

GTER – Multicast Application



- Market demand for Services that can use Multicast
- Network Overview
- Multicast Overview
- Video
- Audio
- Interactive Gaming
- Case Study
- Conclusion

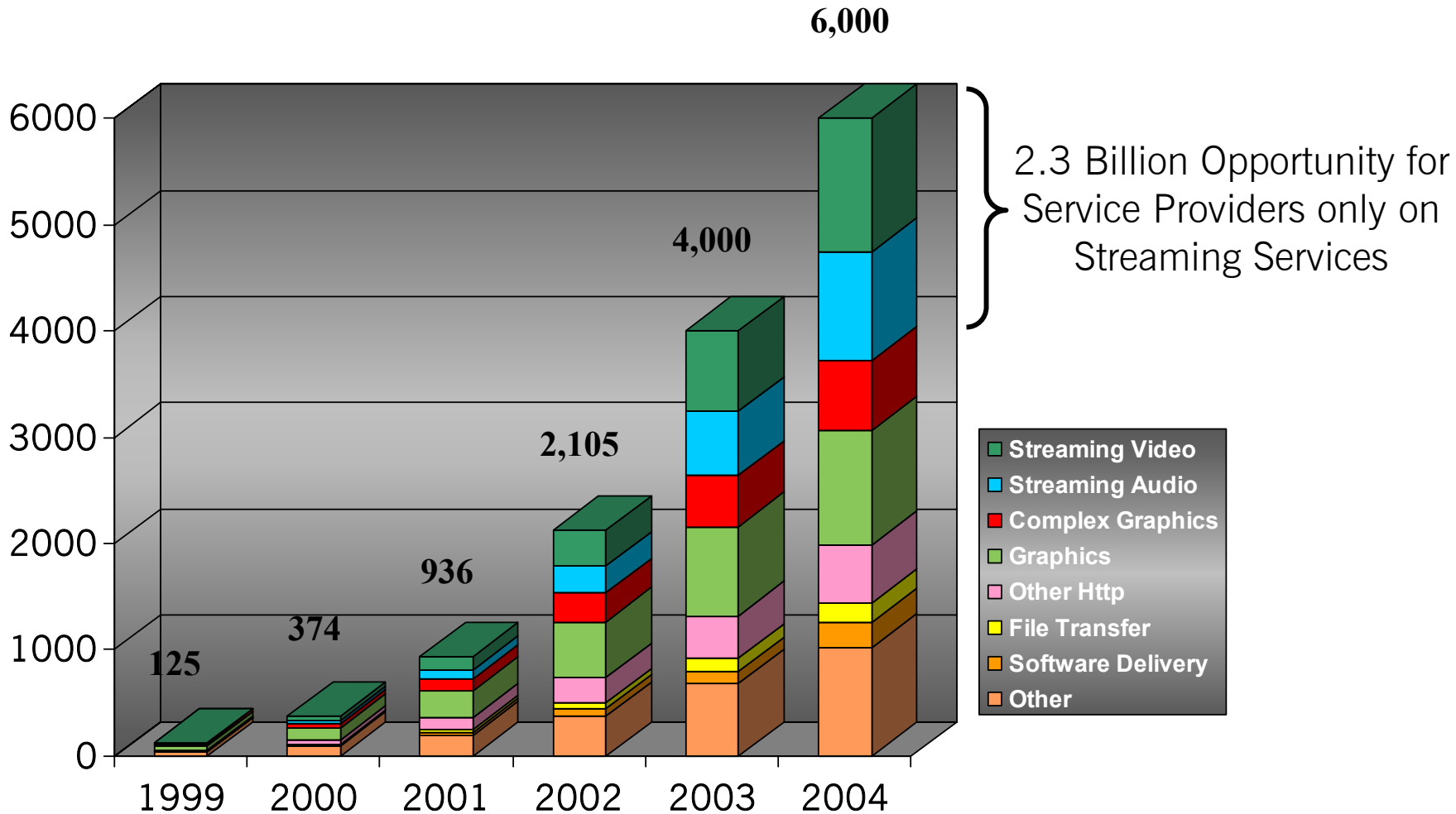
Interesting Content Facts:



- More than 30M homes, w/w, accessed streaming media content in September 2000 - Jupiter Research 2000
- # of web sites, global news, entertainment and sports, offering streaming media has grown from 38% in 1998 to 60% in 1999 - Jupiter Research 2000
- 20% of users who tried to access audio and video on the web were unsuccessful - Arbitron 2000
- Packet Loss over the Internet in North America is 20%-30% at peak - USB Warburg 2000
- The average packet passes through 17 routers [hops] before reaching its destination - iBeam Broadcasting

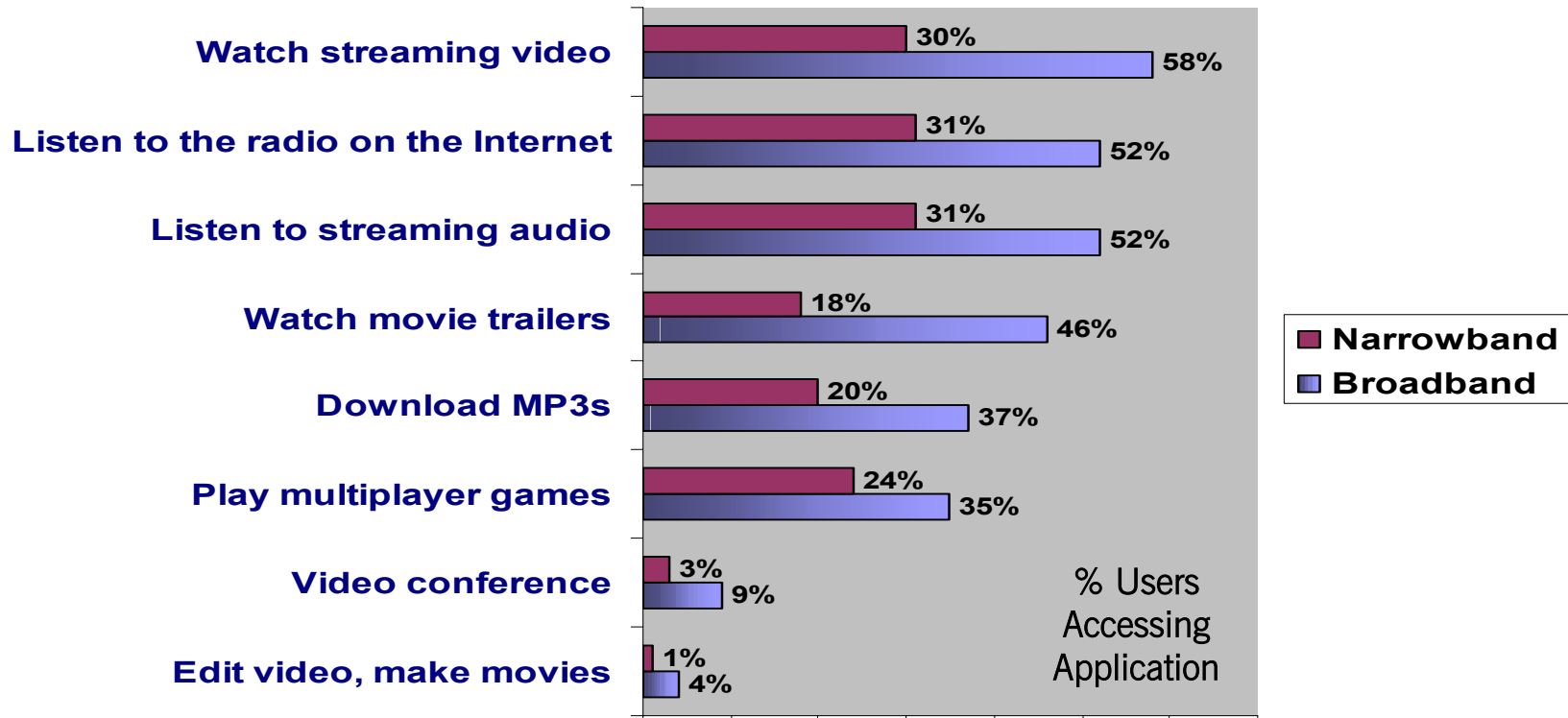
Content Delivery and Distribution

Revenues by Application Segment (\$M)



Source: Internet Research Group, 1999

What's Driving CDNs? Rich Media.



