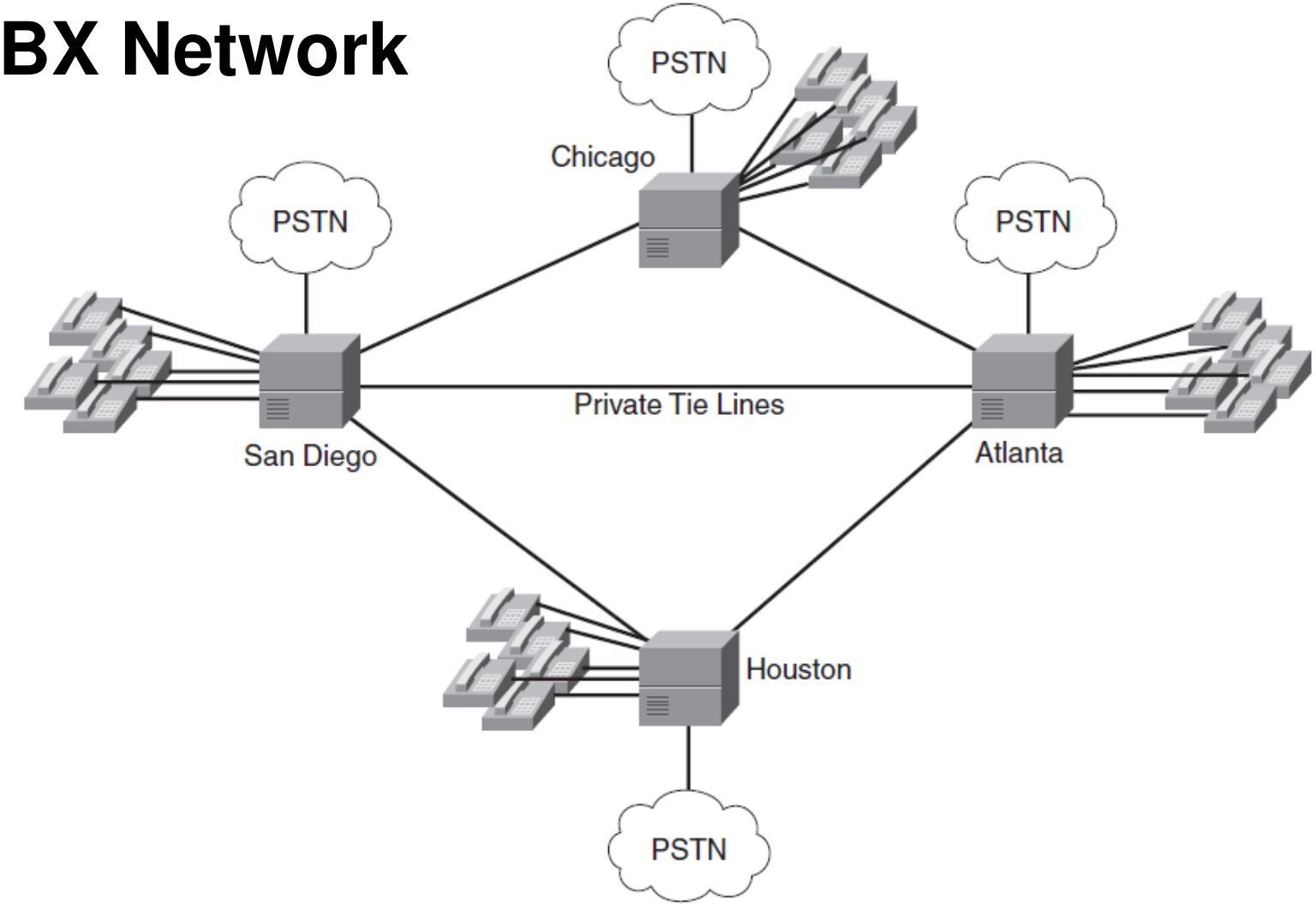
