



# Video im Netz - Fluch oder Segen?



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**Introduction**

**Video Technology**

**Video Networking**

**Traffic Profiles**

**Video @ Cisco**

**AGENDA**



# Business Video Systems



# Enterprise Video

## Set of Challenges ?



### Delivery and Insuring the Experience

- Provide relatively high bandwidth
- Meet performance tolerances (latency, jitter, loss, bursting, admission)
- Insuring wanted video streams service level, managing unwanted



### Digital Media Management

- Capture, Storage, Archive, and Retrieval
- Distribution on-demand or live broadcast



### Client Access

- Access controls, wired and wireless
- Network context/services aware – bridge device gap
- Conferencing and transcoding resources



### Security

- Protection of video sources and content
- Securing content for intellectual property and/or compliance
- Access controls for clients, digital rights



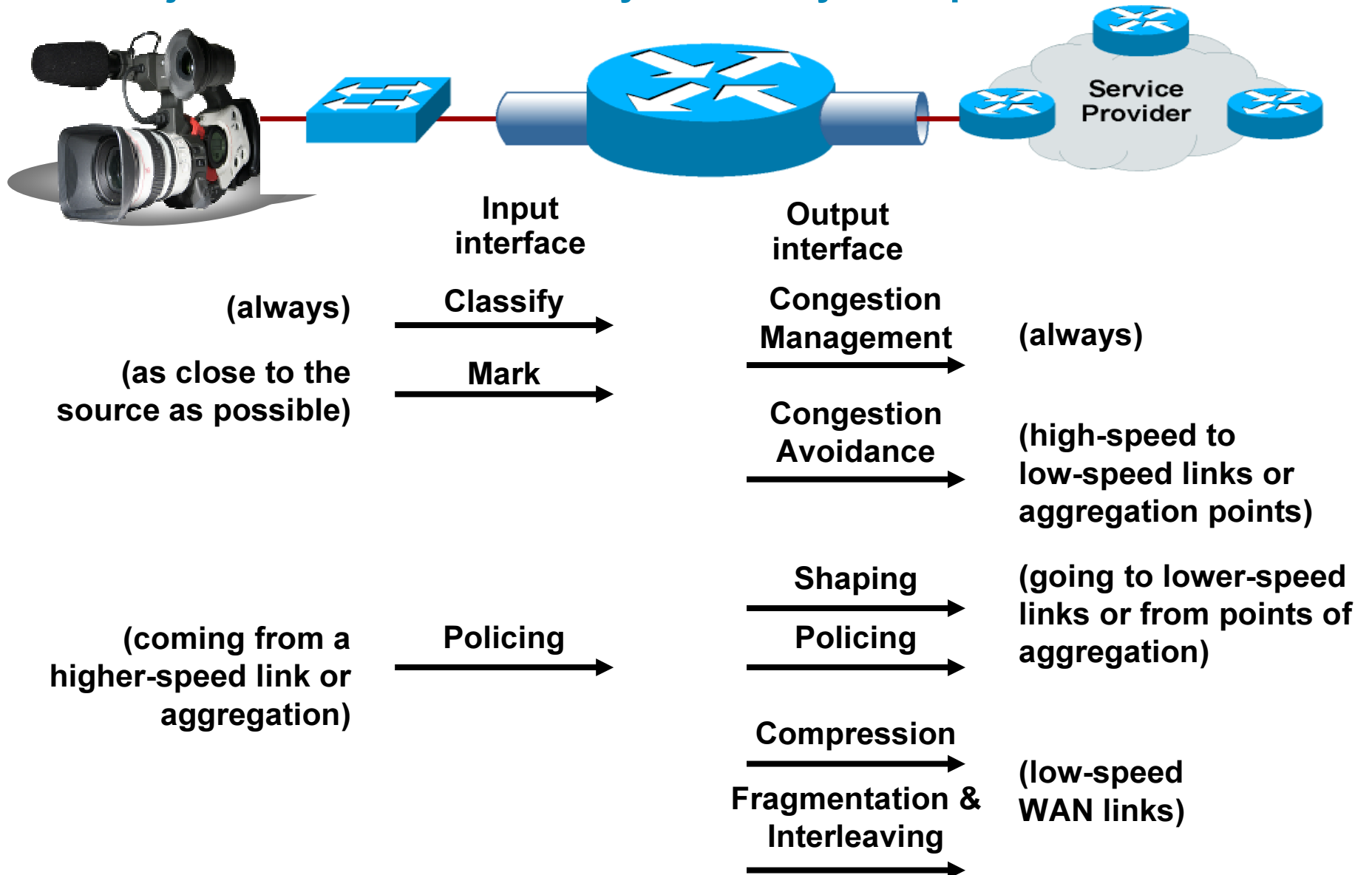
### Integration

- Standalone video applications constrain productivity
- Collaboration driving need for application integration
- Leverage endpoints and resources across multiple video services

# There were times, when video was more difficult to deploy 😊



# Session Objective – Your network knows already how to deal with video - just enable the features you already have paid for.





# Video Technologies



# Resolution Comparison

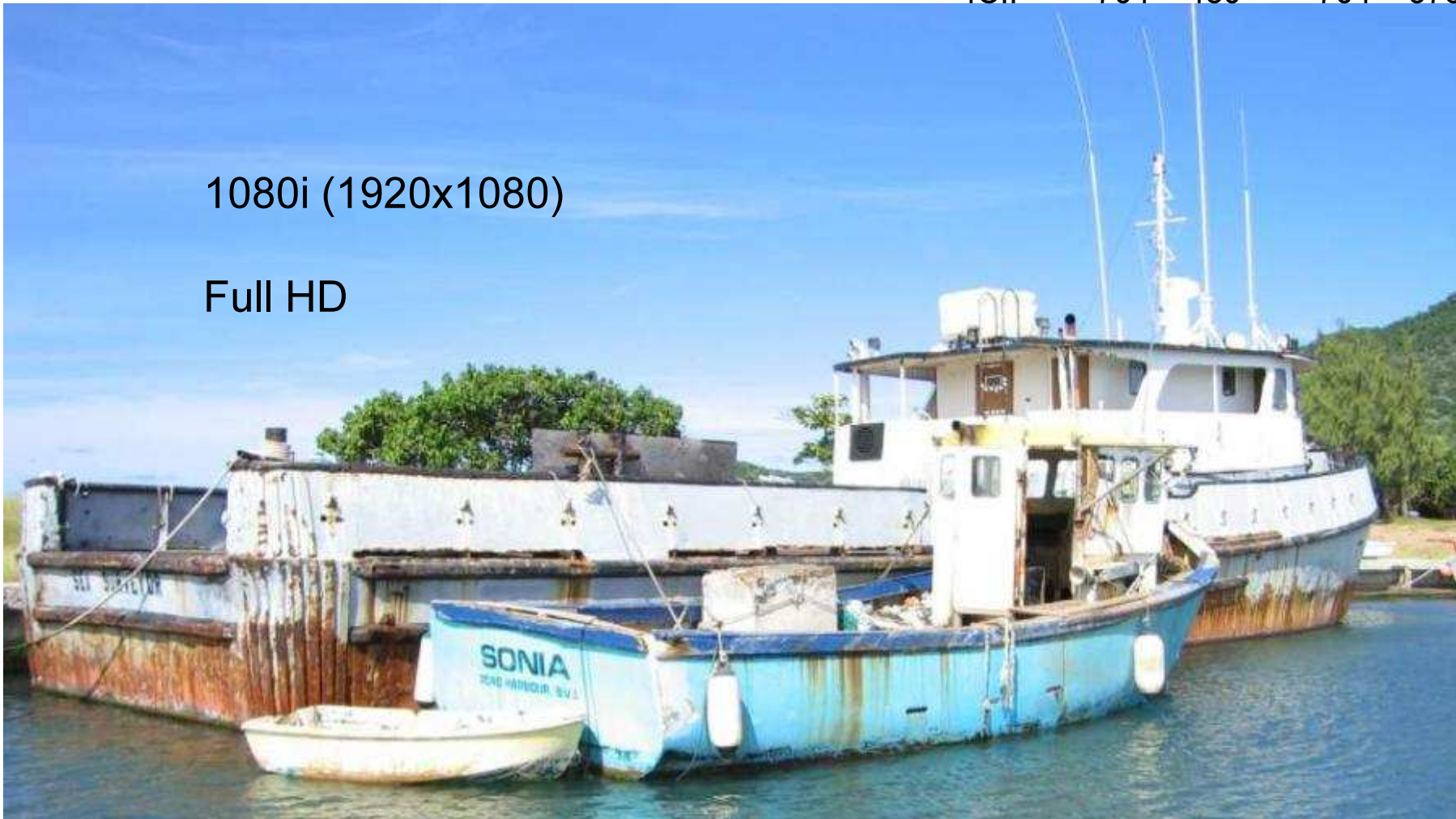
*Relative sizes*

## CIF Formats

| Format | NTSC-based | PAL-based |
|--------|------------|-----------|
| SQCIF  |            | 128 × 96  |
| QCIF   | 176 × 120  | 176 × 144 |
| QCIF+  | 176 × 220  | 176 × 220 |
| CIF    | 352 × 240  | 352 × 288 |
| 2CIF   | 704 × 240  | 704 × 288 |
| 4CIF   | 704 × 480  | 704 × 576 |

1080i (1920x1080)

Full HD



# Video

## CODECs (CODe/DECode)

- Compression can be classified into “Lossless” and Lossy”

Lossless compression is a bit-perfect copy of the original

- Lossless compression has very little gain in reducing video frames,

**Downside:** Requires more bandwidth

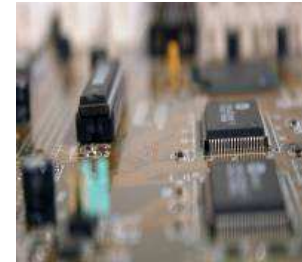
Example—Like WinZip for mp3 audio

- Lossy compression make use of “Perceptual Coding”, produces a good quality copy of the original