More than 10% of the Internet traffic today is streaming media
61% of largest Web sites (1000+ pg.) already have multimedia content
Broadband access will increase 9X from 2000-2004
Broadband access greatly increases the use of multimedia apps:

Customer Expectations:

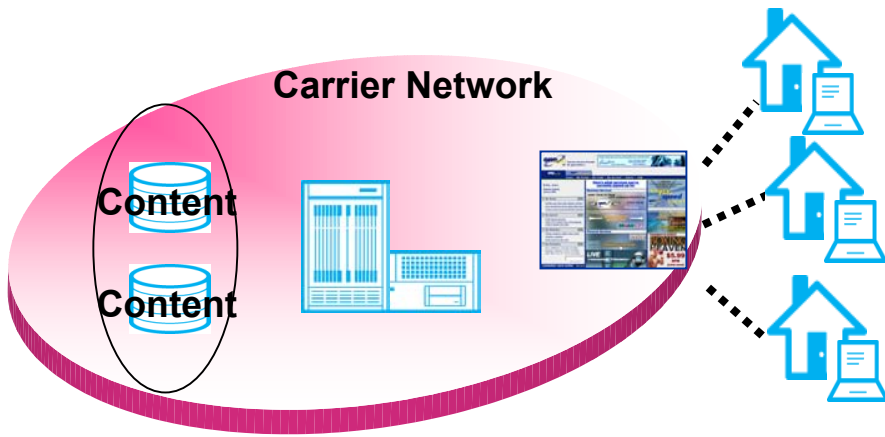
- Network Transparency
 - Network as an Integral Element of a Service
 - No Perceived Presence as a Bottleneck
 - Emulate Local “PC-Based” Performance
- Easy, Fast Access to Desired Content
- Content Personalization
- Expanded Suite of Applications
 - Entertainment, Productivity/Reference, E-Commerce
- Up-to-the Minute, Real-Time Information
- Easy-to-Add Services

Representative Business Models

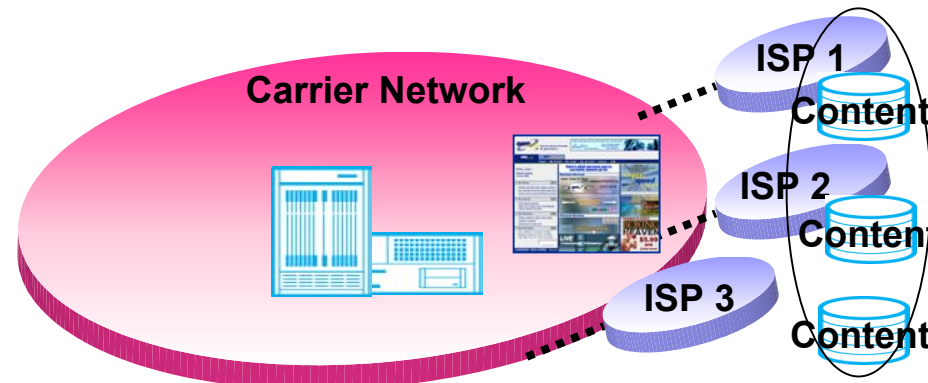


- Service fees
 - ISP pays service provider for network delivery
- Licensing fees
 - Service provider pays content provider a licensing fee for the right to offer content to subscribers (fees vary)
- Revenue sharing
 - Split all revenues received, evenly or unevenly
- Commissions
 - Based on excessive usage by the subscriber
 - New subscriber sign on quota
- Barter transactions
 - Exchange content for banner ads, link on portal or ability to poll users about content preferences

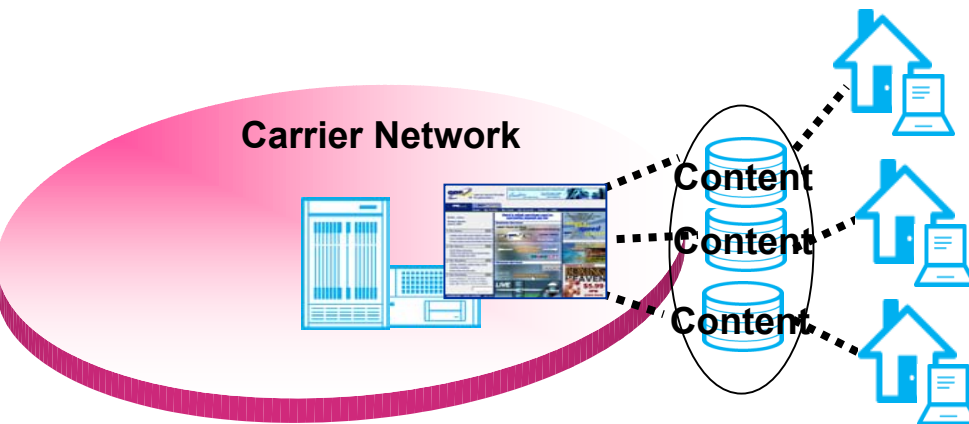
Money making opportunities...



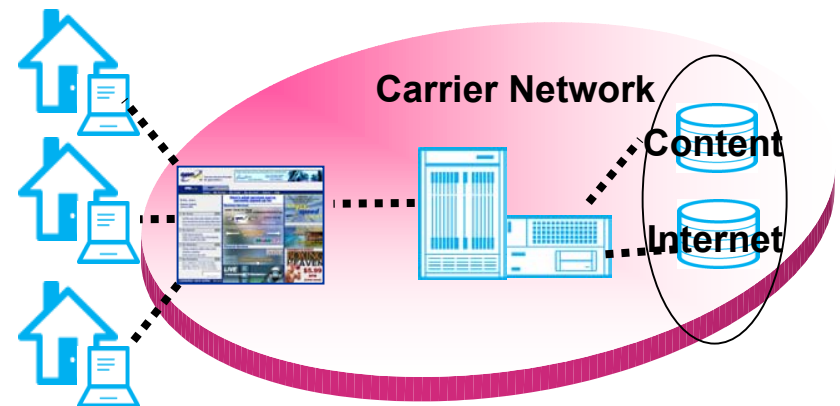
Carrier owns the content



**Wholesale Model:
Carrier provides network**



Third party content



Carrier captive portal

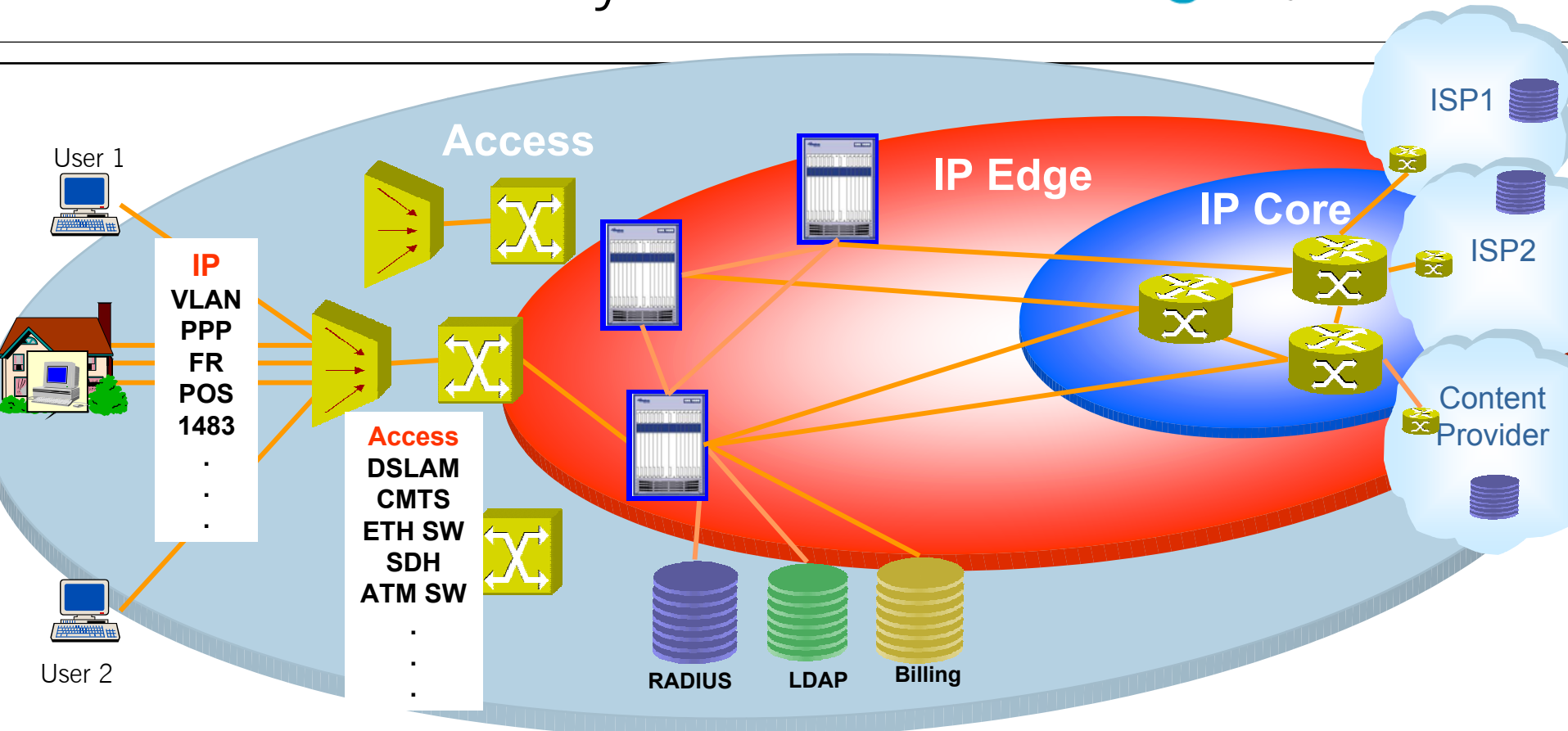
Multicast Application

- Live, simultaneous audio/video broadcast over the Web
 - Concerts, Sporting, Fashion Shows, Seminars, etc.
- i-TV
 - Broadcast Video, Near Video on demand
- All real-time data distribution
 - Stock quotes, news, etc.
- Corporate communications
 - Most sales & Marketing functions
- Distance learning/Virtual Classrooms
- Large, geographically-dispersed video conferences
- Streaming and high bandwidth content distribution to multiple sites and caches
- User-created “shows” and niche programming
- 2.5G and 3G next-gen wireless application (PacketVideo, etc.)

