



# **Preparing a Data Network for Rich-Media Communication (Voice, Video and Data Collaboration)**

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# Agenda

- **Introduction**
- **Quality of Service**
- **Call Admission Control**
- **Security**
- **Summary**

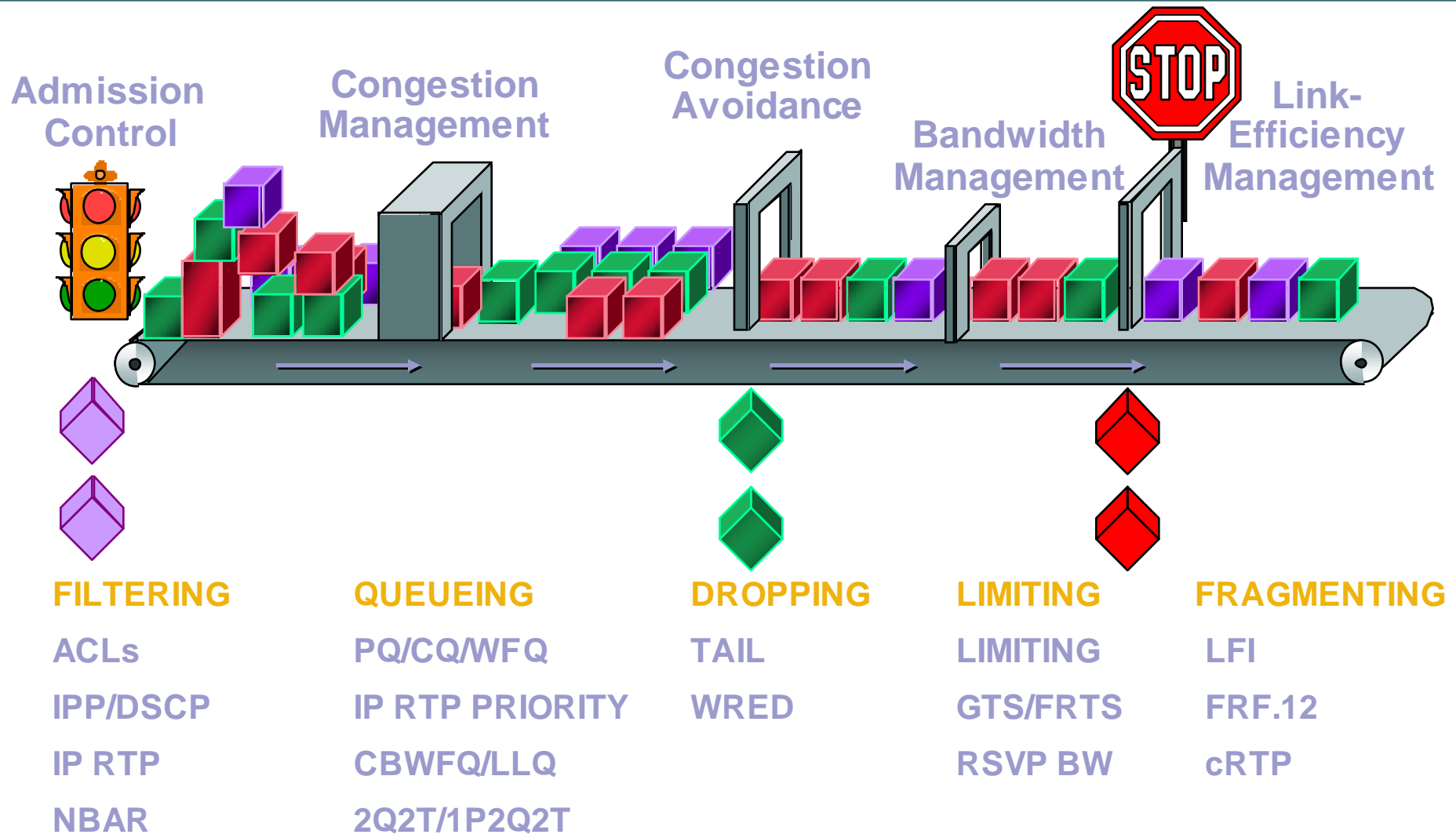
# Introduction

- **High-quality Rich Media on IP requires QoS**
  - Shared media hubs don't support QoS so LAN switches are required
  - Ethernet switches need multi-queue QoS to guarantee voice quality
- **Sufficient bandwidth and admission control is required**
  - Even with QoS if a WAN link is flooded with traffic of the same priority, it will all degrade
- **Users expect the telephones to work all the time**
  - The IP network must provide High Availability
  - Data network service practices may need to change
- **Voice endpoints are usually powered from the network**
  - Historically the PBX or CO with backup power source

# Three Steps for CoS/QoS Implementation

- ***Admission Control*** – Restricting over consumption of network resources by managing and policing calls, for a higher quality experience
- ***Provisioning*** – Accurately calculating the required bandwidth for all application and element overhead
- ***Classification*** – Marking the packet with a specific priority, denoting a requirement for special service from the network - Consider Network Based Application Recognition (NBAR) for data collaboration classification
- ***Scheduling*** – Assigning packets to one of multiple queues (based on classification) for expedited treatment through the network