**Upside:** Smaller file size, adequate quality

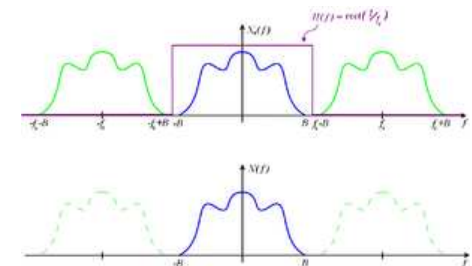
Example—MPEG video and audio

- Lossy compression is used when it is not required to re-create a bit-for-bit copy of the original file after compression



$$X(f) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} x(t) e^{-i2\pi ft} dt.$$

Nyquist–Shannon sampling theorem

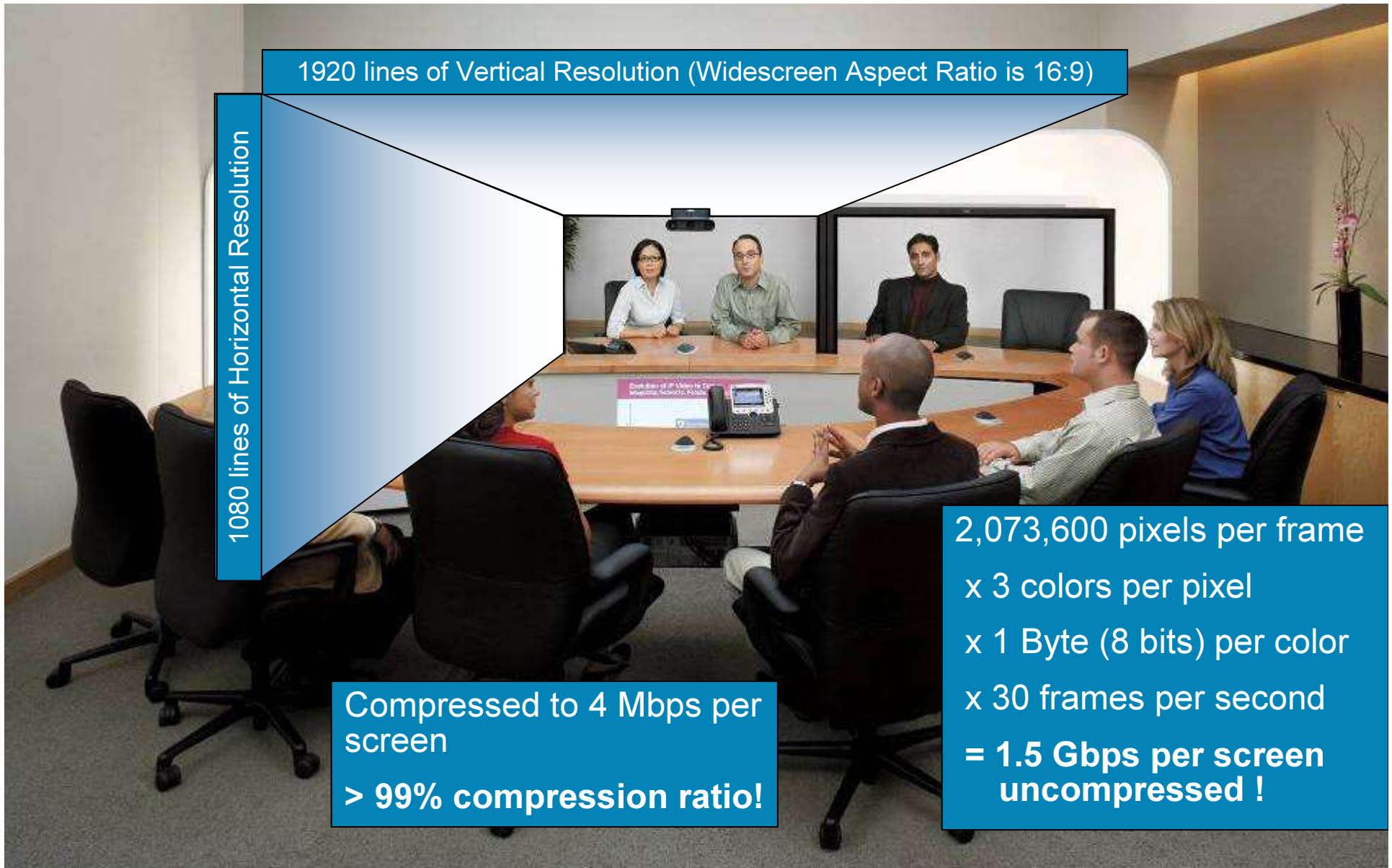


ELECTRICAL SYMBOL FOR ANALOG TO DIGITAL CONVERTER (ADC)

Video compression is the science of representing information in a compact form

# Cisco TelePresence Traffic Characteristics

## Resolution



# Video

## CODECs (CODe/DECode)

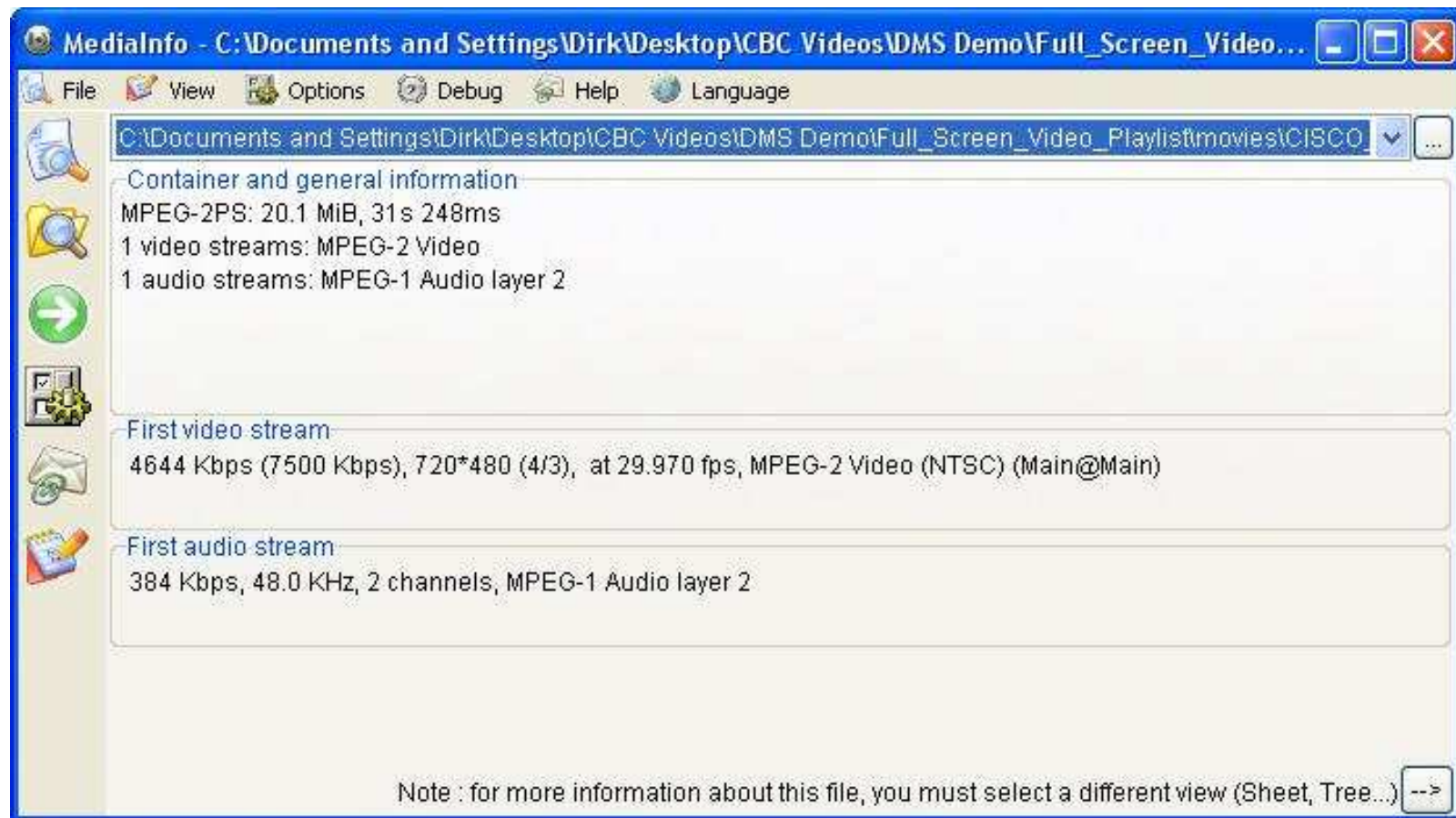
|                        | Application        | Bandwidth         |
|------------------------|--------------------|-------------------|
| MPEG-1                 | VCD                | 0.5 to 1.5Mbps    |
| MPEG-2 (H.262)         | DVD / HDTV         | 1.5 to 20Mbps     |
| MPEG-4 P.2             | Internet- TV       | 64Kbps to 4Mbps   |
| MPEG-4 P.10            | Internet-HDTV      | 500Kbps to 12Mbps |
| H.261                  | Video Conferencing | N x 64Kbps        |
| H.263                  | Video Conferencing | 32Kbps to 2Mbps   |
| H.263+                 | Internet           | 24-64Kbps         |
| H.264 AVC (MPEG4 P.10) | Internet-HDTV      | 500Kbps to 12Mbps |
| H.264/M                | 3G Mobile          | 64-128Kbps        |
| Microsoft™             | Internet-HDTV      | 128Kbps to 15Mbps |
| Real™                  | Internet-HDTV      | 64Kbps to 8Mbps   |
| Sorenson™              | Internet           | 128Kbps to 15Mbps |