Networks



Different Network Layer



Access Network	No IP Services	Number of Physical Ports	Number of Subscribers per Trunk	Price per Port
Edge Routers	IP Intelligence, subscriber level	Number of IP Sub interfaces	Number of IP Services and QoS queue	Price per Subscribers and per IP Services
IP Core	IP Intelligence, Port level	Number of Mbps	Number of Routing Table	Price per Mbps

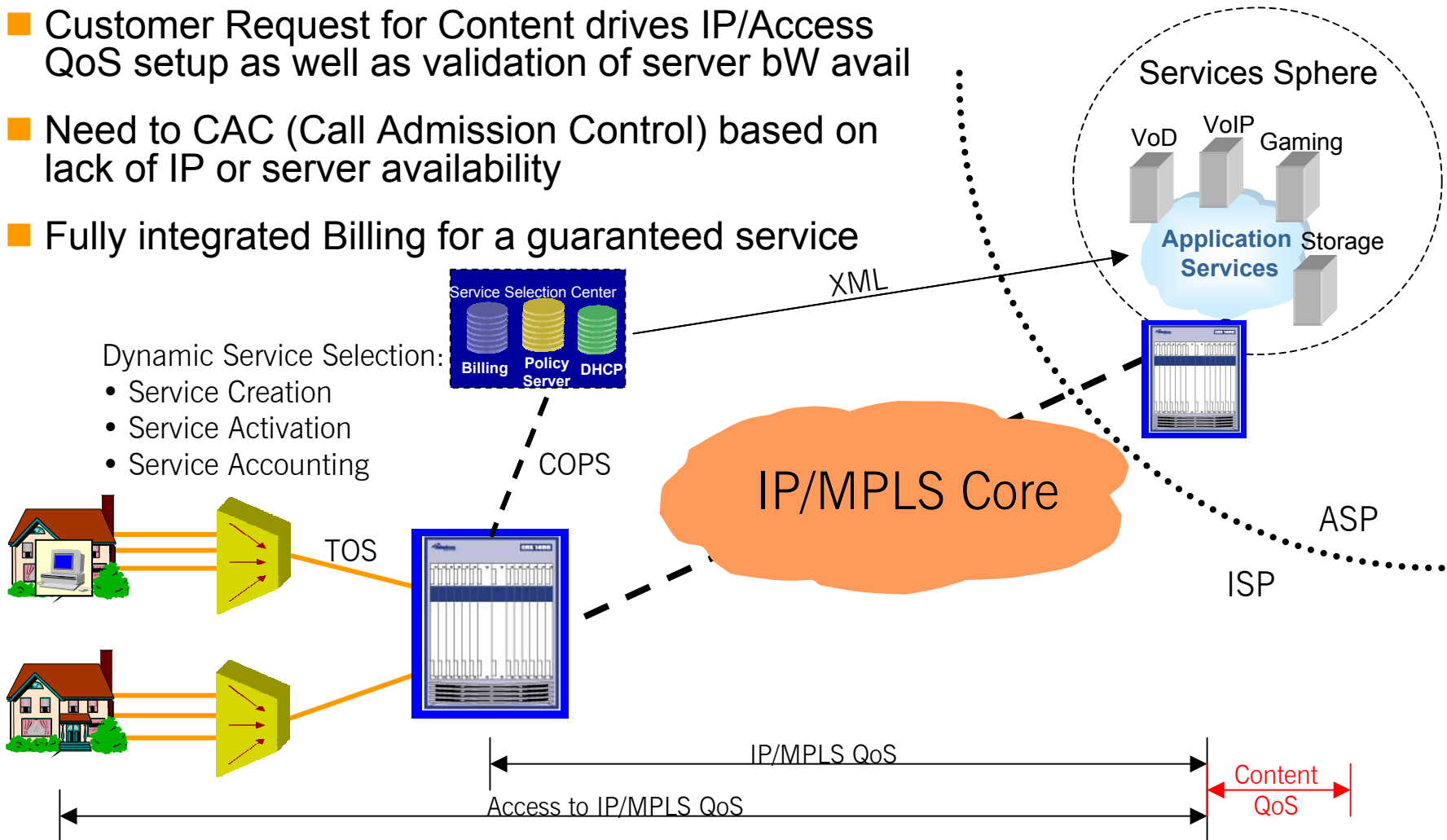
Services Definition

IP Network Services	Application Services
Routing Services Multicast Services IP QoS Differentiated Services Policy Enabled Networking Dynamic Network Based VPNs	Security Services: Firewalls Intrusion Detection Virus Scanning NAT Voice Services Unicast Video on Demand Multicast Streaming Video Application Hosting Gaming Storage Area Networks NetNanny Server Redundancy

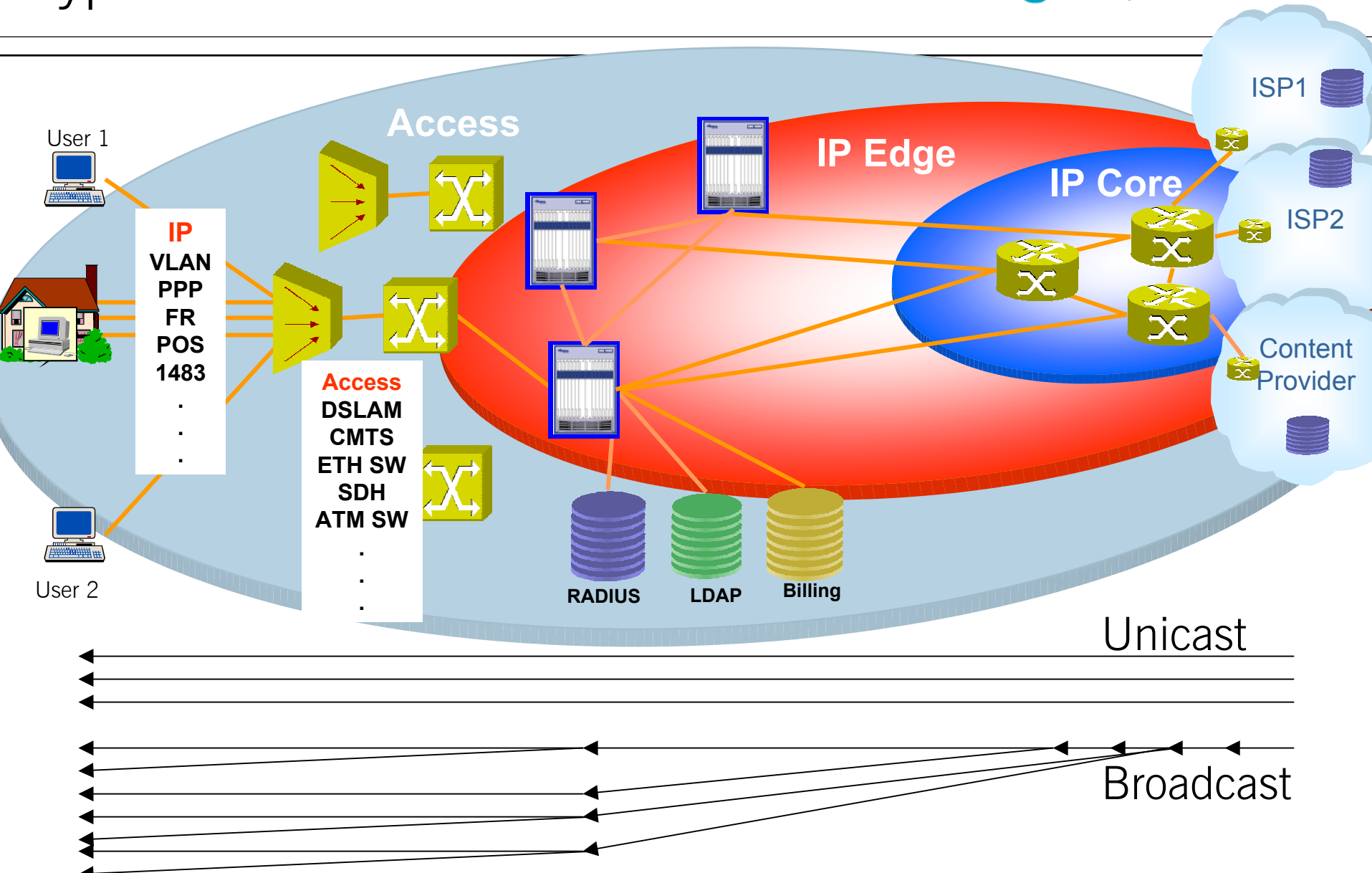
- *IP Network Services are fundamental to all Application Services*
- *Services are IP, not ATM, based*

New model for Content Delivery:

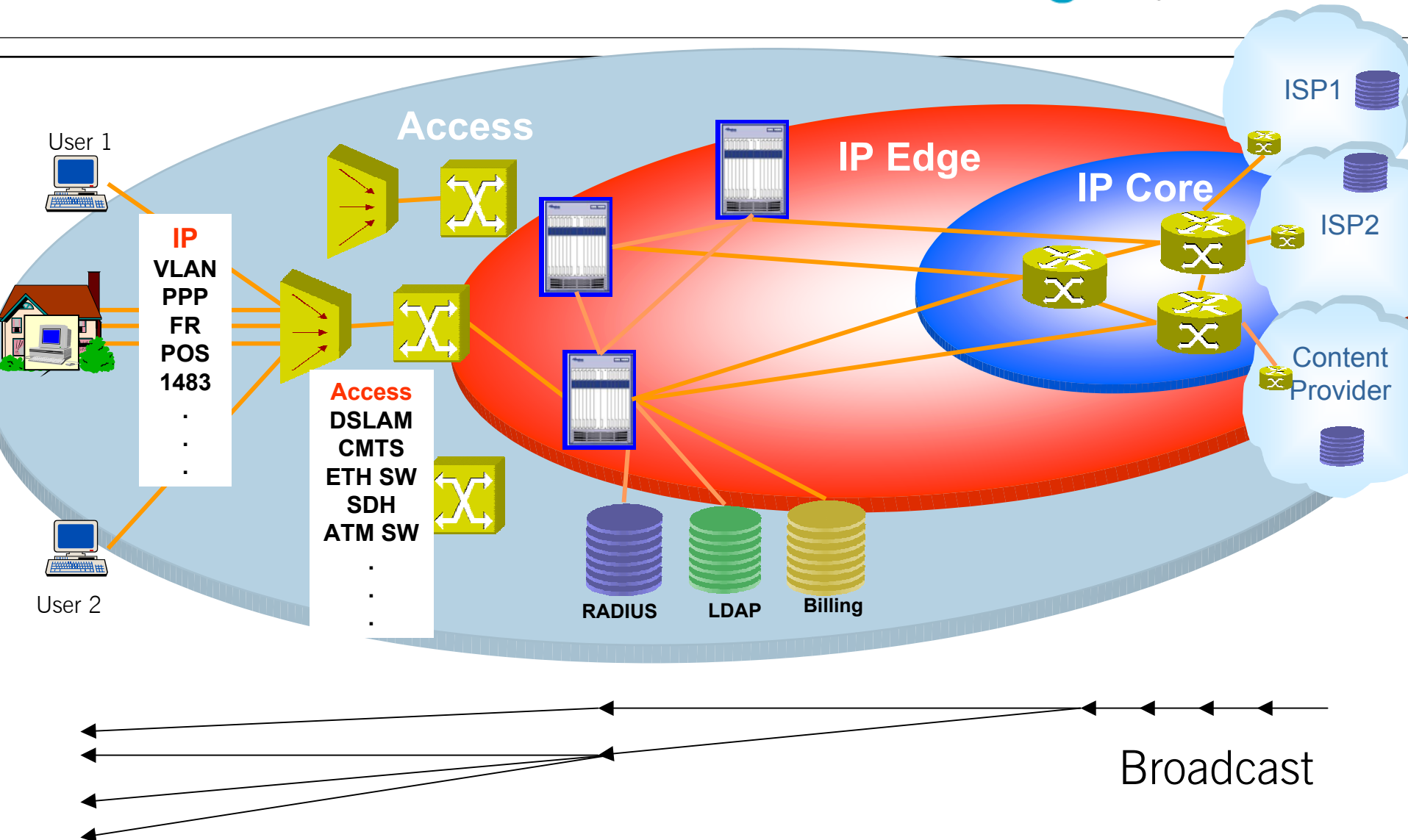
- Customer Request for Content drives IP/Access QoS setup as well as validation of server bW avail
- Need to CAC (Call Admission Control) based on lack of IP or server availability
- Fully integrated Billing for a guaranteed service



Types of IP Flows



Multicast



Multicast



Sparse Mode vs Dense Mode Protocols

- Sparse mode
 - Focused on limited distribution
 - Assumes that those who want data will request it (join)
 - Must explicitly join multicast group to receive data
 - State info maintained for *each* source at *each* router that has group members
- Dense mode
 - Focused on wide distribution
 - Assumes that those who don't want data will complain (prune)
 - Must explicitly leave multicast group to stop receiving data
 - State info maintained for *each* source at *every* router in the network

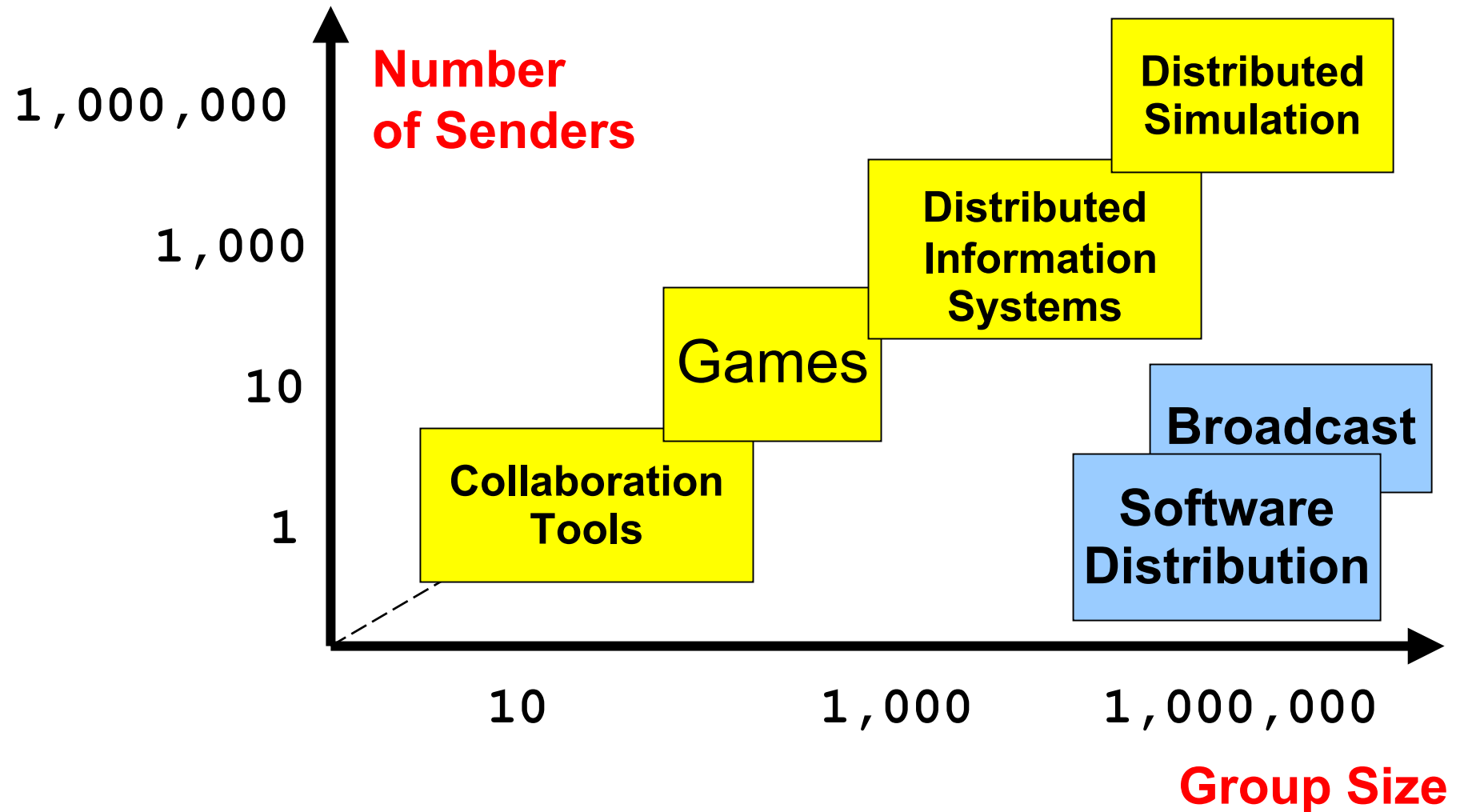
IETF

PIM-SM
CBT

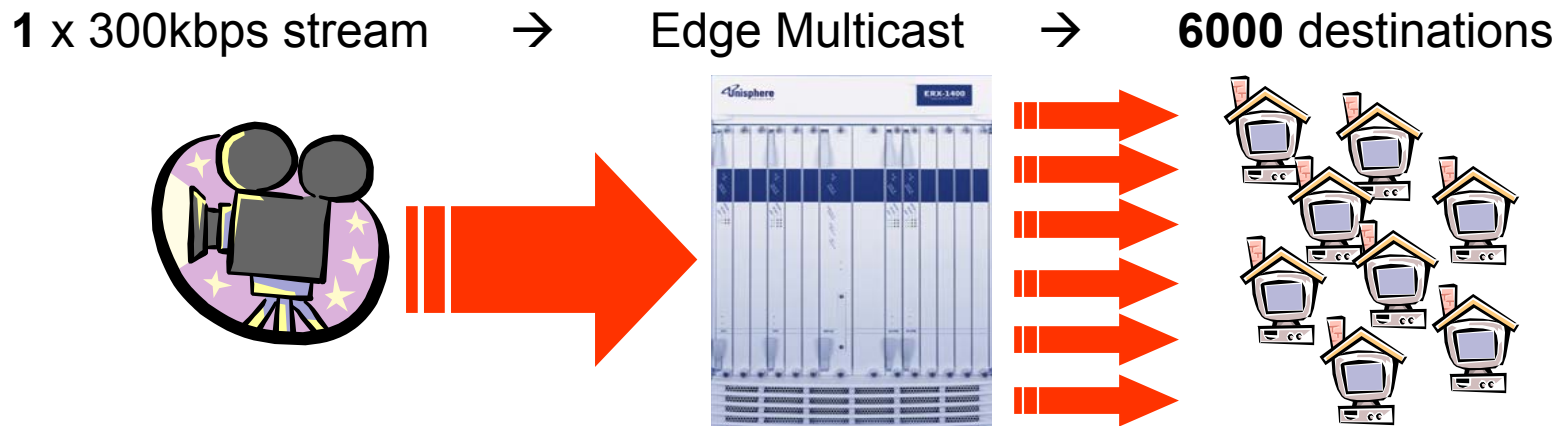
DVMRP
PIM-DM
MOSPF

IGMP

Multicast Central to Content Delivery



Case 1. Multicast of **one 300 kbps stream** (1 multicast group) to **6000 destinations**.