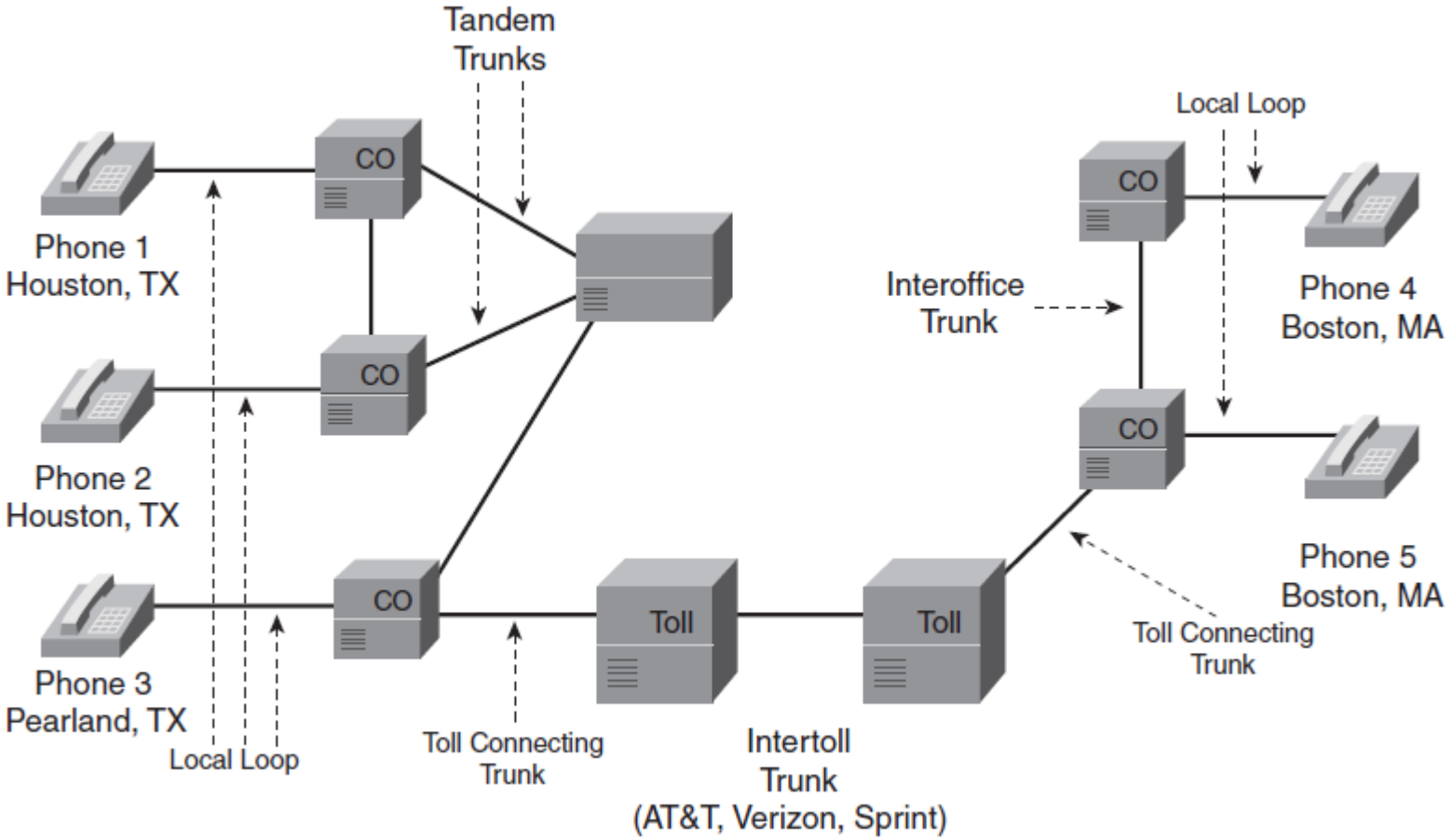
Chapter 15