# What Is QoS?



## FILTERING

- ACLs
- IPP/DSCP
- IP RTP
- NBAR
- RSVP

## QUEUEING

- PQ/CQ/WFQ
- IP RTP PRIORITY
- CBWFQ/LLQ
- 2Q2T/1P2Q2T

## DROPPING

- TAIL
- WRED

## LIMITING

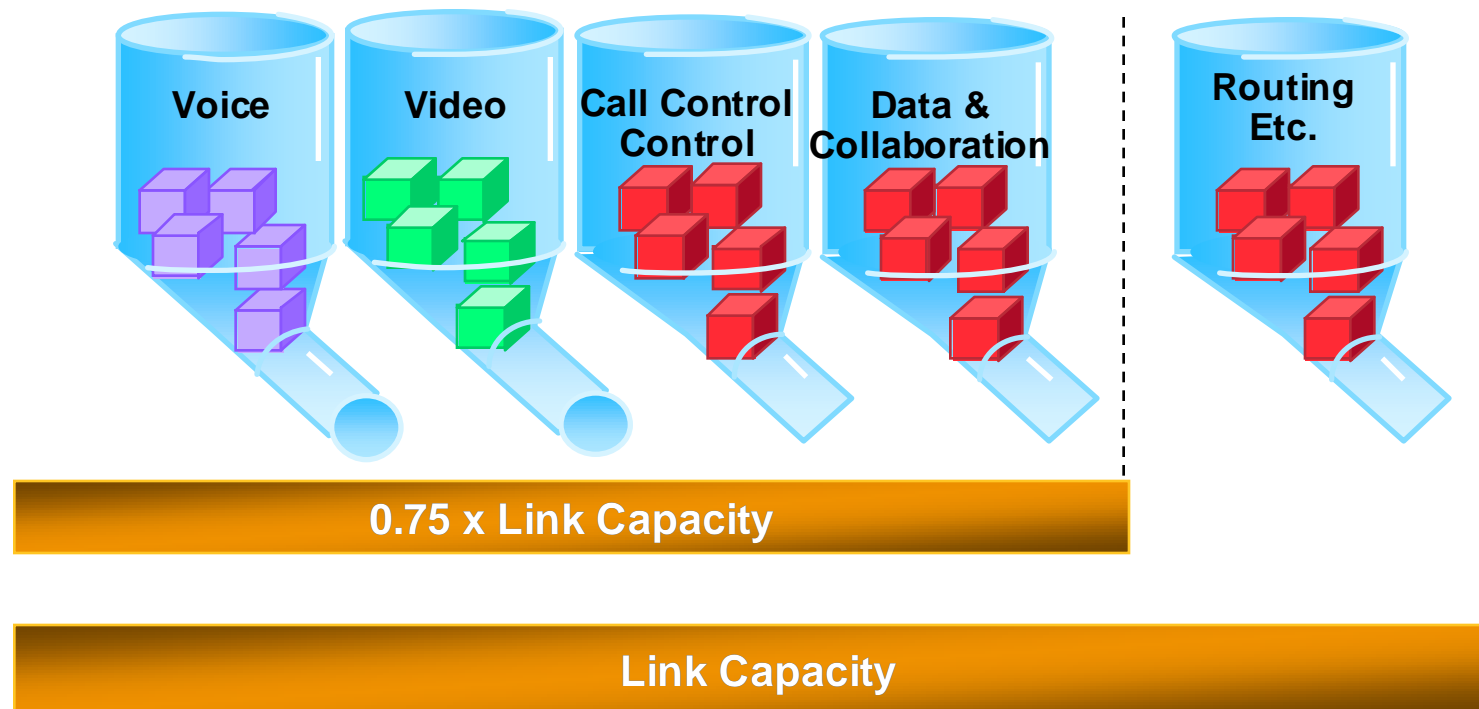
- LIMITING
