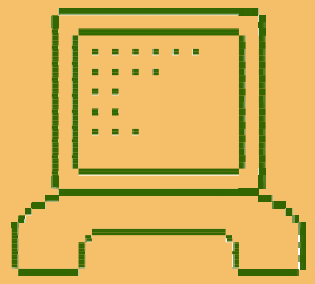


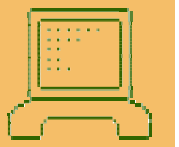
A Buyer's Guide to IP Telephone System Standards

Michael Bayer

Computer Telephony Solutions

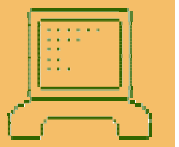
www.CTExpert.com

Introductions



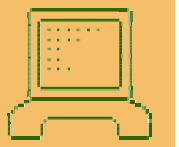
- Michael Bayer
  - President, Computer Telephony Solutions
    - Company dedicated to CTI Plug and Play
  - Author, "CTI Solutions and Systems”
  - Member CTExpos Advisory Board
  - mbayer@CTExpert.com
  - www.CTExpert.com

Objectives



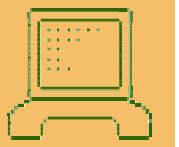
- Provide context for IP Telephony track
- Present a coherent framework for IP Telephony
- Explain key concepts
- Identify the important specifications and standards
- Point to sources of more information

What this session is NOT about

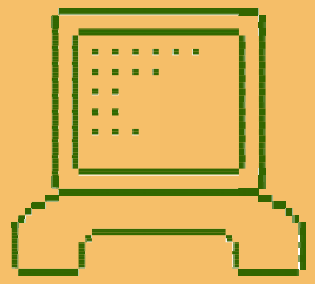


- Detailed discussion of protocols and APIs
- Product reviews and recommendations
- Unified messaging or other specific product categories in depth
- Material to be covered in other IP Telephony Track sessions

Agenda



- 1. Evolution of Telephone Systems
- 2. Computer Telephony Frameworks
- 3. Switching Fabrics
- 4. Call Control Interfaces
- 5. Media Services Interfaces
- 6. Other Interfaces
- 7. Putting It All Together
- General Q&A

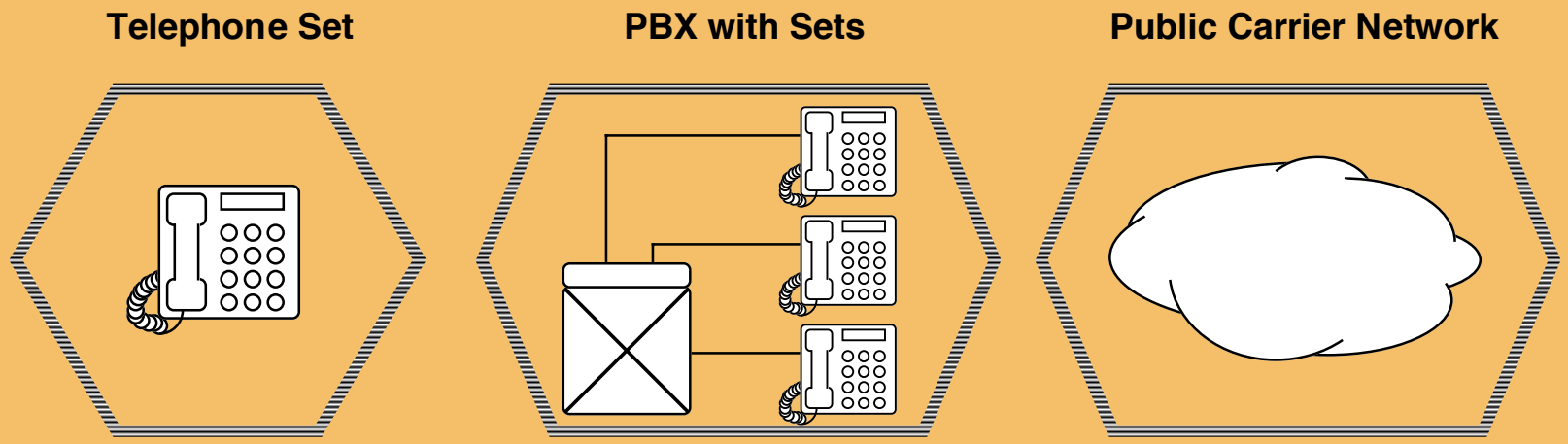


Part 1:

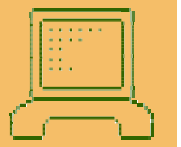
Evolution of Telephone Systems

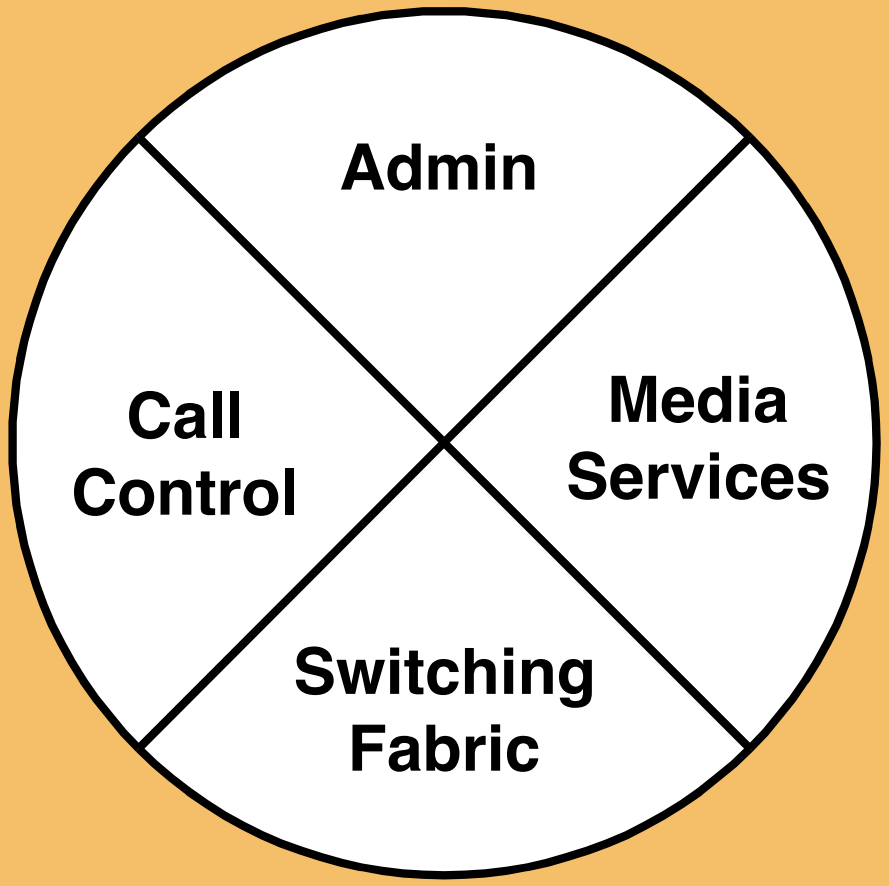
Telephone Systems

- Component or subset of a telephone network
- Typically the part of a telephone network over which the observer has control
- Size and Scope are essential factors in identifying applicable standards