Motion Pictures  
Expert Group

ITU

# MediaInfo

<http://mediainfo.sourceforge.net/en>



# Spatial Redundancy

- Move prediction – Frames types



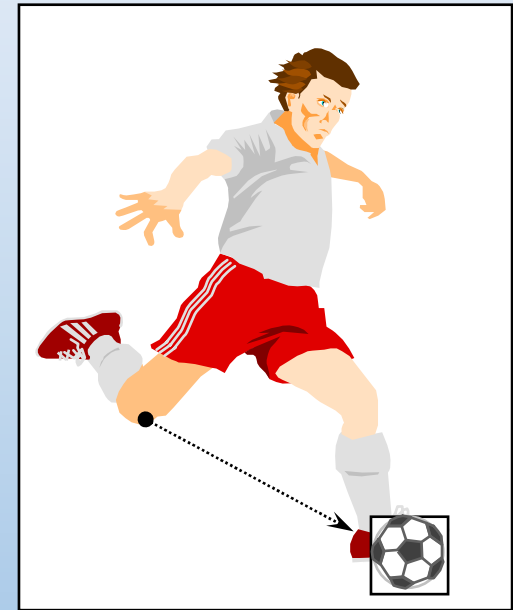
**I(intra) Frame**

Full frame



**B(i-directional) Frame**

Ball move only encoded  
between I & P

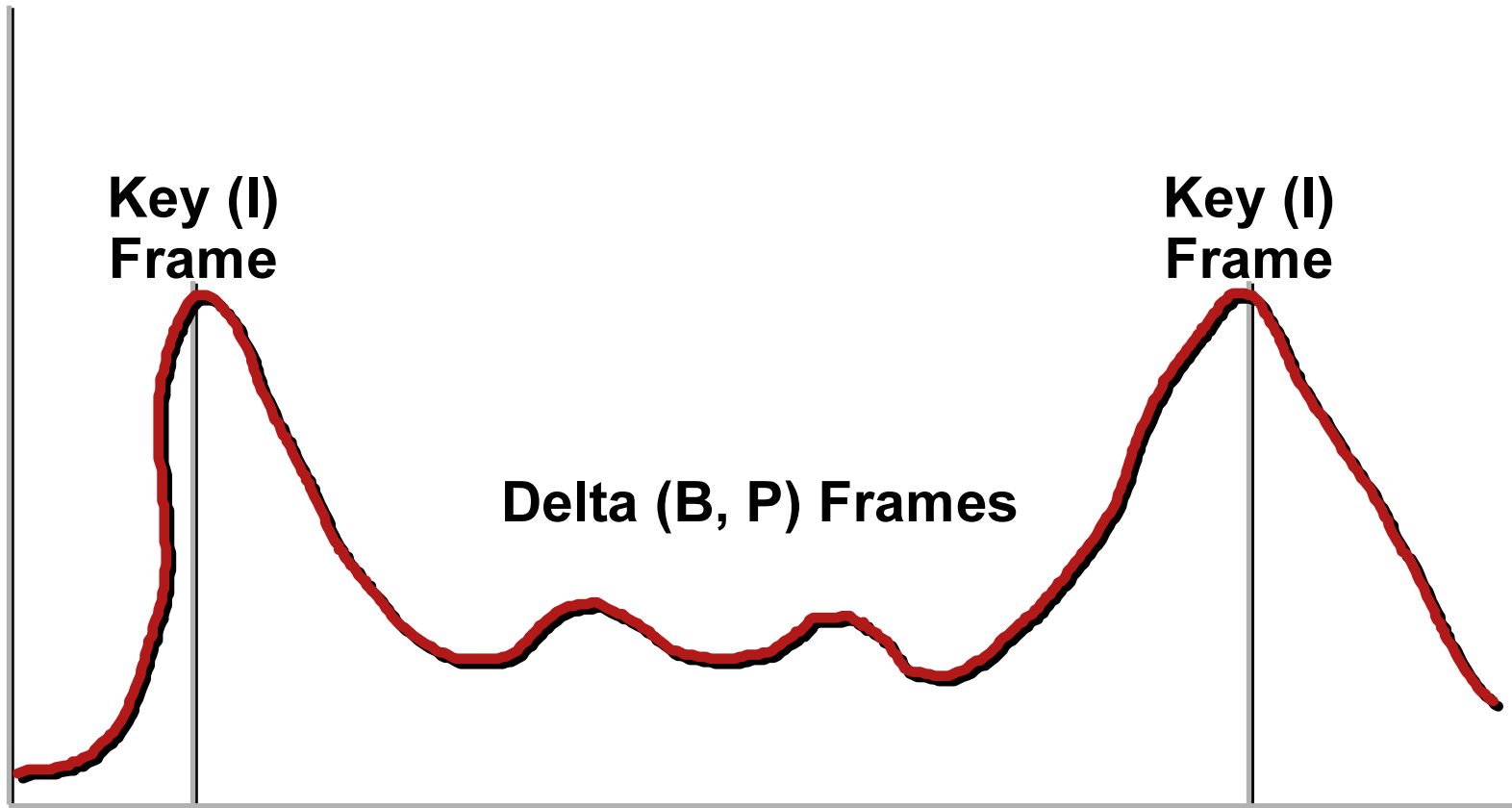


**Predictive Frame**

Encoded ball with moving  
vector, from I frame

# MPEG Video over IP: Traffic Pattern

Bandwidth



**No Constant Bitrate !**

**Time**

# Packet Loss Ratio (PLR) Impact



0% PLR

Result worsens depending on compression used



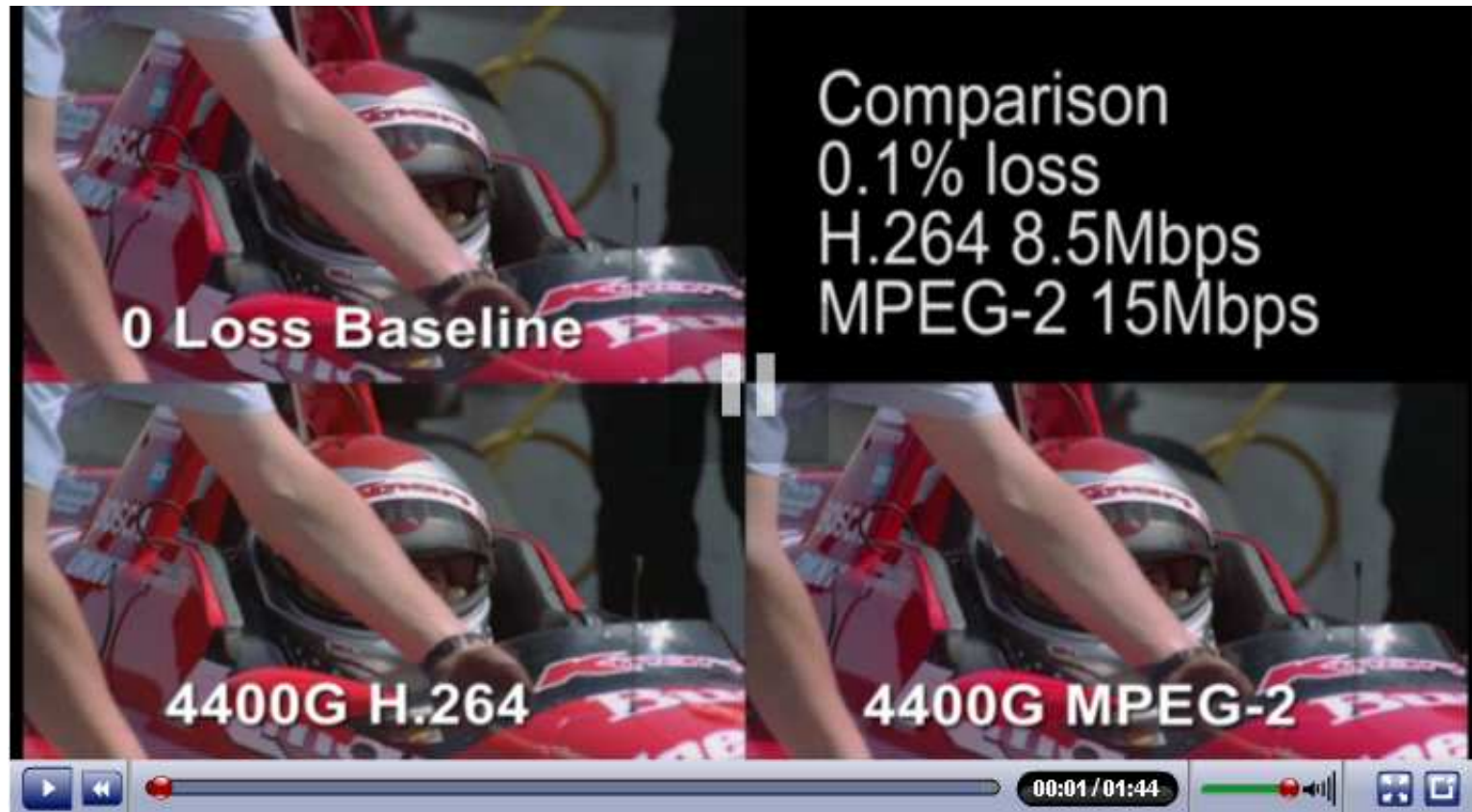
0.05 % PLR



0.5 % PLR

# Compression and PLR example

## Cisco Digital Media Player 4400






# Video Networking



# Network Infrastructure

## Traffic Profiles and Requirements

A blue rounded rectangle containing a laptop icon on the left and a line graph on the right. The graph shows a fluctuating data line with a peak. The word "Data" is written in white at the top of the rectangle.