- GTS/FRTS
- RSVP BW

## FRAGMENTING

- LFI
- FRF.12
- cRTP

# Sources of Trouble for VoIP Provisioning

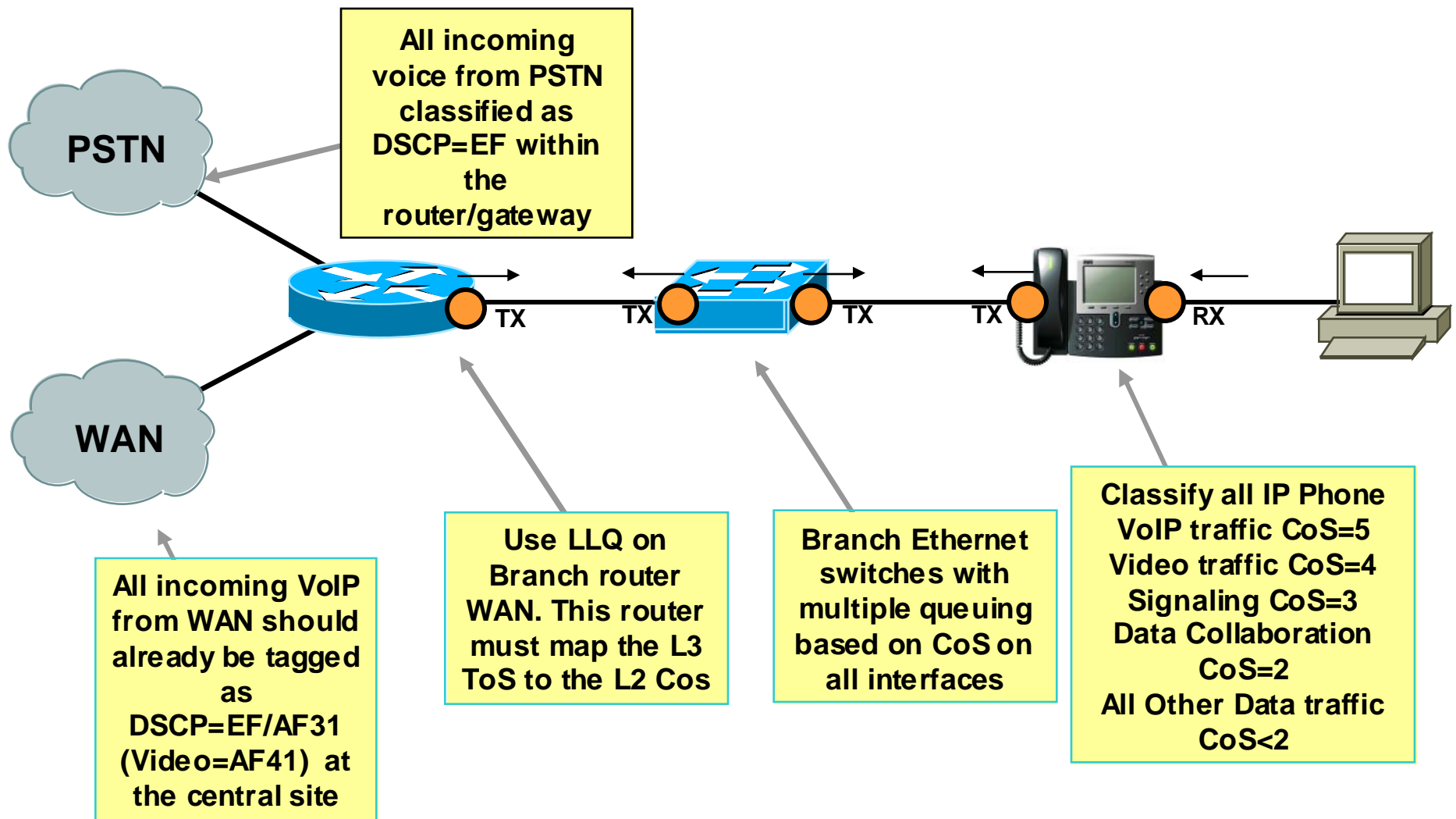
Especially important on low-speed links—  
Engineer the network for data, voice, and video