- Ingress = 300kbps – 1 Multicast Stream
- Egress = 1,800Mbps (12 STM-1) – 6,000 Stream of 300kbps

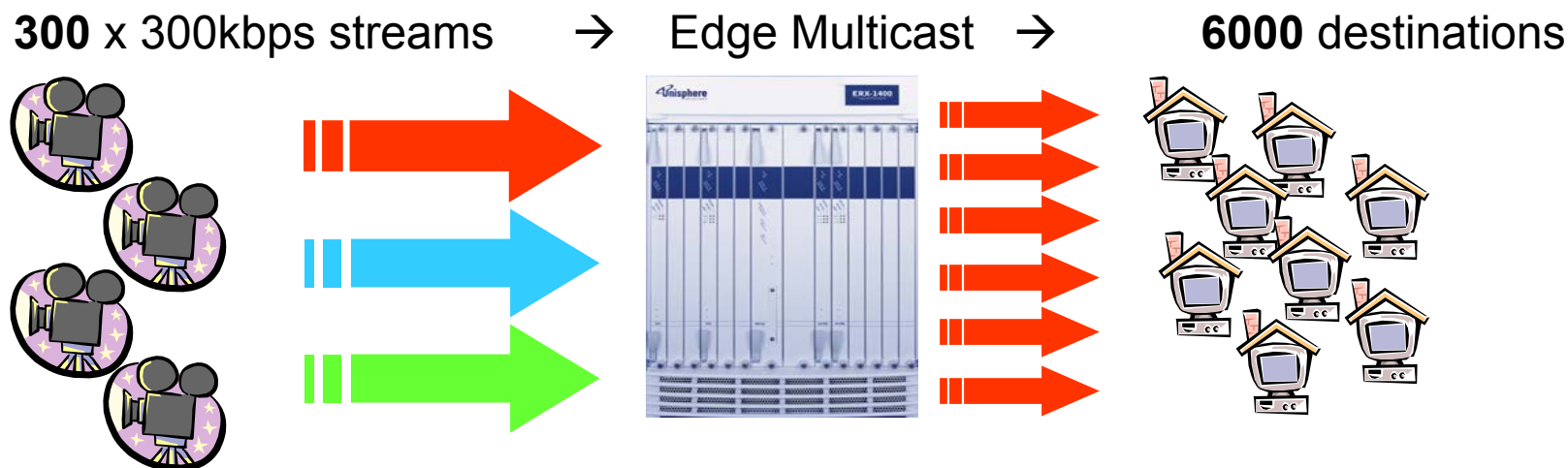
Case 2 : Multicast 1 stream of 100kbps traffic to 16,000 destinations

1 x 100kbps stream → Edge Multicast → 16000 destinations



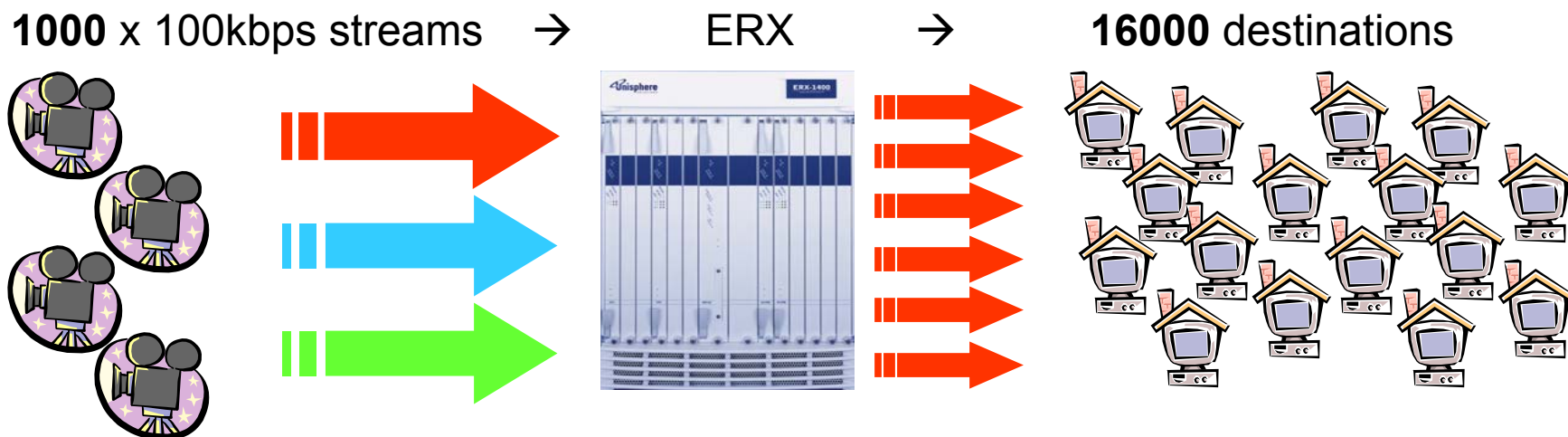
- Ingress = 100kbps – 1 Multicast Stream
- Egress = 1,600Mbps (11 STM-1) – 16,000 Stream of 100kbps

Case 3. Multicast of 300 x 300Kbps streams (300 multicast groups). Aggregate of 6000 destinations total.



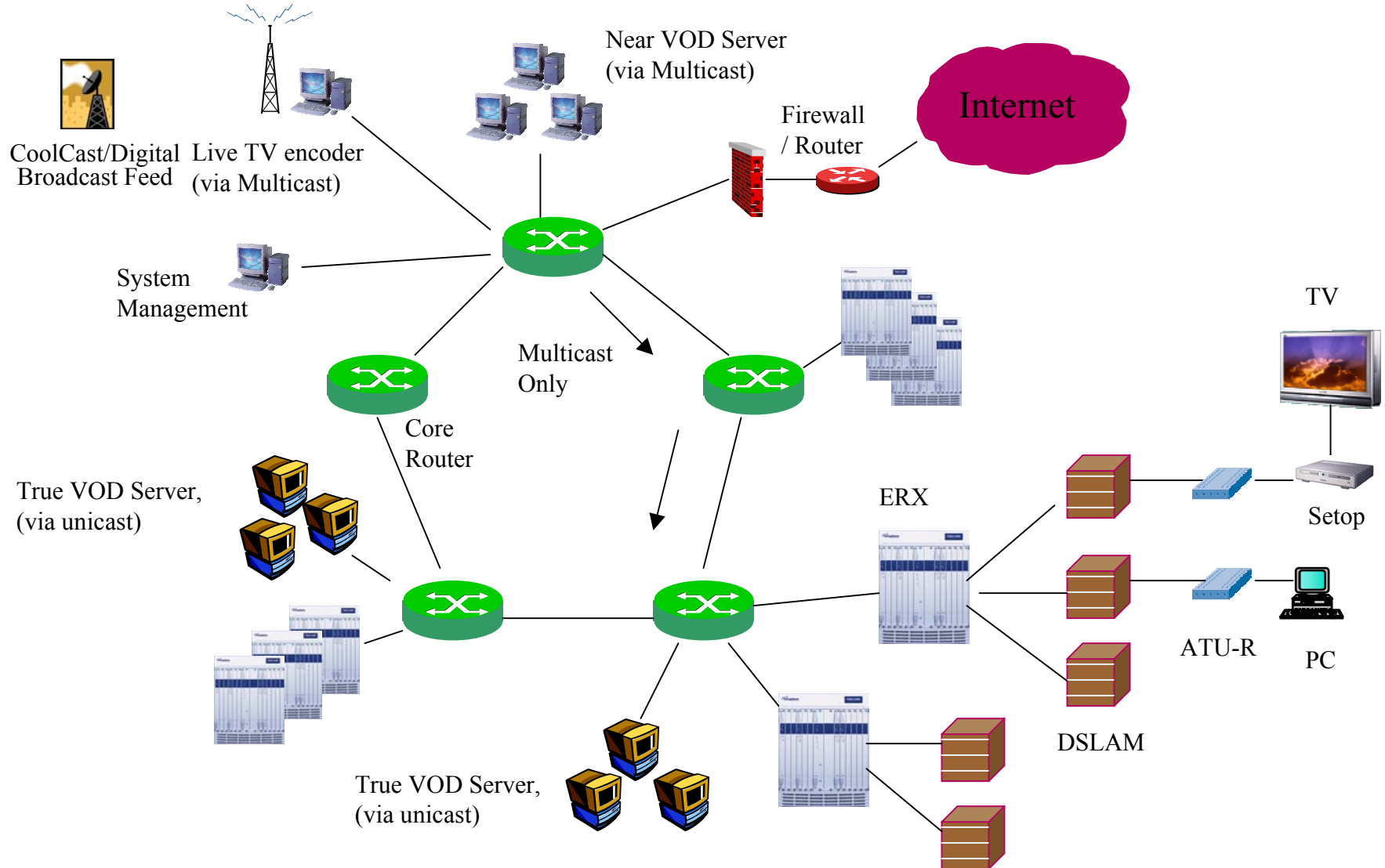
- Ingress = 90Mbps – 300 Multicast Stream
- Egress = 1,800Mbps (12 STM-1) – 6,000 Stream of 300kbps

Case 4 : 1000 streams of 100kbps traffic, each multicast to 16 destinations.