PBX Network



Chapter 15

Trunks



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Chapter 15

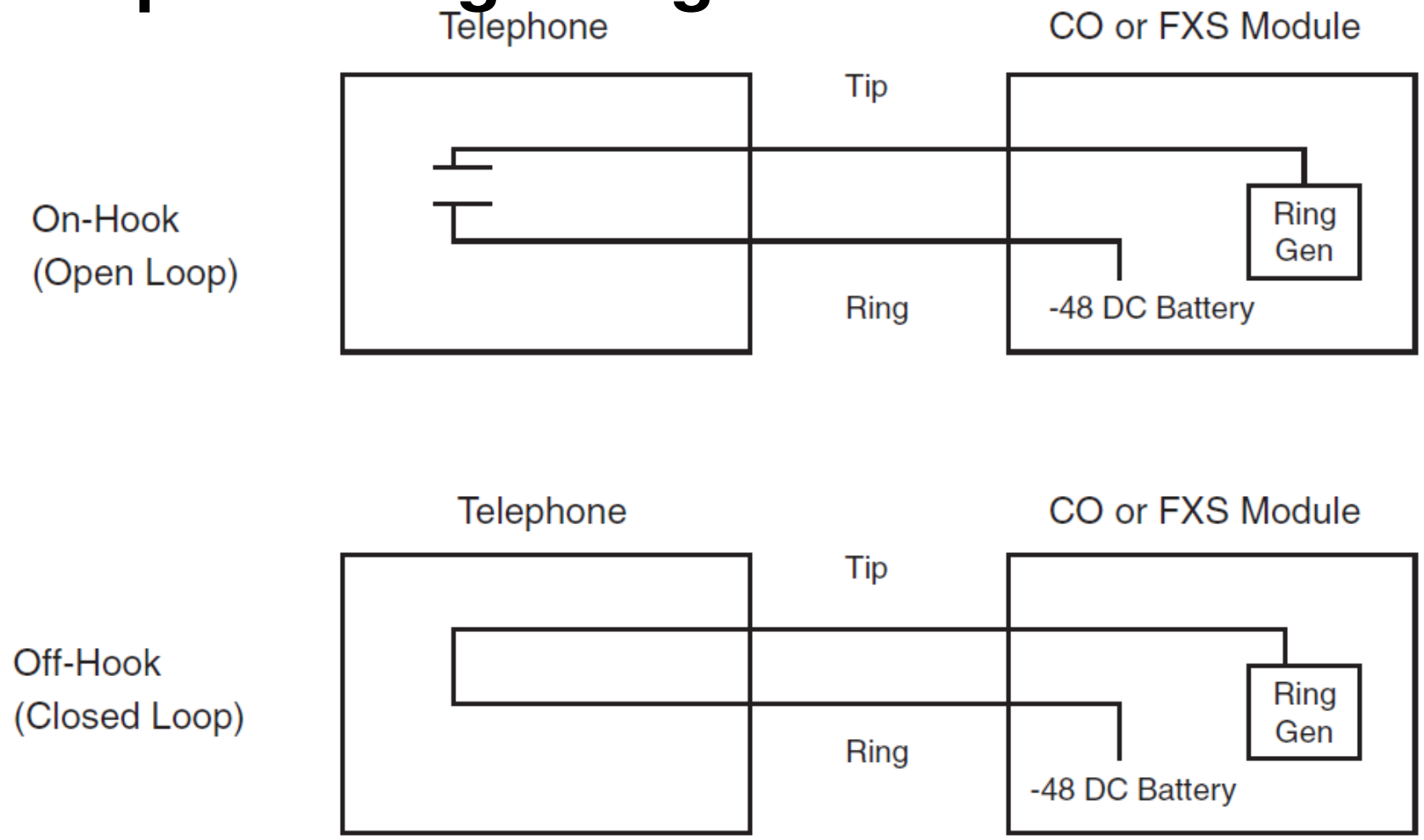
PSTN

- **Ports**
  - **Foreign Exchange Station (FXS)**
  - **Foreign Exchange Office (FXO)**
  - **Ear and Mouth (E&M)**
  - **Channelized T1 (or E1)**
  - **ISDN Primary Rate Interface (PRI)**

- **Signaling Types**
  - **Supervisory** provides call control and phone state (on-hook and off-hook)
  - **Addressing** provides dialed digits
  - **Informational** provides information such as dial and busy tones