**Data**

- Smooth / bursty
- Benign/greedy
- Drop insensitive
- Delay insensitive
- TCP retransmits

**Traffic Patterns for Data Vary Among Applications**

**Generally well understood or monitored**

**Uses all types of IP protocols**

**Includes Uni-cast and Multi-cast**

**Data Classes:**

Mission-Critical Apps

Transactional/Interactive Apps

Bulk Data Apps

Best Effort Apps (Default)

# Network Infrastructure

## Traffic Profiles and Requirements

### Video-Conf



- Bursty
- b/w consuming
- Drop sensitive
- Delay sensitive
- **UDP priority**

- Latency  $\leq 150$  ms
- Jitter  $\leq 30$  ms
- Loss  $\leq 1\%$

One-Way Requirements

**IP/VC Has the similar networking requirements as VoIP**

**Different Traffic Patterns (BW per frame varies greatly)**

**Unicast**

**Point to point / Multipoint**

**Established designs include QoS, High Availability,**

# Network Infrastructure

## Traffic Profiles and Requirements

### TelePresence



- Bursty
- Drop sensitive
- Delay sensitive
- Jitter sensitive
- **UDP priority**

- Latency\*  $\leq 150\text{ms}$
- Jitter  $\leq 10\text{ ms}$
- Loss  $\leq 0.05\%$
- Bandwidth (10 Mbps\* per screen @1080P)

One-Way Requirements

\* CTS 550/1000 v1.4  
1080p / best

**TelePresence bandwidth varies based on the resolutions and has Radically Different Traffic Patterns**

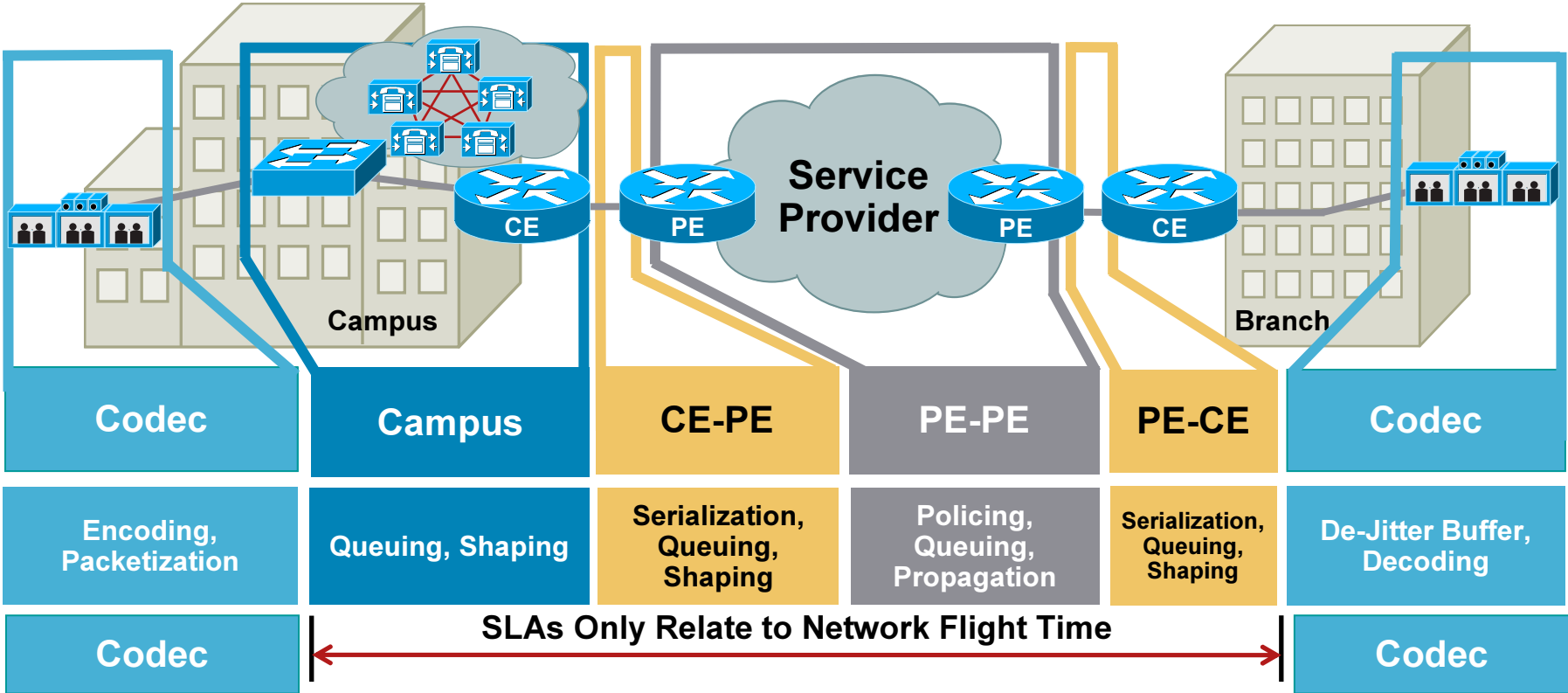
**6 resolution combinations**

**Total bandwidth factors include**

- Number of screen sessions (inc audio)
- Audio add-in
- Auto-collaboration channel
- Interoperability channels
- TelePresence version

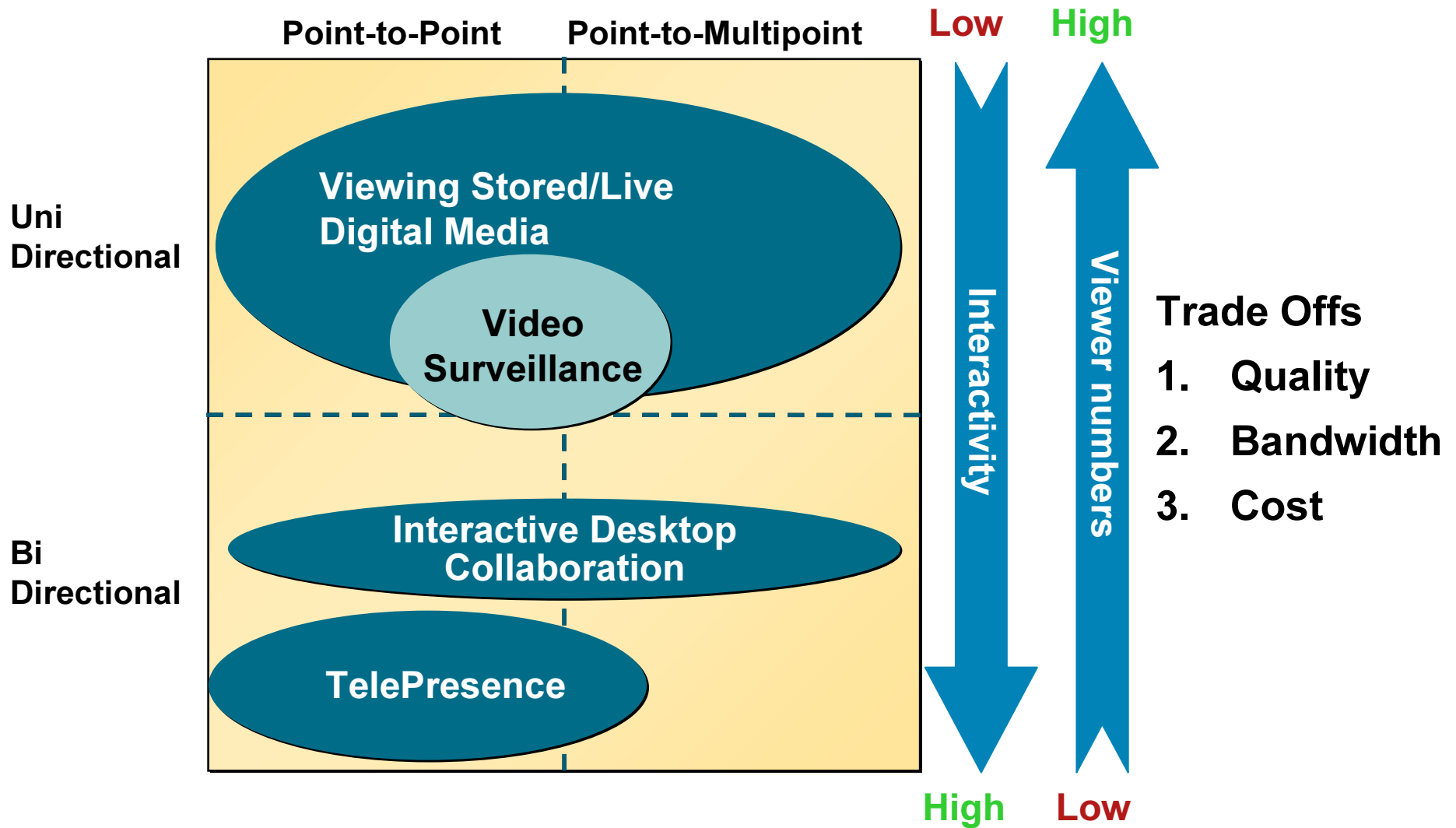
# Cisco TelePresence Traffic Characteristics