- Ingress = 100Mbps – 1.000 Multicast Stream
- Egress = 1,600Mbps (11 STM-1) – 16,000 Stream of 100kbps

Delivering Incremental Revenue: Multicast TV and VOD



Video



Taxonomy of video applications

- Digital Video Download
- VOD
- NVOD
- Streaming Video
- IP TV
- Video Conferencing
- Distance Learning
- Medical imaging/telemedicine
- Surveillance
- TV/Film production/distribution (backhaul)

- Video file download
 - Broadband connection
- Video-on-demand (video flow directed to single user)
 - Adequate bandwidth end-to-end
 - 700 kbps to 5 Mbps (example – Intertainer requires 3.375 Mbps)
 - Display important determinate of requirement
 - Predictable latency, low jitter – per hop QOS
 - Non-interfering flows – end-to-end QOS
 - Dynamic control of
 - Bandwidth
 - Channels
- iTV (Multiple users view common broadcast flow)
 - Capabilities as in VOD plus content to multiple users (Multicast)
- Video conferencing point-to-point and between conference bridge and users
 - Efficient mechanism to distribute same
 - Return channel at same rate as broadcast channel

TV Customized to the user's preferences*

- Base package: the 25 broadcast channels you want from all global news/entertainment broadcast sources
- Premium channels incremental
- VOD at incremental cost
- Attention for delay to change channels, join new Multicast Group must be fast

*See *The Future of TV*, Mark Fischetti, MIT Technology Review, November 2001

Audio



Audio and Voice Transport Requirements

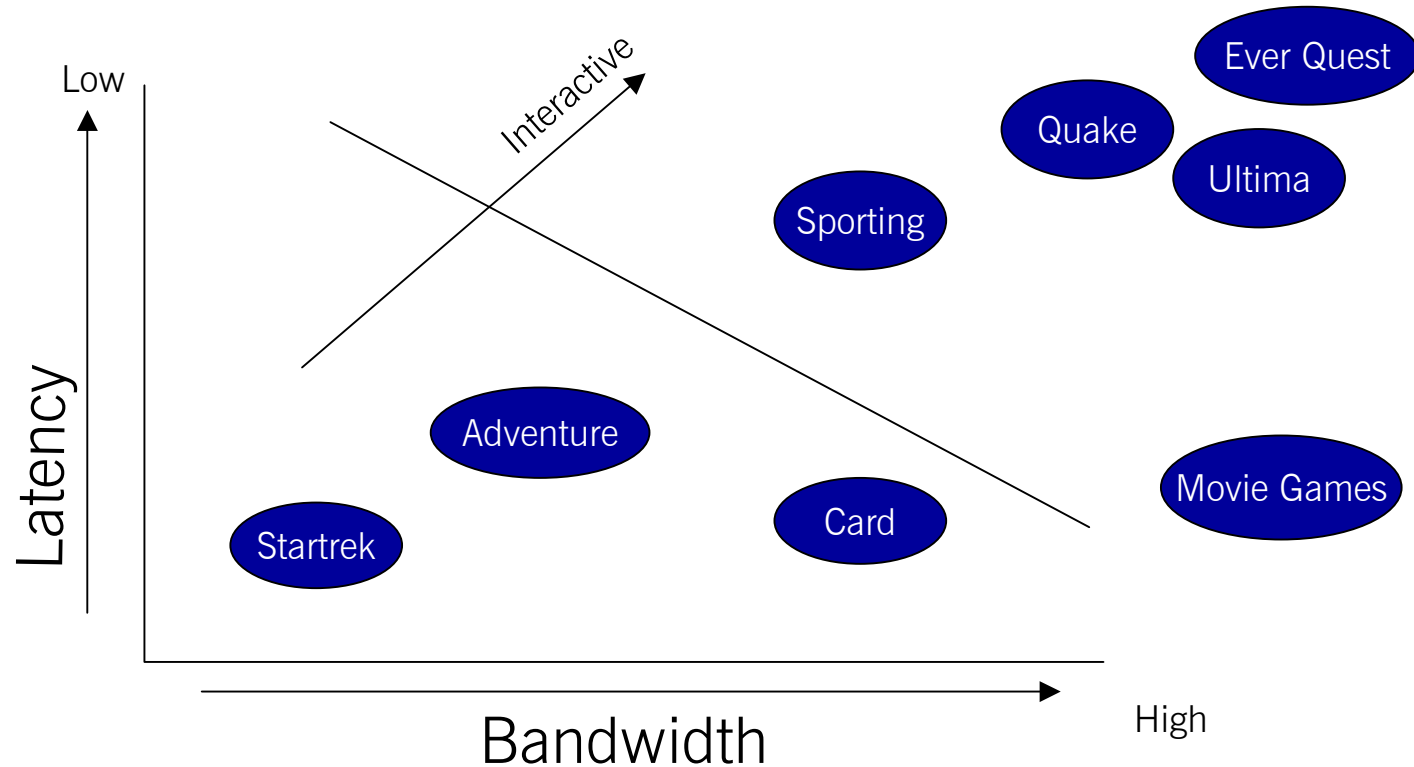


- Adequate best-effort bandwidth to carry significant file-sharing traffic
 - Son-of-Napster
 - Gang-of-Five
- QOS protection against file-sharing traffic
- Low-latency, low jitter transport for voice applications
 - Total RT delay ≤ 160 ms for high-quality voice
 - Minimizing jitter helps minimize overall delay
- Low latency, low jitter transport for real-time FM/CD-quality audio
 - CD Quality
 - MP3 with over-sampling: 160 kbps
 - MP3: 128 kbps
 - Window Media Player: 128 kbps
 - FM Radio
 - MP3: 64 kbps
- Multicast in support of live broadcast