Chapter 15

Loop-Start Signaling



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Chapter 15

E&M Signaling

- **Analog**
- **PBX-to-PBX**

- **Immediate start – Venter 200ms og sender digits**
- **Wink start – Venter på off-hook og sender så digits**
- **Delay dial – Venter 200ms, if off-hook send digits else wait**

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CAS and CCS Signaling

- **CAS bruger in-band signaling**
  - **T1 or E1**
  - **DTMF**

- **CCS bruger out-of-band signaling**
  - **ISDN PRI or BRI**

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Addressing Digit Signaling

- **Pulse or rotary dialing**
- **Dual-tone multifrequency (DTMF) dialing**

Frequency	1209 Hz	1336 Hz	1477 Hz
697 Hz	1	ABC 2	DEF 3
770 Hz	GHI 4	JKL 5	MNO 6
852 Hz	PRS 7	TUV 8	WXY 9
941 Hz	*	OPER 0	#

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Chapter 15

Other PSTN Services

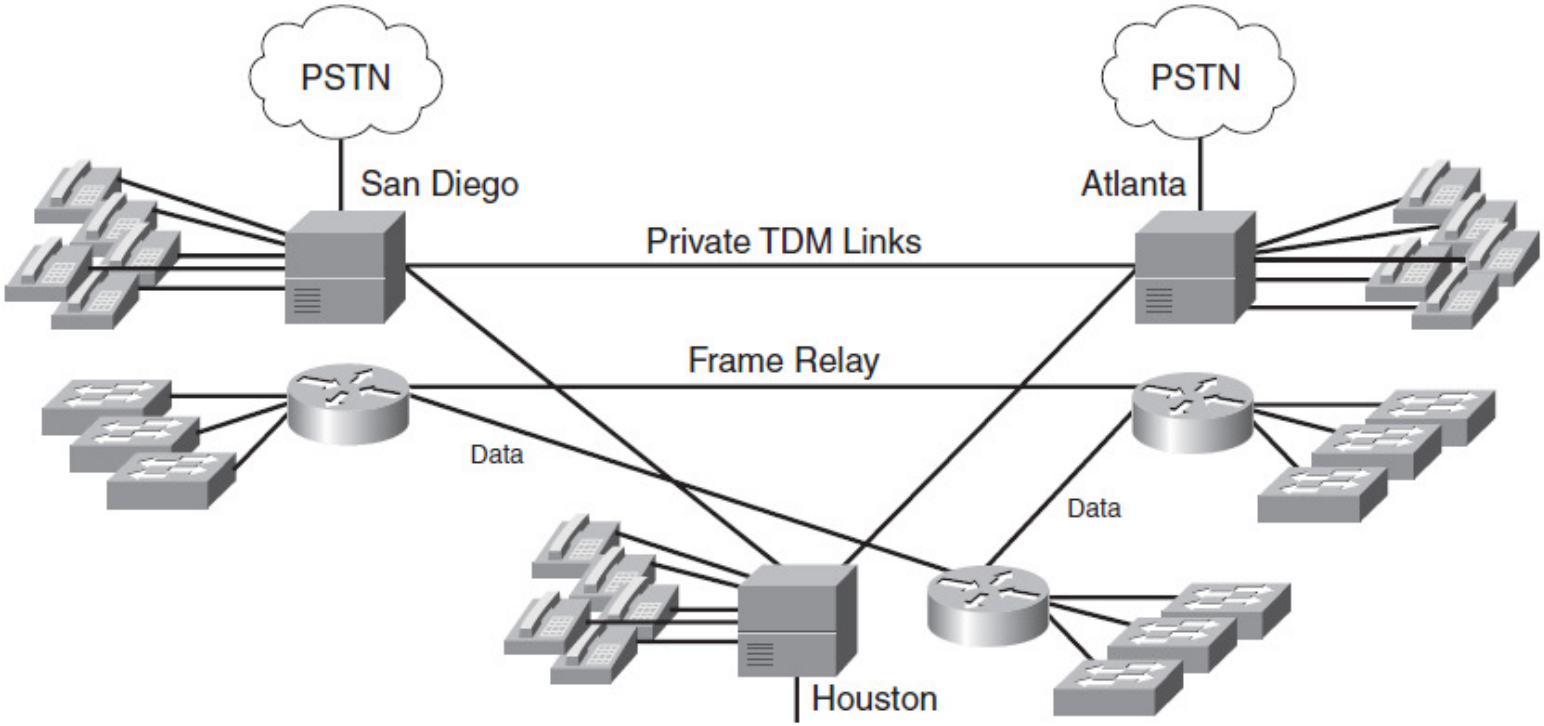
- Centrex
- Voice mail
- Database services
- Interactive voice response (IVR)
- Automatic call distribution (ACD)