## Latency, Jitter and Loss Targets and Thresholds



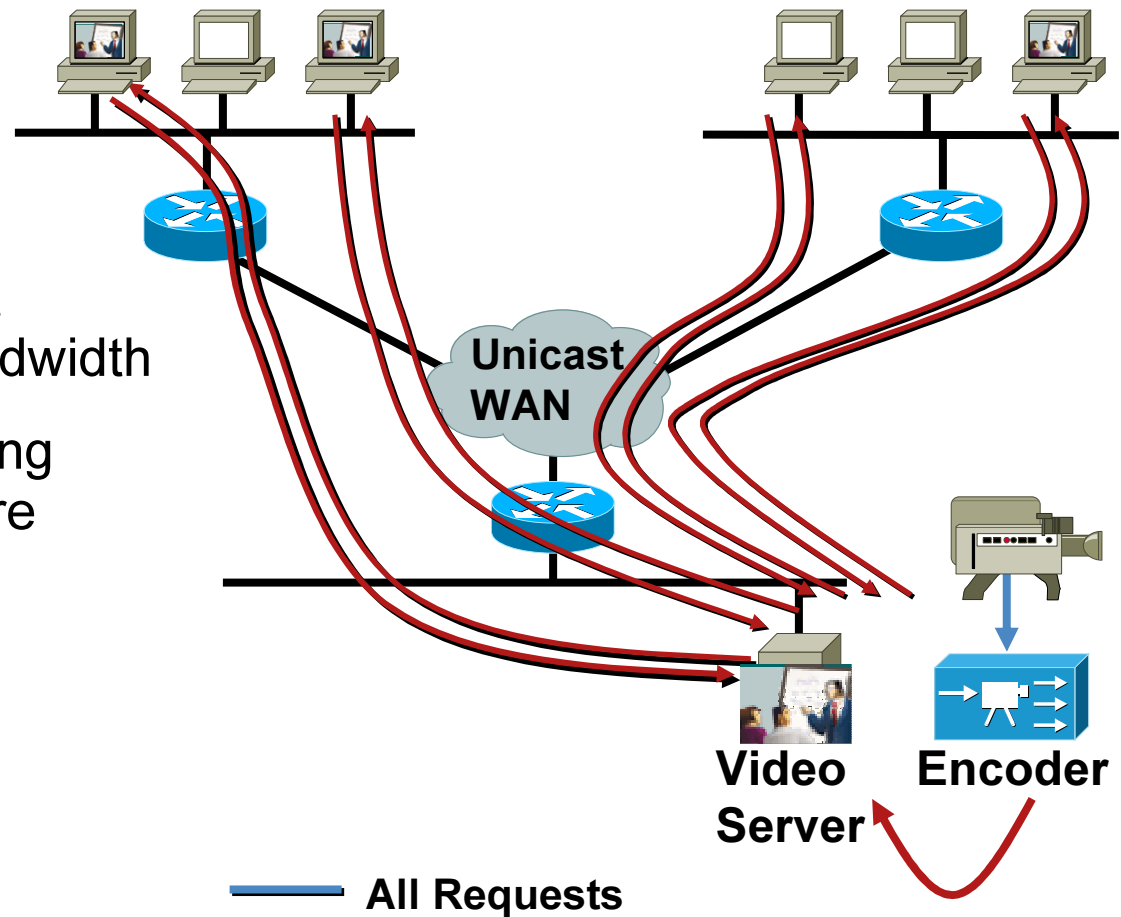
| Metric  | Target | Threshold 1 (Warning) | Threshold 2 (Call Drop) | Enterprise Component | Service Provider Component |
|---------|--------|-----------------------|-------------------------|----------------------|----------------------------|
| Latency | 150 ms | 200 ms                | 400 ms                  | 20%                  | 80%                        |
| Jitter  | 10 ms  | 20 ms                 | 40 ms                   | 50%                  | 50%                        |
| Loss    | 0.05%  | 0.10%                 | 0.20%                   | 50%                  | 50%                        |

# Different Delivery Models



# Live Video on Unicast Network

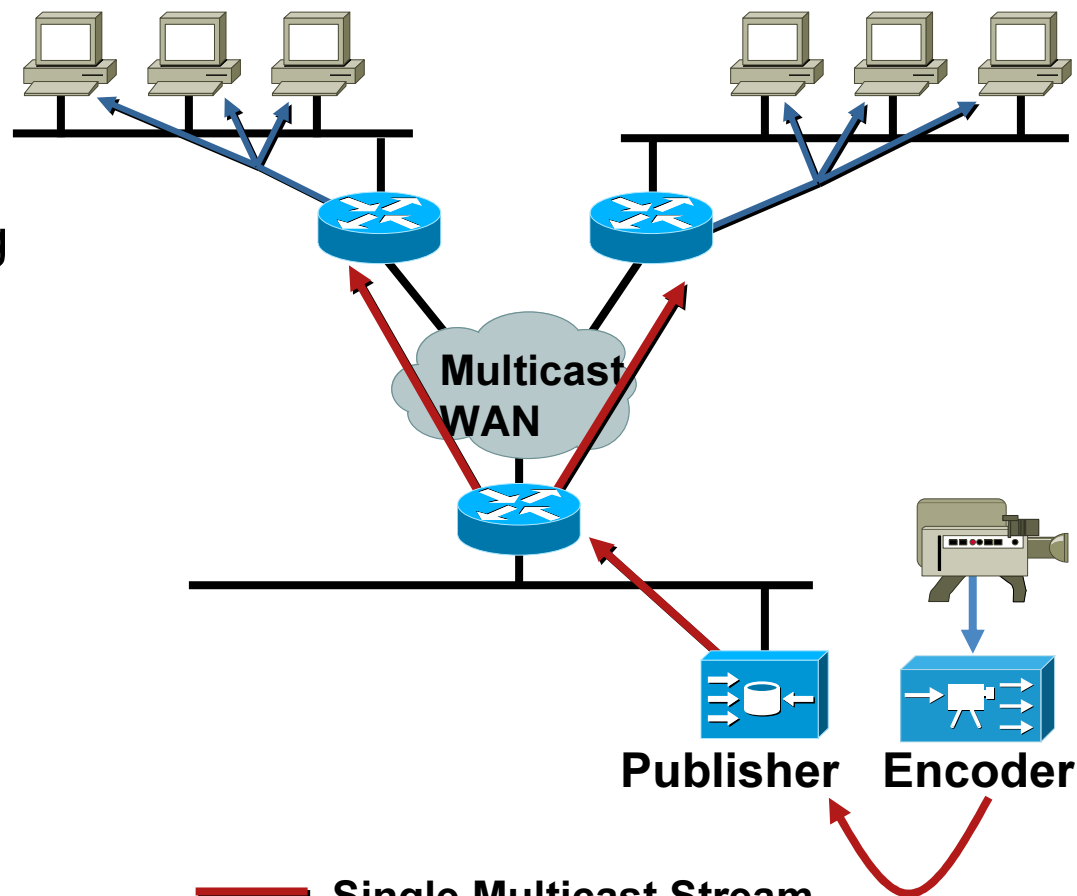
- Separate stream for each client across the WAN
- Sum of all clients must be less than WAN bandwidth
- Not practical on anything but optical infrastructure



# Live Video on Multicast Network

- Multicast enabled LAN and WAN
- Requires event planning and administration

## PIM Routing



- Single Multicast Stream Replicated by WAN Network
- Single Multicast Stream Replicated by LAN Network

# Differentiated Services Model

Network traffic identified by class

Network QoS policy enforces differentiated treatment of traffic classes

You choose the level of service for each traffic class

Like using a package delivery service

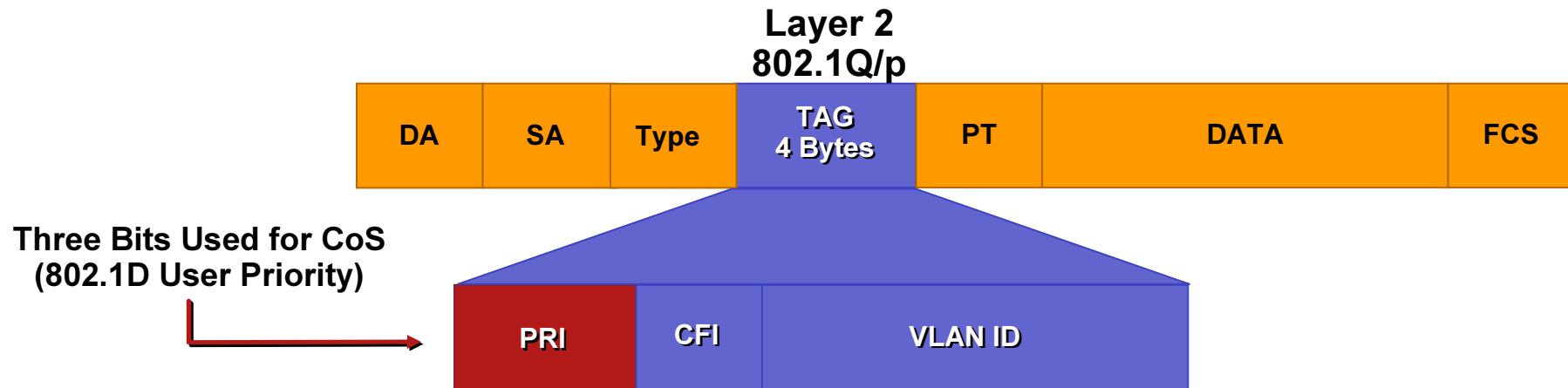


***Do you want overnight delivery?***

***Do you want 2-day air delivery?***

***Do you want 3- to 7-day ground delivery?***

# Layer 2 Class of Service CoS



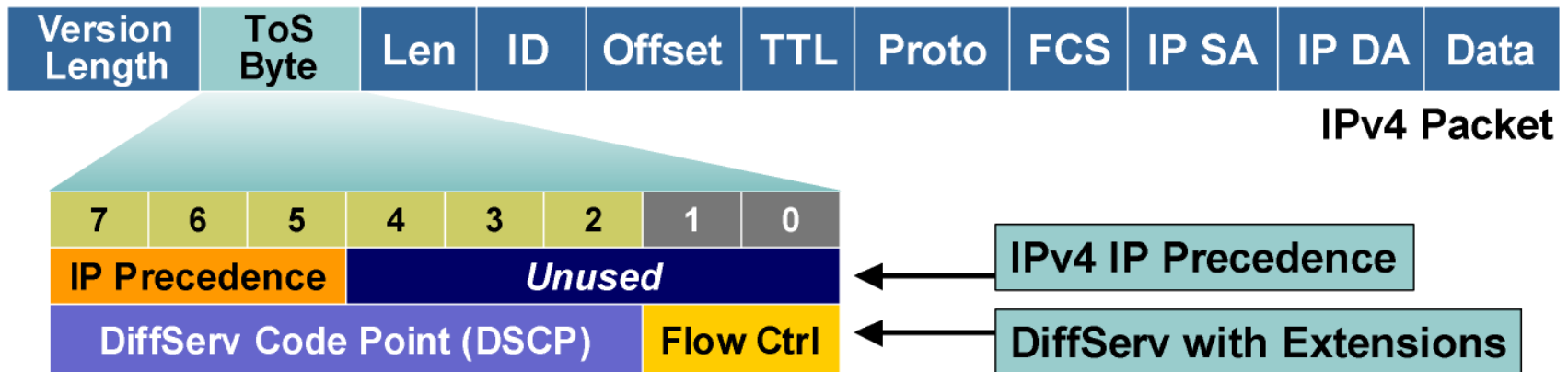
- 802.1Q trunking, contains fields for setting CoS