$$\text{Link Capacity} = (\text{Min BW for Voice} + \text{Min BW for Video} + \text{Min BW for Data}) / 0.75$$

# Branch QoS

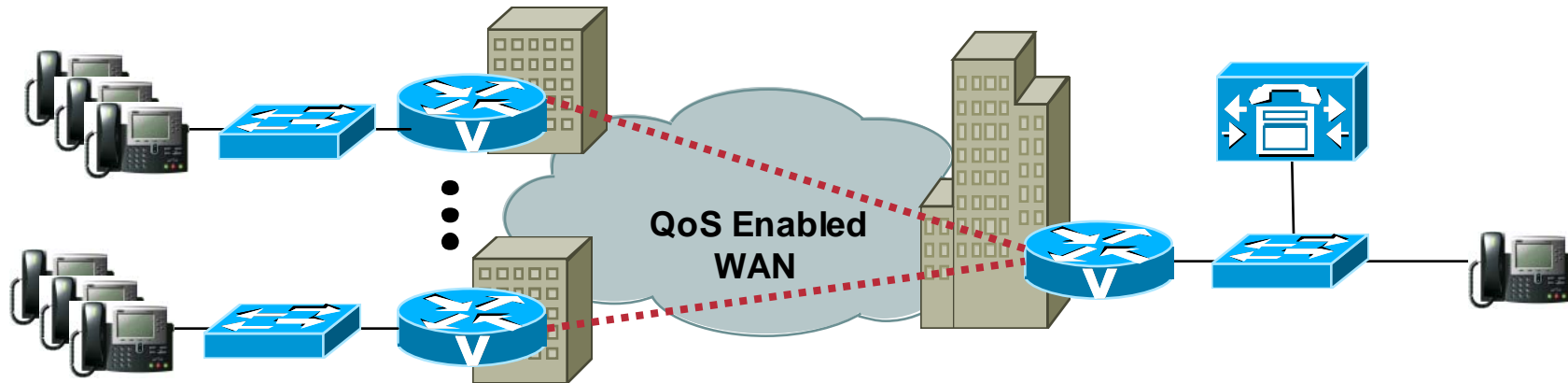
## Bearer Plane Traffic



# Enabling the WAN

## General Guidelines

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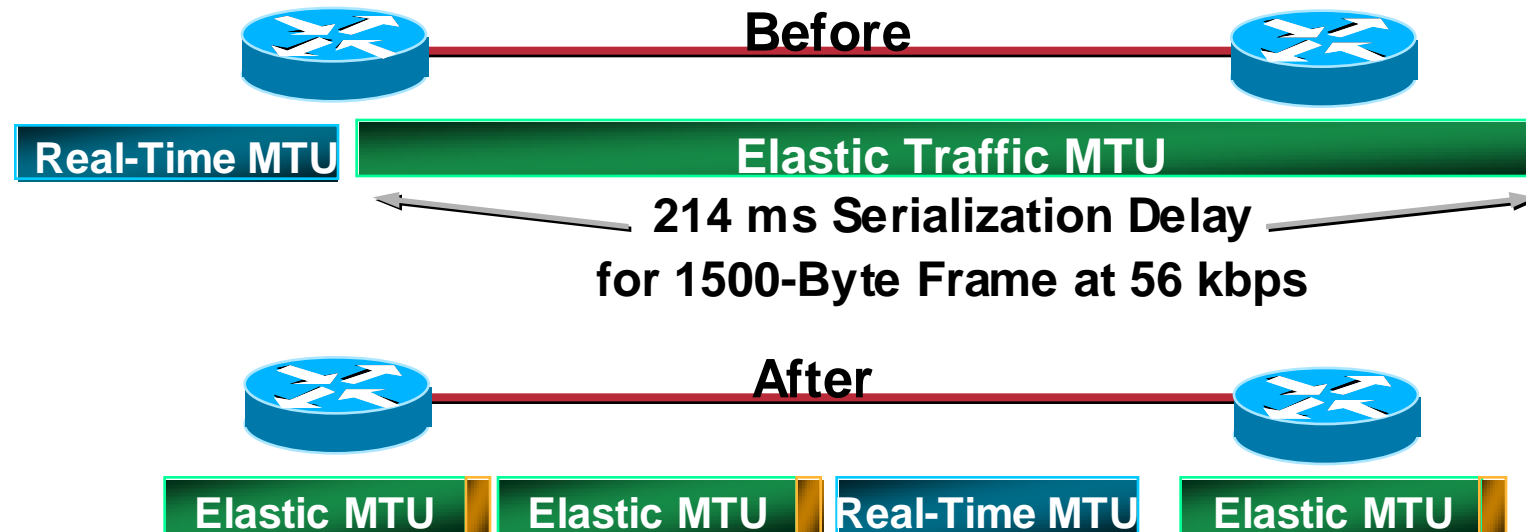


- **Use Differentiated Services or IP Precedence (IETF RFC 2474) on all WAN interfaces in a voice-over-data network**  
Voice (DSCP=EF), Video (DSCP=AF41), Call Control (DSCP=AF31), Data Collaboration (DSCP=AF21)
- **Use MLPPP LFI (RFC 1990) or FRF.12 on WAN connections below 768 kbps**
- **Properly provision the WAN bandwidth for the sum of all applications**  
Use Compressed RTP (IETF RFC 2508) when possible to reduce bandwidth requirements