- Erlang

Chapter 15

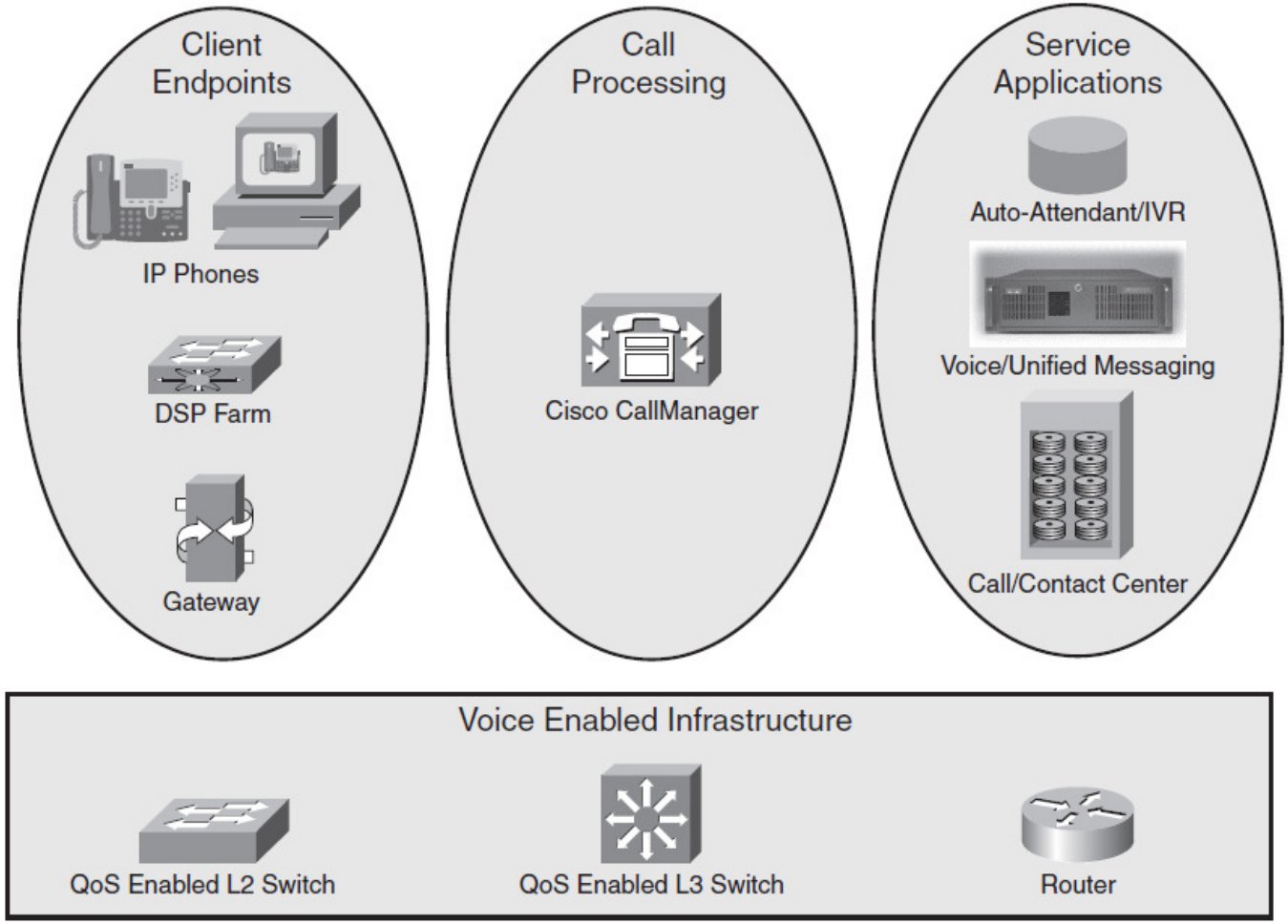
Integrated Multiservice Networks

- **Voice over Frame Relay (VoFR)**
- **Voice over Asynchronous Transfer Mode (VoATM)**
- **Voice over Internet Protocol (VoIP)**