This is the 802.1p priority

| <i>CoS</i> | <i>Application</i>   |
|------------|----------------------|
| 7          | Reserved             |
| 6          | Reserved             |
| 5          | Voice Bearer         |
| 4          | Videoconferencing    |
| 3          | Call-Signaling       |
| 2          | High-Priority Data   |
| 1          | Medium-Priority Data |
| 0          | Best-Effort Data     |

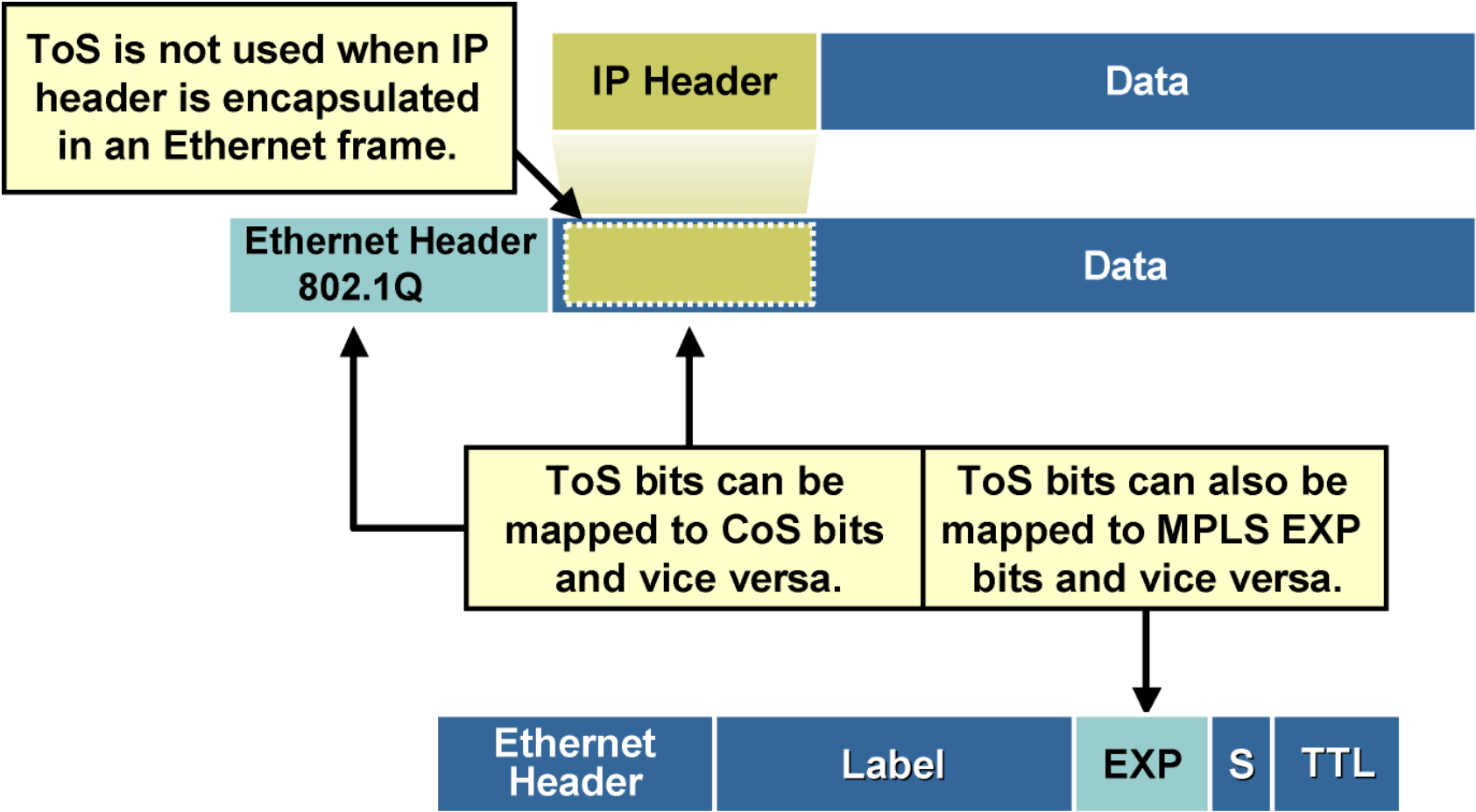
# Classification and Marking at the Network Layer

## IP Precedence and DSCP

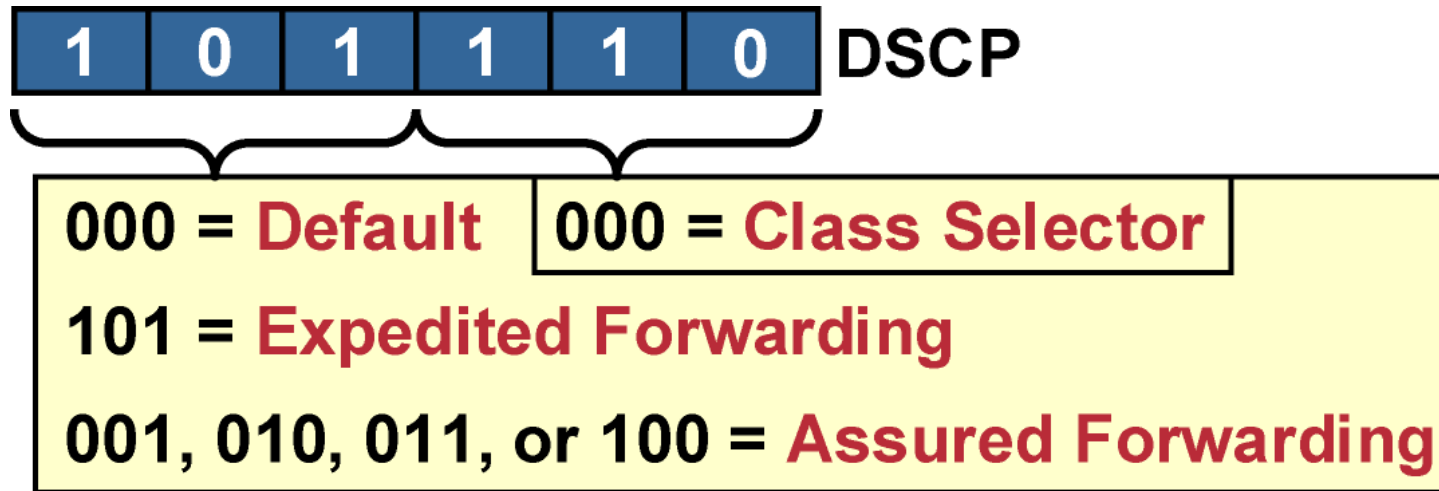


- **IP Precedence:** Three most significant bits of ToS byte are called IP precedence—other bits unused.
- **DiffServ:** Six most significant bits of ToS byte are called DSCP—remaining two bits used for flow control.
- DSCP is backward compatible with IP precedence.

# Mapping CoS to Network Layer QoS



# Per-Hop Behavior

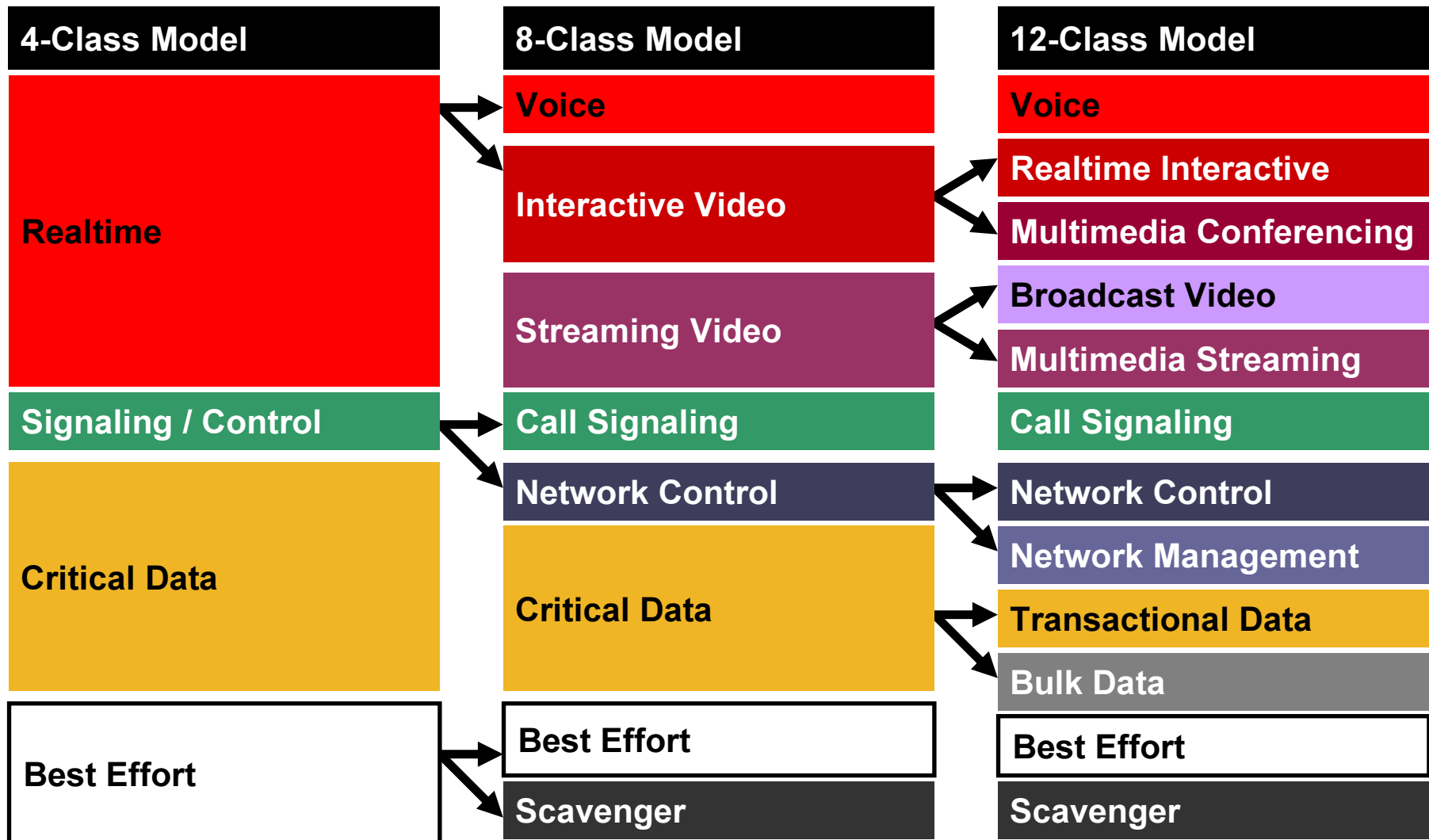


DSCP selects PHB throughout the network

- Default** PHB (FIFO, Tail Drop)
- Expedited Forwarding** (EF) PHB
- Assured Forwarding** (AF) PHB
- Class Selector** (IP precedence) PHB