Interactive Gaming



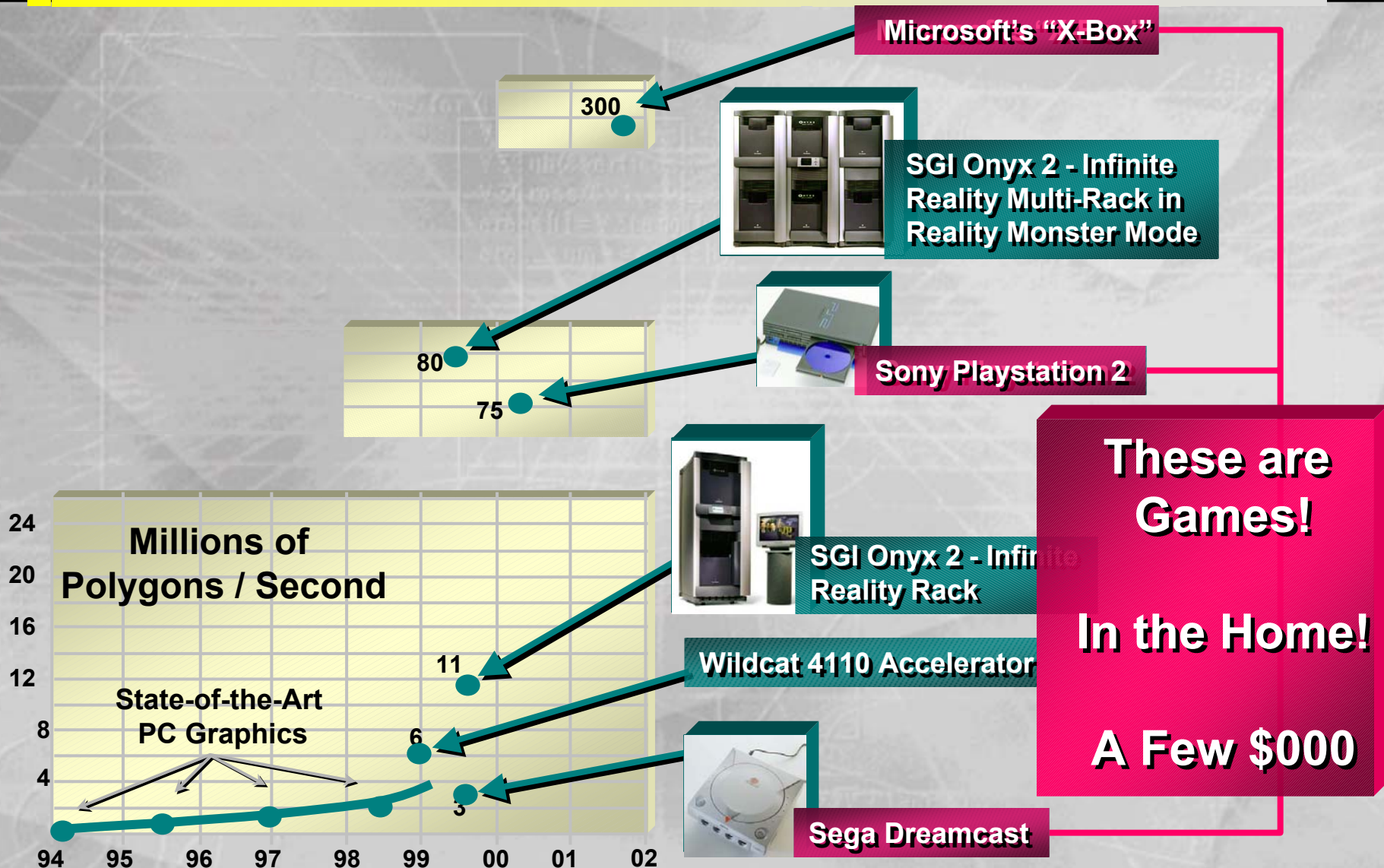
Technology Evolution



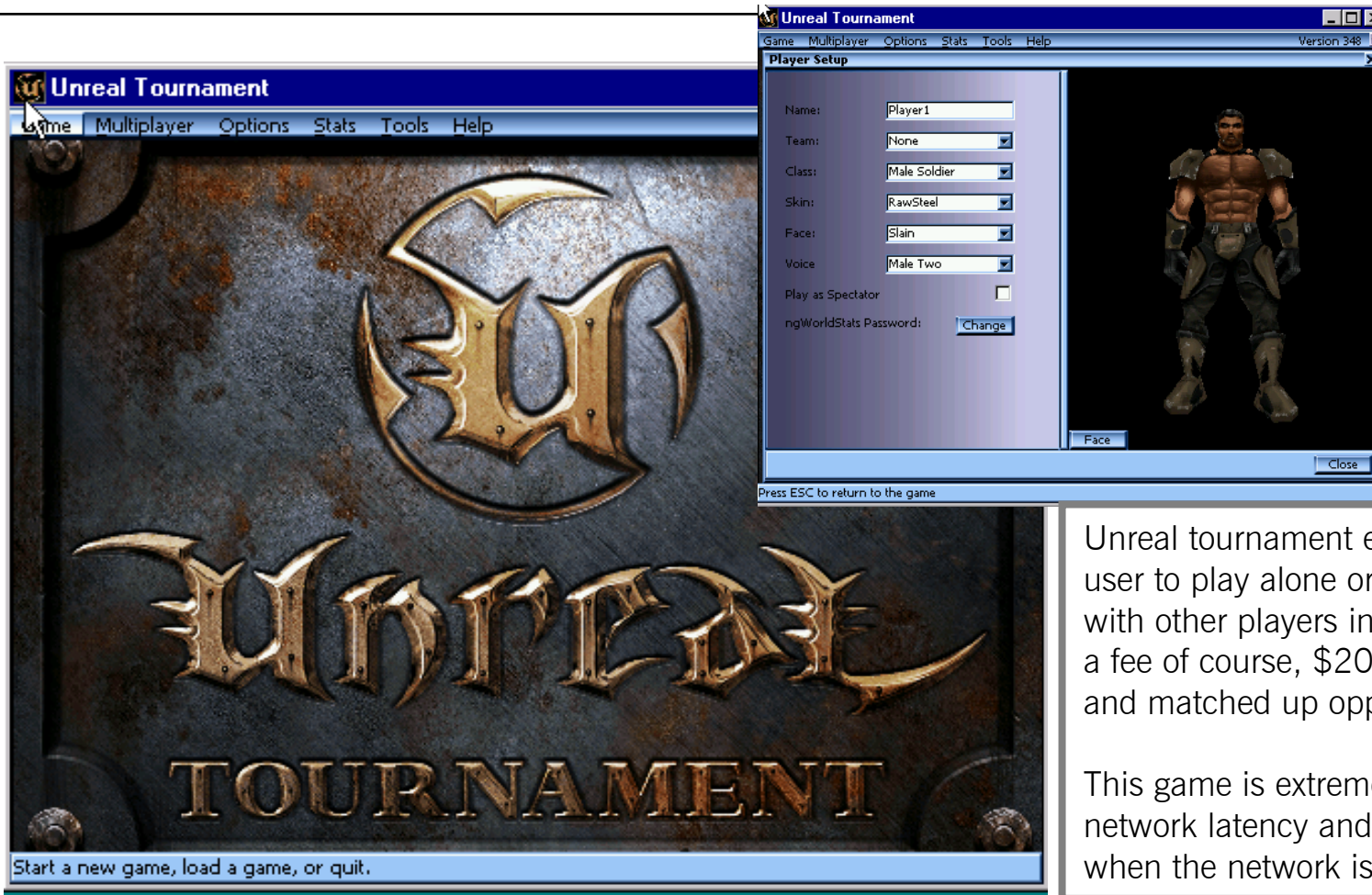
Slow, best effort connection = death!

- Merging of on-line and off- line technologies
 - Dedicated game controllers
 - Network improvements

The Next Level ...



Unreal Tournament offers Multiplayer Gaming on a pay-per-episode model



Unreal tournament enables the end user to play alone or be matched up with other players in cyber space (for a fee of course, \$20 including game and matched up opponents).

This game is extremely intolerant of network latency and lets you know when the network is having trouble.

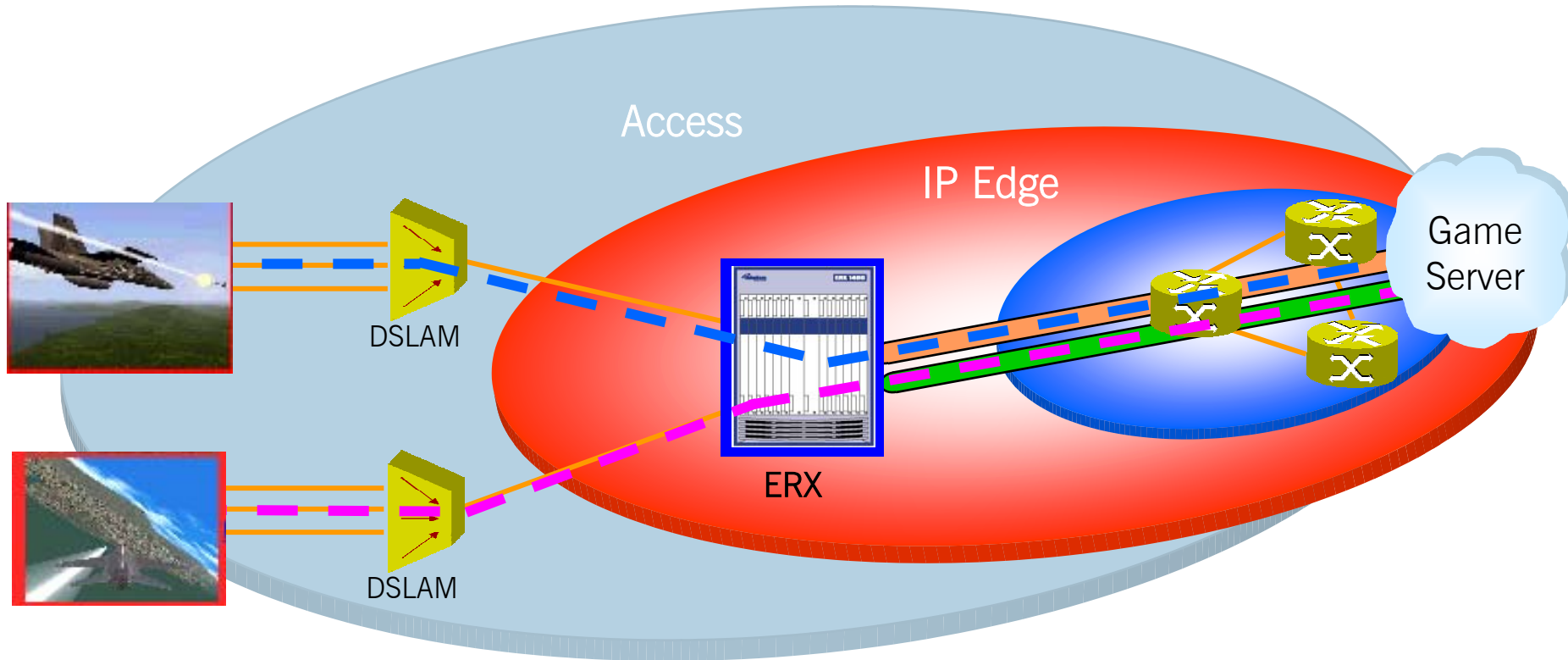
Unisphere is not partners with these companies which provide content. And, your customers might never be either! You must take into consideration that some of these companies might never be interested in partnering with service providers to distribute their content.