Chapter 15

IPT Components



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IPT Deployment Models

- Single-Site Deployment
- Multisite centralized WAN call processing
- Multisite distributed WAN call processing
- CallManager Express deployment

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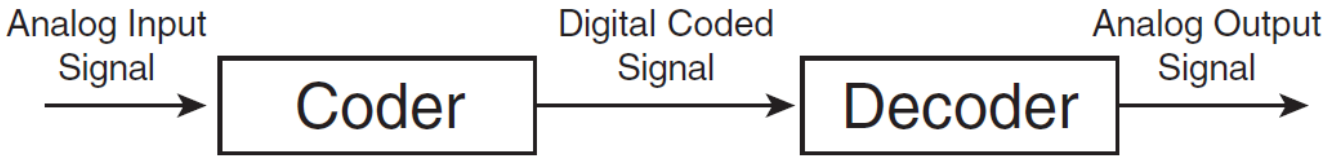
IPT Codex

Codec	Bit Rate	MOS
G.711u	64 kbps	4.1
G.711a	64 kbps	4.1
G.723.1	6.3 kbps	3.9
G.723.1	5.3 kbps	3.65
G.726	16/24/32/40 kbps	3.85
G.728	16 kbps	3.61
G.729	8 kbps	3.92



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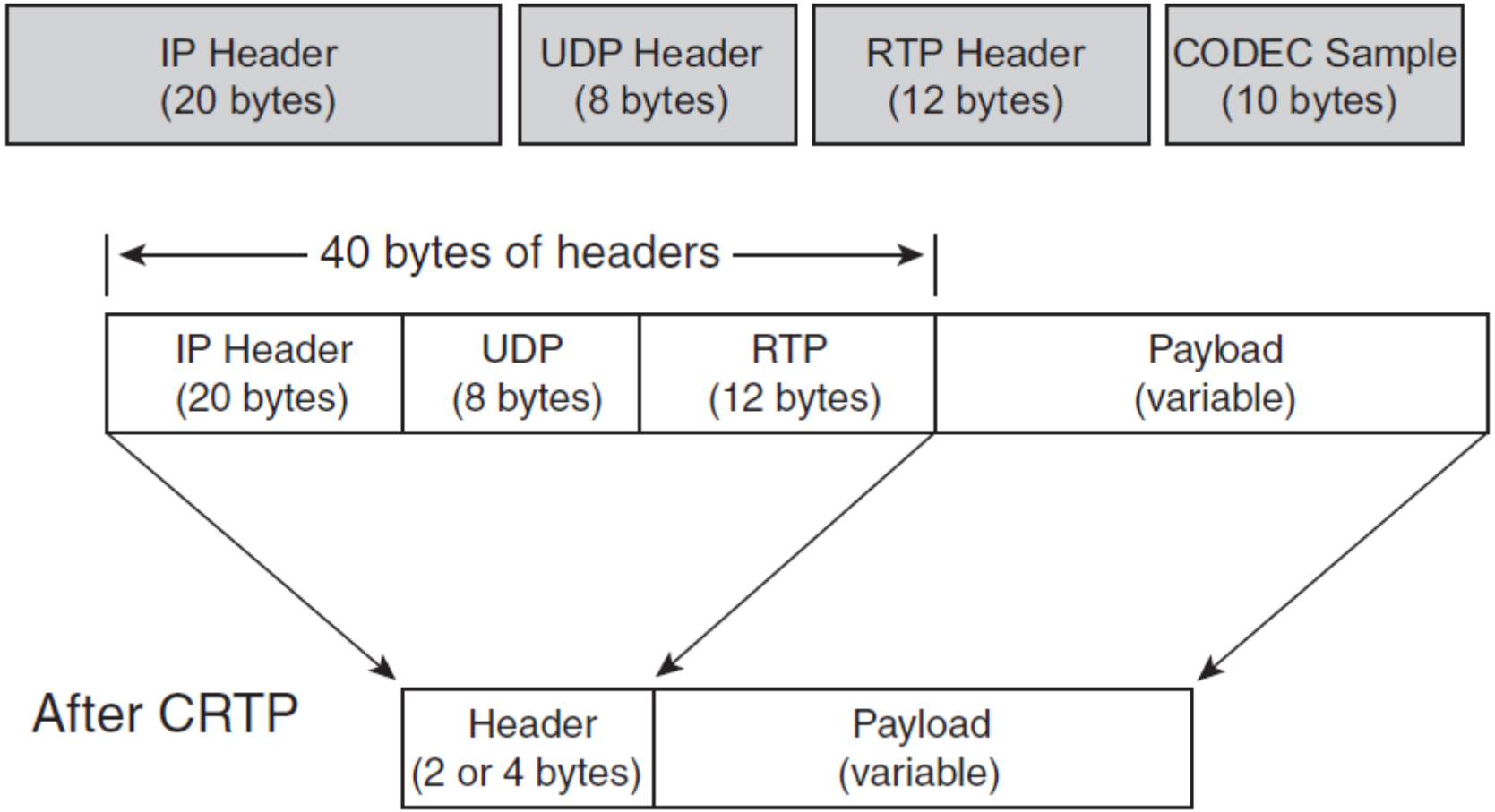
VoIP Control and Transport Protocols