# QoS – How Many Classes?

Business Requirements Will Evolve and Expand over Time



# Cisco Video Apps DiffServ QoS Recommendations (RFC 4594-Based)

| Application Class        | Per-Hop Behavior | Admission Control | Queuing & Dropping         | Application Examples                              |
|--------------------------|------------------|-------------------|----------------------------|---|
| VoIP Telephony           | EF               | Required          | Priority Queue (PQ)        | Cisco IP Phones (G.711, G.729)                    |
| Broadcast Video          | CS5              | Required          | (Optional) PQ              | Cisco IP Video Surveillance / Cisco Enterprise TV |
| Realtime Interactive     | CS4              | Required          | (Optional) PQ              | Cisco TelePresence                                |
| Multimedia Conferencing  | AF4              | Required          | BW Queue + DSCP WRED       | Cisco Unified Personal Communicator               |
| Multimedia Streaming     | AF3              | Recommended       | BW Queue + DSCP WRED       | Cisco Digital Media System (VoDs)                 |
| Network Control          | CS6              |                   | BW Queue                   | EIGRP, OSPF, BGP, HSRP, IKE                       |
| Call-Signaling           | CS3              |                   | BW Queue                   | SCCP, SIP, H.323                                  |
| Ops / Admin / Mgmt (OAM) | CS2              |                   | BW Queue                   | SNMP, SSH, Syslog                                 |
| Transactional Data       | AF2              |                   | BW Queue + DSCP WRED       | Cisco WebEx / MeetingPlace / ERP Apps             |
| Bulk Data                | AF1              |                   | BW Queue + DSCP WRED       | E-mail, FTP, Backup Apps, Content Distribution    |
| Best Effort              | DF               |                   | Default Queue + RED        | Default Class                                     |
| Scavenger                | CS1              |                   | Min BW Queue (Deferential) | YouTube, iTunes, BitTorrent, Xbox Live            |

# Bandwidth Requirements

## Calculating Layer 2/3 Overhead

- Harder to calculate video because video is **bursty** in nature
- General rule of thumb is to add 20% for all layer 2/layer 3 overhead
- Call speed is typically the “**maximum**” transmission of the call; average is usually much less

### Video Data Rate and Bandwidth Required

|             |
|-------------|
| 128k = 153k |
| 384k = 460k |
| 512k = 614k |
| 768k = 921k |
| 1.5M = 1.8M |



# Traffic Profiles

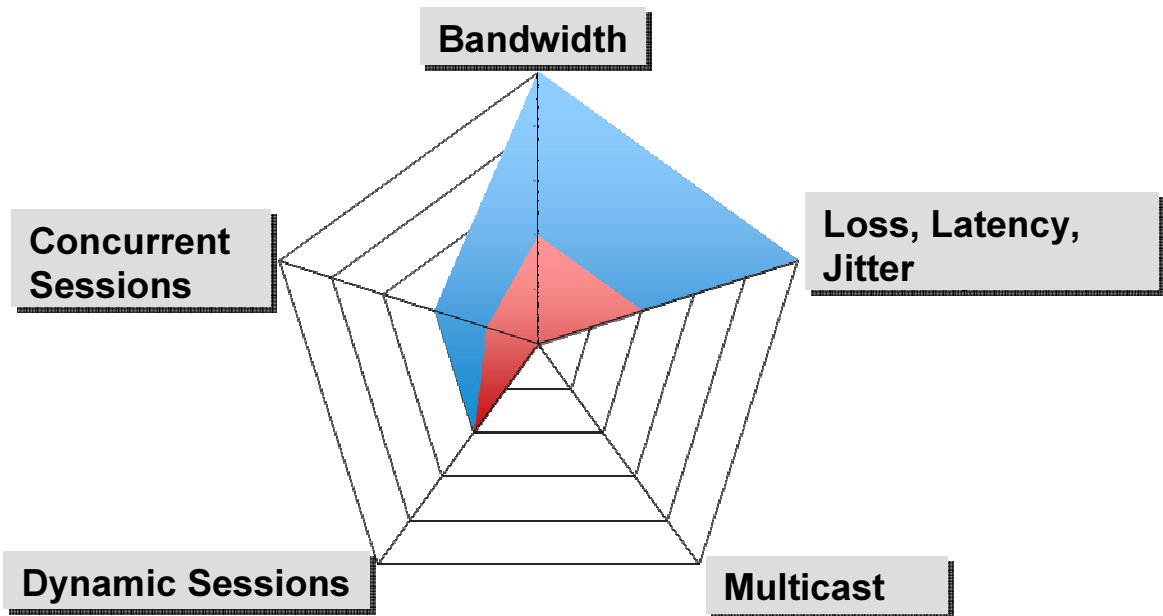


# Enterprise Video

## TelePresence & Video Conferencing



- High Availability
- Scale
- Bandwidth
- Visibility
- Management
- Security
- QOS



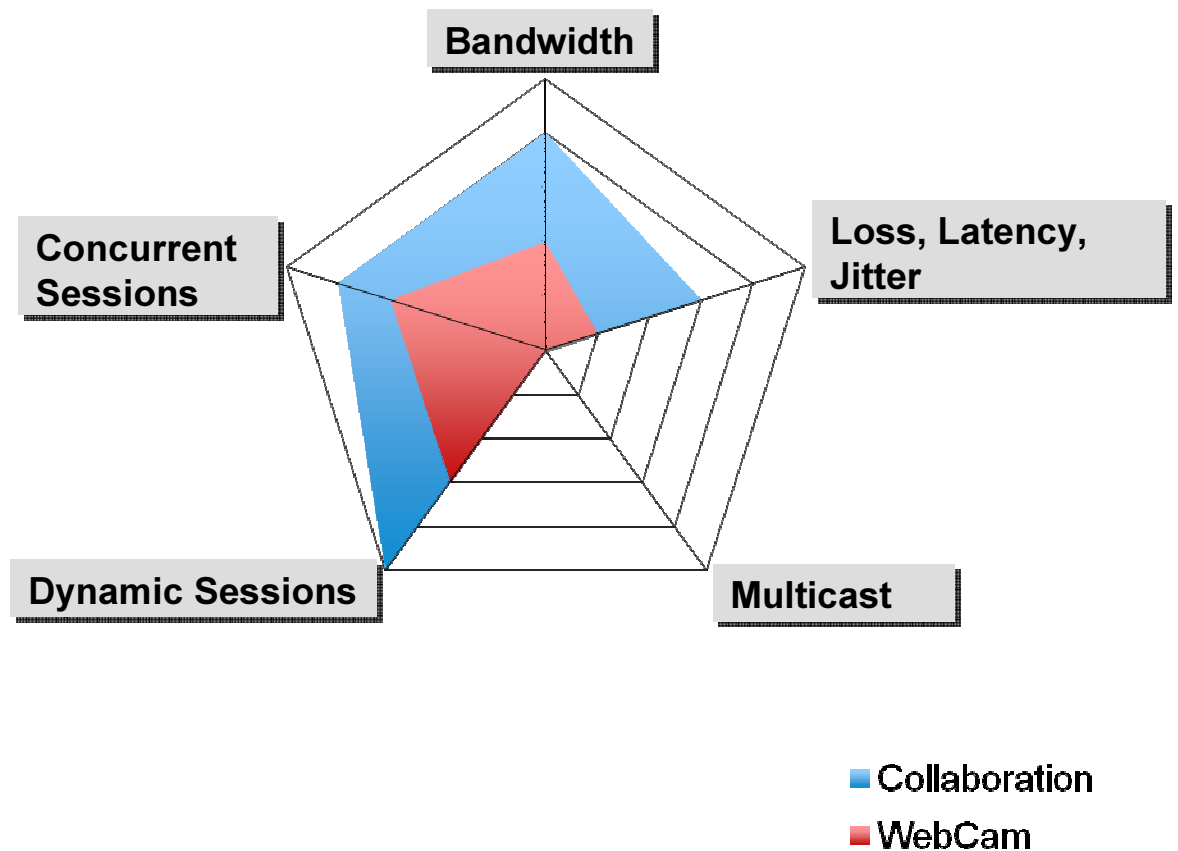
■ TelePresence  
■ Conferencing

# Enterprise Video

## Desktop Video Collaboration & WebCams



- High Availability
- Scale
- Bandwidth
- Visibility
- Management
- Security
- QOS