- **Traffic shaping is required for all Frame Relay and ATM/FR networks**
- **Call Admission Control is required when the number of calls can overwhelm the provisioned LLQ (PQ) bandwidth**
- **NBAR can recognize and classify packets based on the application or on web page accessed**

# Slow Link-Efficiency Tools

Fragmentation and Interleave Not Needed on Links Greater Than 768 kbps

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## Mechanisms

Pt to Pt Links: MLPPP with Fragmentation and Interleave (IETF RFC 1990)

Frame Relay: FRF.12

ATM: MLPPP over ATM

ATM/Frame-Relay Interworking: MLPPP over ATM and Frame-Relay

Bandwidth/call for CRTP + G.729a

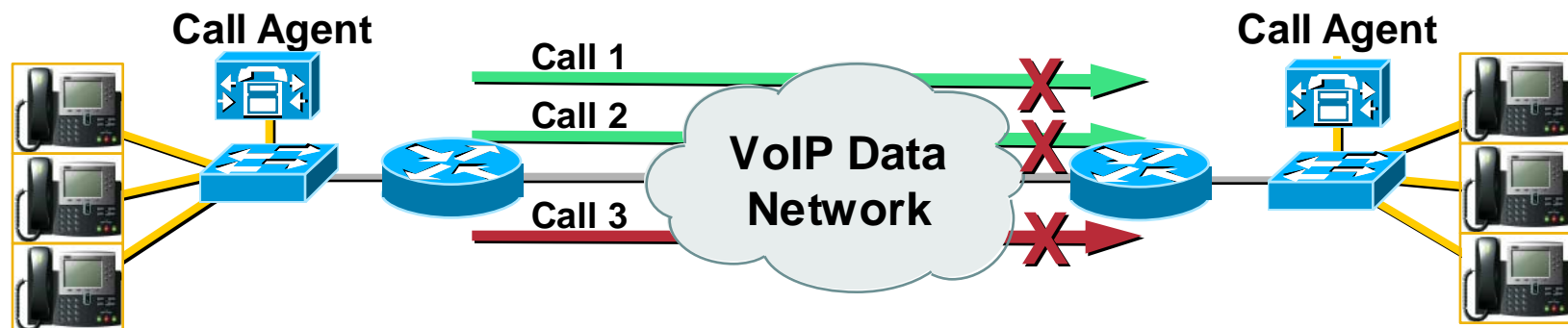
4Kbps Packet + 8Kbps media + 25% of link for overhead routing etc.