- Dynamic Host Configuration Protocol (DHCP)
- Domain Name System (DNS)
- TFTP
- Skinny Station Control Protocol (SSCP)
- Session Initiation Protocol (SIP)
- Real-time Transport Protocol (RTP)
- Real-time Transport Control Protocol (RTCP)
- Media Gateway Control Protocol (MGCP)
- H.323

Chapter 15

Compressed RTP (CRTP)



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H.323 Protocols

	Video	Audio	Data	Transport
H.323 protocol	H.261	G.711	T.122	RTP
	H.263	G.722	T.124	H.225
		G.723.1	T.125	H.235
		G.728	T.126	H.245
		G.729	T.127	H.450.1
				H.450.2
				H.450.3
				X.224.0

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Chapter 15

IPT Design

- Bandwidth
- Voice Activity Detection (VAD)
- Delay
  - Propagation delay
  - Processing delay
  - Serialization delay
  - Dejitter delay
- QoS
  - CRTP
  - LFI - Link Fragmentation and Interleaving
  - PQ-WFQ
  - LLQ
  - Auto QoS

Chapter 15

Auto QoS

- **WAN**
  - **Automatically classifies RTP and VoIP control packets**
  - **Builds VoIP Modular QoS in the Cisco IOS Software**
  - **Provides LLQ for VoIP bearer traffic**
  - **Provides minimum-bandwidth guarantees by using CBWFQ for VoIP control traffic**
  - **Enables WAN traffic shaping where required**
  - **Enables LFI and RTP where required**
- **LAN**
  - **Enforces a trust boundary at the Cisco IP Phone**
  - **Enforces a trust boundary on the Catalyst switch access and uplink and downlink ports**
  - **Enables strict priority queuing and weighted round robin for voice and data traffic**
  - **Modifies queue admission criteria by performing CoS-to-queue mapping**
  - **Modifies queue sizes, as well as queue weights where required**
  - **Modifies CoS-to-DSCP and IP Precedence-to-DSCP mappings**

Chapter 15

IPT Design Recommendations

- Use separate VLANs/IP subnets for IP phones.
- Use private IP addresses for IP phones.
- Place CallManager and Unity servers on filtered VLAN/IP subnets in the server access in the data center.
- Use IP precedence or DSCP for classification and marking.
- Use LLQ on WAN links.
- Use LFI on slower-speed WAN links.
- Use CAC to avoid oversubscription of priority queues.

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