- Low-latency transmission of control data
 - Round trip delay ≤ 200 msec (≤ 100 preferred) for Ultima as example
- Support for both text and voice chat simultaneous/unimpeded by control flow
- Strong multicast capability
- Emerging need for streaming and broadcast video

Case Study



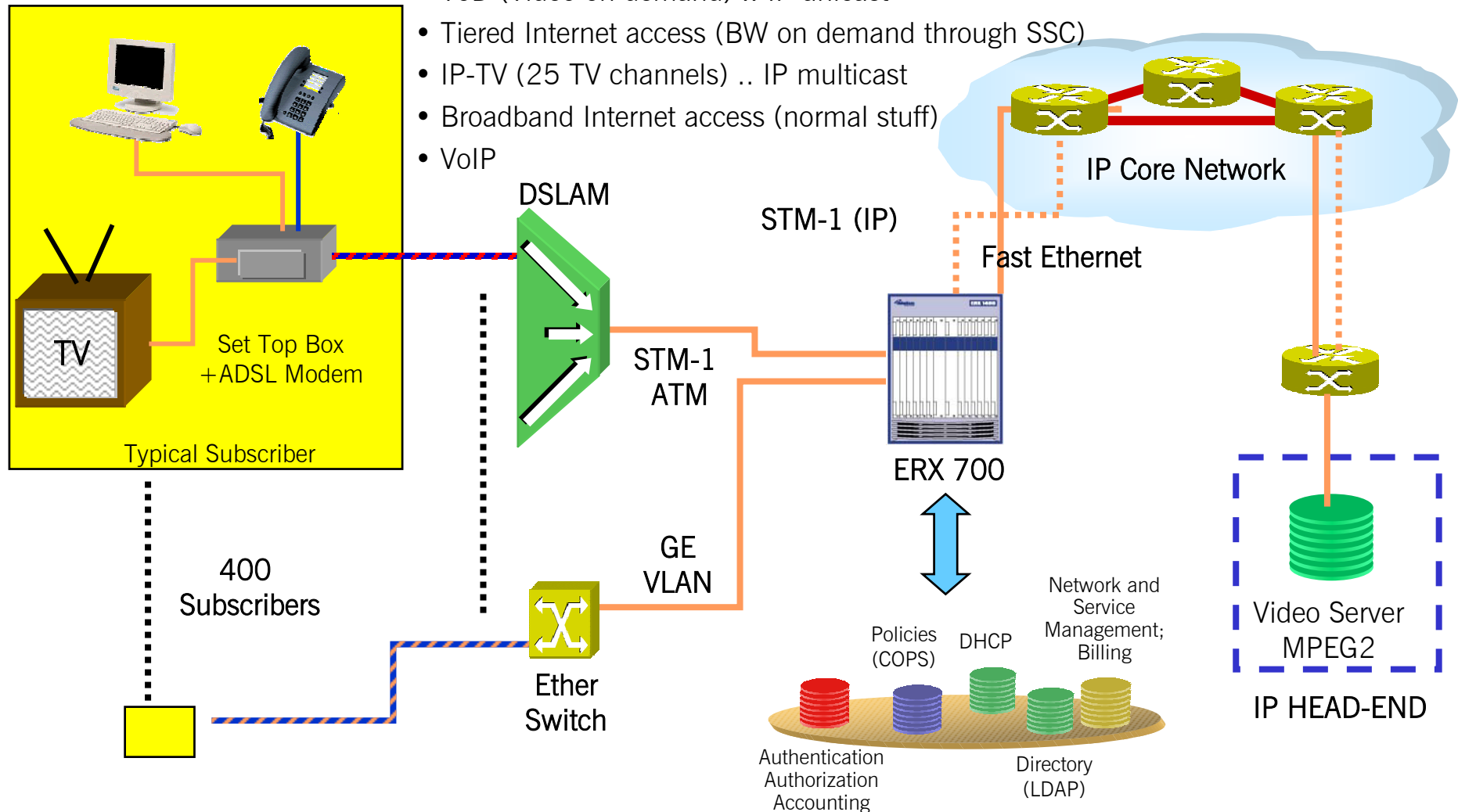
Delivering Incremental Revenue: Interactive Gaming over DSL



Example of Current Implementation:
Korea Telecom – 2m subscribers today.
Growing to 35% of world market in CY2001.

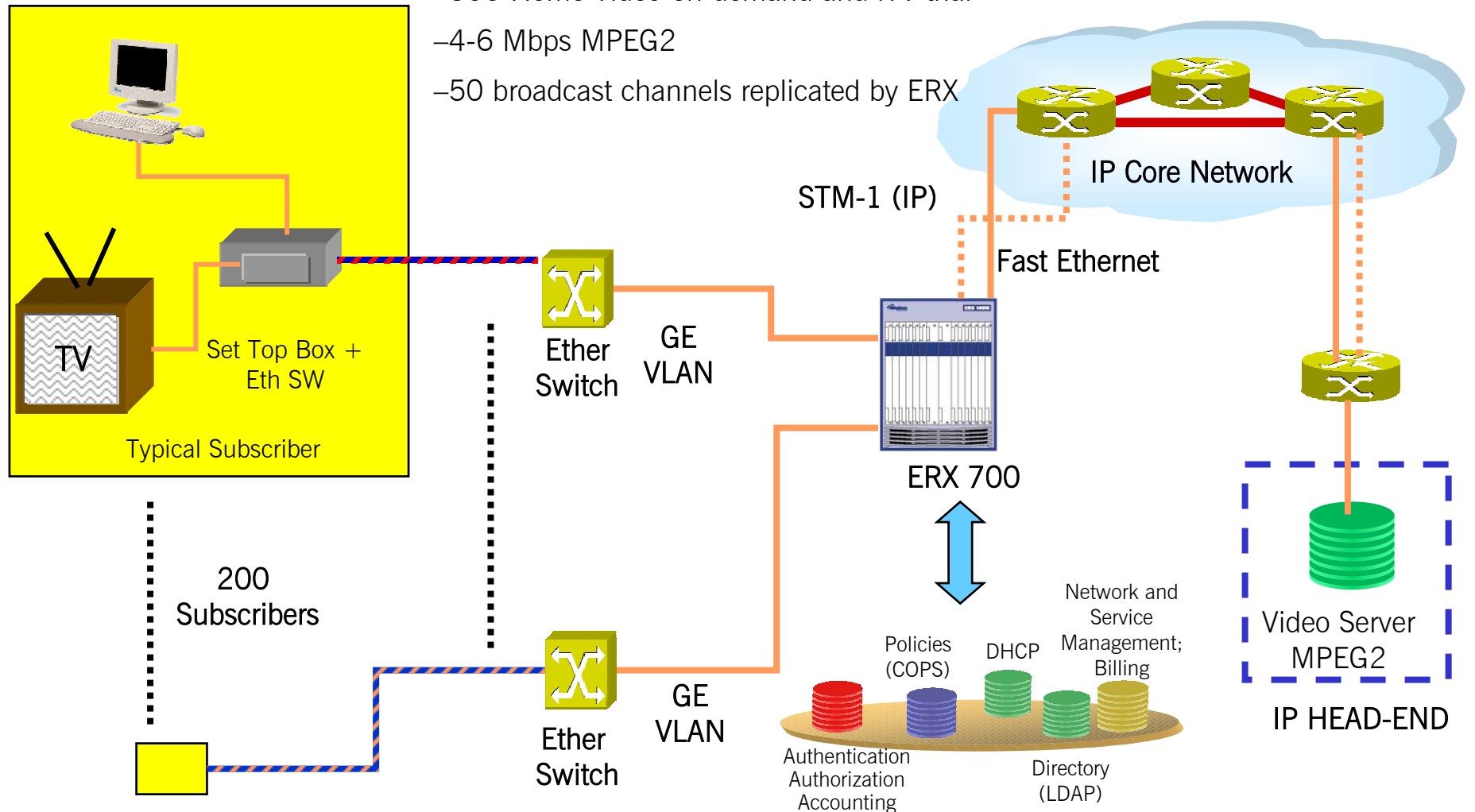
Customer X

- VoD (Video on demand) .. IP unicast
- Tiered Internet access (BW on demand through SSC)
- IP-TV (25 TV channels) .. IP multicast
- Broadband Internet access (normal stuff)
- VoIP



Customer Y

- 300 Home Video-on-demand and iTV trial
- 4-6 Mbps MPEG2
- 50 broadcast channels replicated by ERX



Conclusion



- Multicast is not the application, but can help to delivery better user experience
- Multicast can lower the cost to delivery real-time content
- Content providers and Network Providers can't work alone, must agree to join force to delivery better service
- Multicast and MPLS together is a great combination to build an optimized Network to delivery real-time content with QoS
- Multicast is becoming a key technology because Broadband deployment is scaling
- Multicast Router implementation must scale to support mass deployment
- As ATM word with non-blocking architecture, the IP world must have wire-speed Network element to support traffic
- Call admission control must be considered in order to offer SLA
- Protocols choice, SM/DM/etc., could impact on user experience

- BGMP - Border Gateway Multicast Protocol
- CBT - Core Based Trees
- DVMRP - Distance Vector Multicast Routing Protocol
- IGMP - Internet Group Management Protocol
- MBGP - Multiprotocol extensions to BGP
- MSDP - Multicast Source Discovery Protocol
- PIM - Protocol Independent Multicast (sparse & dense)

The Weapons in Unisphere's Arsenal



- Wirespeed QOS: Queue, Classify, and Schedule (QCS)
 - Rate shaping/limiting
 - Per Flow Queuing
 - CAC
- Physical/Logical density
- Multicast
 - Superior replication capabilities
 - Superior multicast routing protocol support and performance
 - Access – towards end-user
 - Trunk – towards content provider
- SSC