The only required middle-box - dns / rendezvous service
- No restriction on which end initiates flows
- All participants share a consistent network view



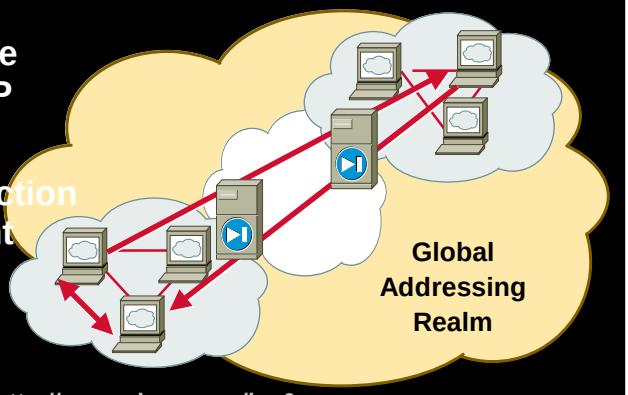
## Current Internet environment

- IPv4 with NAT
  - deployment synchronization
  - scaling limitations
  - restricted topologies
  - single point of failure



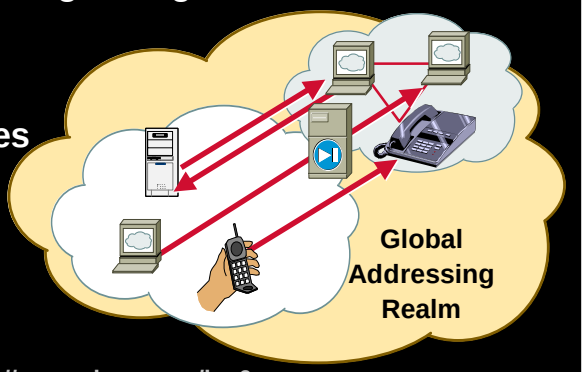
## Games

- Multi-player game requires consistent network view
  - More than one player per ISP connection
  - N-way connection establishment matrix



## Collaboration / real-time interpersonal communication

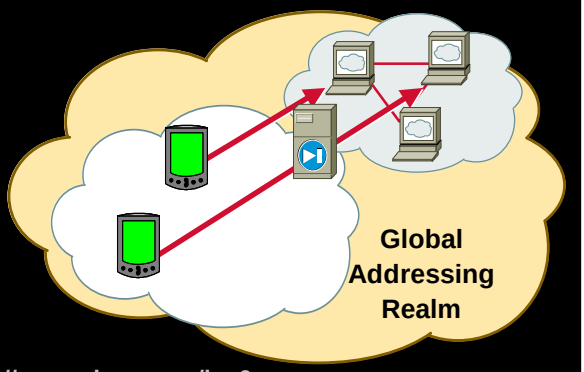
- Asymmetric characteristics of NAT
  - im/voice : netmeeting
- Multiple streams - originating from opposite ends
  - mm training
- Always-on services
  - IP phone






## Personal file server

- Always-on services
  - personal file servers



## Summary

- Moving to IPv6 provides
  - Application development simplicity
  - Application deployment simplicity
  - Infrastructure diagnostic simplicity
  - Consumer use simplicity



## Questions?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## Specific things to look for

- **Storing IP address in 4 bytes of an array.**
- **Use of explicit dotted decimal format in UI.**
- **Obsolete / New:**

| | | |
|---|---|---|
| **AF_INET** | **replaced by** | **AF_INET6** |
| **SOCKADDR_IN** | **replaced by** | **SOCKADDR_STORAGE** |
| **IPPROTO_IP** | **replaced by** | **IPPROTO_IPV6** |
| **IP_MULTICAST_LOOP** | **replaced by** | **SIO_MULTIPOINT_LOOPBACK** |
| **gethostbyname** | **replaced by** | **getaddrinfo** |
| **gethostbyaddr** | **replaced by** | **getnameinfo** |



## IPv6 literal addresses in URL's

- From RFC 2732

Literal IPv6 Address Format in URL's Syntax To use a literal IPv6 address in a URL, the literal address should be enclosed in "[" and "]" characters. For example the following literal IPv6 addresses:
FEDC:BA98:7654:3210:FEDC:BA98:7654:3210

3ffe:2a00:100:7031::1

::192.9.5.5

2010:836B:4179::836B:4179

would be represented as in the following example URLs:
http://[FEDC:BA98:7654:3210:FEDC:BA98:7654:3210]:80/index.html

http://[3ffe:2a00:100:7031::1]

http://[::192.9.5.5]/ipng

http://[2010:836B:4179::836B:4179]

## Other Issues

- **Renumbering & Mobility routinely result in changing IP Addresses –**

  **Use Names and Resolve, Don't Cache**

- **Multihomed Servers**

  **More Common with IPv6**

  **Try All Addresses Returned**

- **Using New IPv6 Functionality**



## Porting Steps -Summary

- **Use IPv4/IPv6 Protocol/Address Family**
- **Fix Address Structures**
  - **in6_addr**
  - **sockaddr_in6**
  - **sockaddr_storage to allocate storage**
- **Fix Wildcard Address Use**
  - **in6addr_any, IN6ADDR_ANY_INIT**
  - **in6addr_loopback, IN6ADDR_LOOPBACK_INIT**
- **Use IPv6 Socket Options**
  - **IPPROTO_IPV6, Options as Needed**
- **Use getaddrinfo()**
  - **For Address Resolution**

# IPv4-IPv6 Co-Existence / Transition

- A wide range of techniques have been identified and implemented, basically falling into three categories:
  - (1) dual-stack techniques, to allow IPv4 and IPv6 to co-exist in the same devices and networks
  - (2) tunneling techniques, to avoid order dependencies when upgrading hosts, routers, or regions
  - (3) translation techniques, to allow IPv6-only devices to communicate with IPv4-only devices
- Expect all of these to be used, in combination