# Sources of Trouble for VoIP & Real Time Data

## Call Admission Control (CAC)

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**Example:**  
**WAN Bandwidth Can Only Support 2 Calls**  
**What Happens when 3rd Call Attempted?**



**Call 3 on Data Network**  
**Would Cause Poor Quality for ALL 3 Calls**

**Need To Prevent Third Call from Traversing IP WAN;**  
**Dial Overflow to PSTN Is Preferred**

# QOS and Bandwidth Summary

- **Classify at the network edge**  
Voice/video/data collaboration endpoint is now the edge of the managed network
- **QoS begins in the campus to support voice quality**
- **Properly provision the WAN bandwidth**
- **Advanced QoS tools are required for all VoIP WAN designs**
- **End-to-end QoS, CAC and correct provisioning is required for voice/video quality, real time response in collaboration, fax, modem, and TDD functions over an IP network**

# Network Security

- **Authentication of devices and users before encryption of media**

Without authentication systems are vulnerable to “man in the middle” attacks which easily defeat the encryption
- **Authentication is required for high system availability to prevent denial-of-service attacks**

Prevents unauthenticated users/devices from gaining access to the network to mount a denial-of-service attack
- **The entire network needs to be involved in an effective network security system**
- **Consider Data Collaboration servers inside vs. outside your firewalls (On Net Collaboration servers)**

# Summary

- **Use QoS in LAN, MAN, and WAN**

No shared media LANs—Switched LANs only

End-to-end QoS/CAC required for voice/video/modem/fax/TDD over IP

- **Bandwidth requirements**

Calculated total requirements, use Call Admission Control and cRTP

- **Network-based authentication and security**

**Collaboration Servers inside firewalls**

# Glossary

- **2Q2T/1P2Q2T= 2 standard queues with 2 tail-drop thresholds per queue/one strict priority queue, 2 standard queues with 2 WRED-drop thresholds per queue**
- **ACL= access control list**
- **AF31/41= assured forwarding**
- **ATM = Asynchronous Transmission Mode**
- **CBWFQ/LLQ= class-based weighted fair queuing/low latency queuing**
- **CoS = Class of Service**
- **cRTP= compressed real-time transport protocol**
- **DSCP= differentiated services code point**
- **EF= expedited forwarding**
- **FR= Frame Relay**
- **FRF.12= frame relay forum**
- **GTS/FRTS= generic traffic shaping/frame relay traffic shaping**
- **IETF= Internet Engineering Task Force**
- **IPP/DSCP= internet protocol precedence/ differentiated services code point**
- **LFI= link fragmentation- interleaving**
- **MLPPP LFI= multilink point to point protocol/ link fragmentation- interleaving**
- **MTBF= meantime between failure**
- **MTU= maximum transmission unit**
- **NBAR= network based application recognition**
- **PQ/CQ/WFQ= priority queuing/class-based weighted fair queuing**
- **QoS= Quality of Service**
- **RFC= Request For Comments**
- **RSVP BW= resource reservation protocol bandwidth**
- **RTP= real-time transport protocol**
- **RX= receive**
- **TAIL= when a queue fills up, all packets at the tail end get dropped**
- **TDD= Telephony Device for the Deaf**
- **ToS= Type of Service**
- **TX= transmit**
- **WRED= weighted random early detection**



# **Preparing a Data Network for Rich-Media Communication (Voice, Video and Data Collaboration) Thank you for you time.**

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