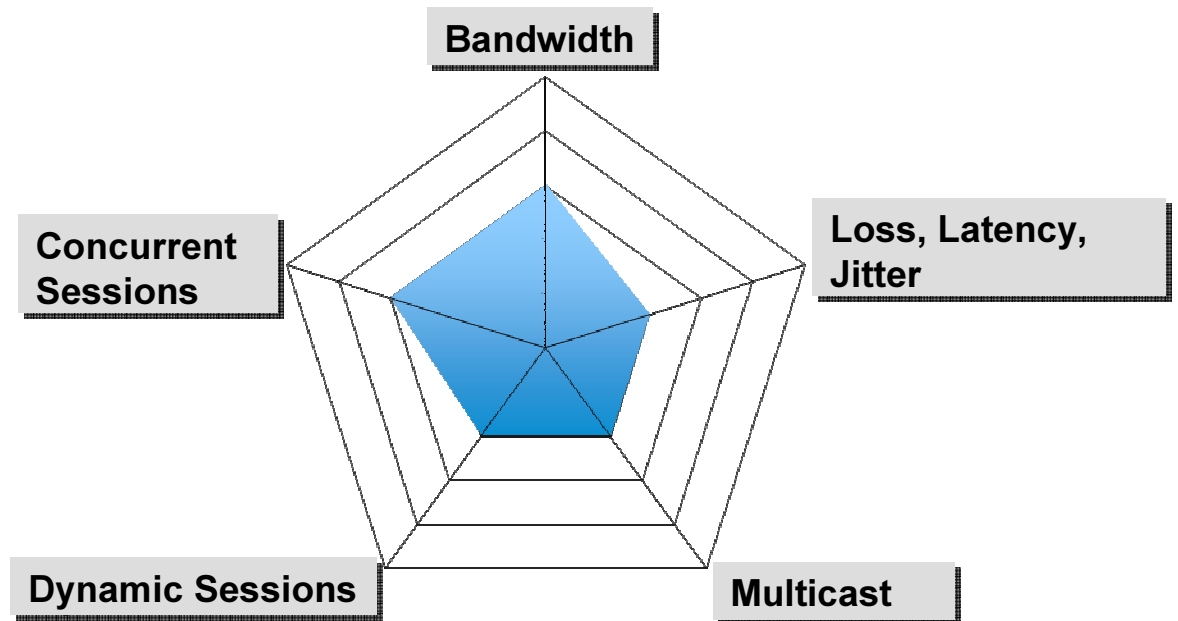


# Enterprise Video

## Video Surveillance



- IP Multicast
- High Availability
- Scale
- Bandwidth
- Visibility
- Management
- Security
- QOS



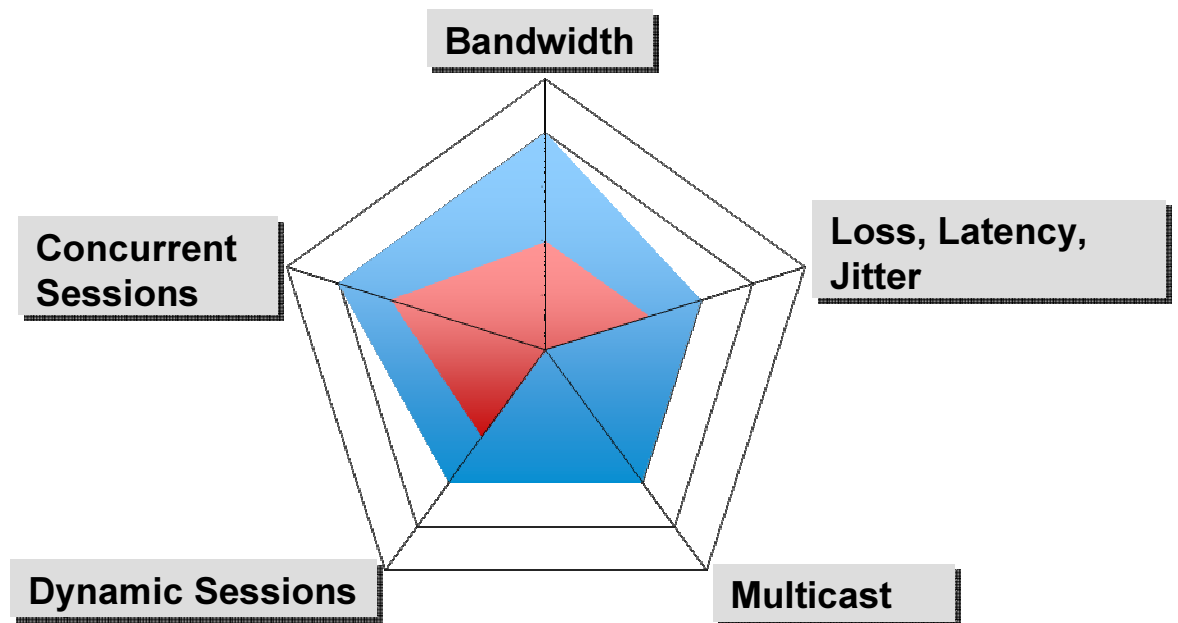
■ IP Video Surveillance  
■ CCTV

# Enterprise Video

## Digital Signage & Video on Demand



- IP Multicast
- High Availability
- Scale
- Bandwidth
- Visibility
- Management
- Security
- QOS

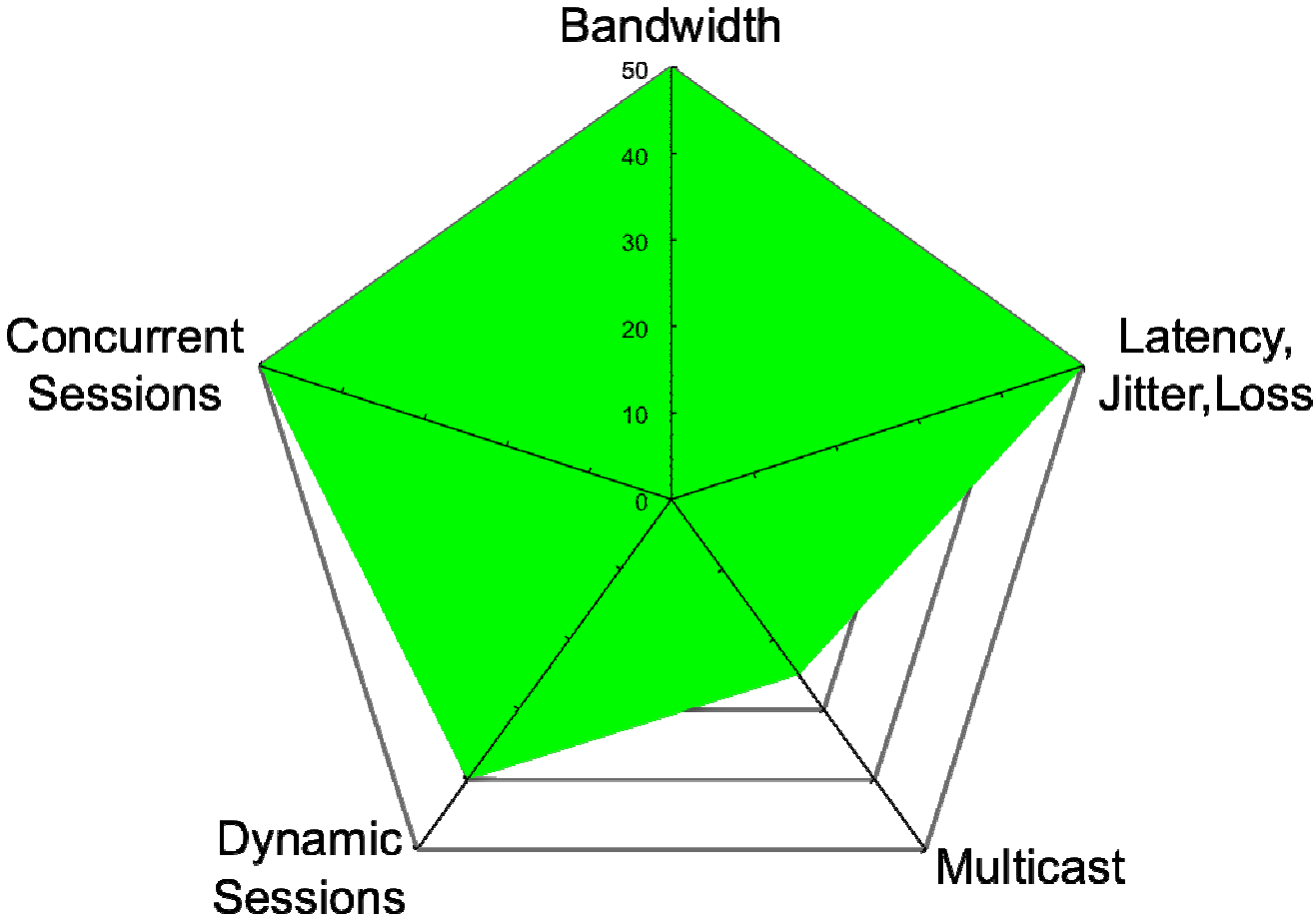


- Digital Signage
- Video on Demand

# Enterprise Video

Increasing Demands/ Control on the Network

All Video



■ All Video



# Video @ Cisco





# Cisco on Cisco Video Solutions



## TelePresence

- 284 Systems installed globally
- 164,585 meetings, \$278M saved



## Digital Media

- 1200+ Screens deployed ( exploding )
- 87,000 Videos streamed per Month
- 800 new studio produced, 350 UGC videos/mo



## WebEx

- 65,000+ meetings monthly
- 250,000 attendees per month



## Video Surveillance

- 4,255 cameras across 586 sites in 87+ countries
- Protecting over 18+ million square feet

Sales

Marketing

Services

Legal

Manufacturing

HR

R & D

IT

Finance

# Key Take Aways

- *AVVID - Architecture for Voice, Video, and Integrated Data*



**ca. 1997 ! == more than 10 years !**

- Already a Cisco network in place? → just enable **QoS**
- Cisco has already implemented the required features and functions since years
- Cisco continuously develops standards for networking / video networking
- Cisco has a strong experience in deploying large video networks



# Q & A