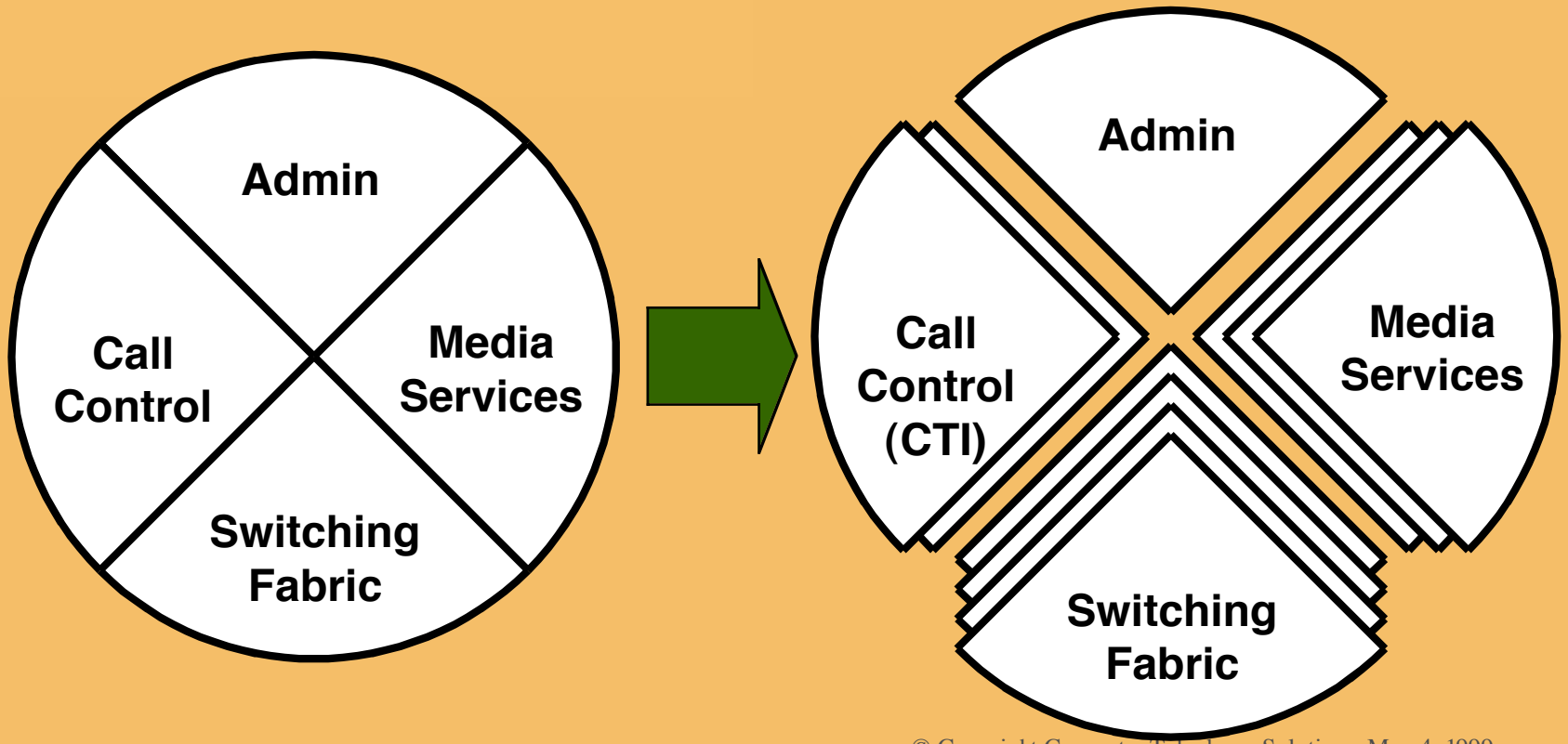
Telephone System Technologies



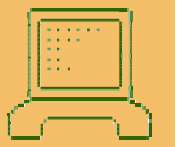


Computer Telephony Revolution

- Using off-the-shelf computer technologies to implement telephone system components
- Shift from Monolithic to Modular systems

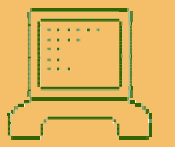


Switching Fabric



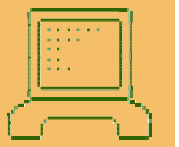
- Establishes media stream channels between endpoints and conveys signaling information
- Traditional Switching Fabric
  - TDM bus backplanes connecting line cards
  - Analog (POTS) and digital (T-1, ISDN, proprietary) telephony circuits
- IP Telephony Switching Fabric
  - Packetized voice over conventional IP networking infrastructure
  - Typically based on off-the-shelf computer technology

CT Media Access/Services



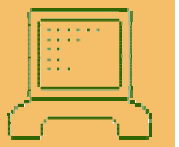
- Tone Detection and Generation
- Recording and Playback
- Text-to-Speech
- Speech Recognition
- Modulated Data (Modem/Fax)
- Digital Data (Compressed Video, etc.)
- Call Binding

CTI



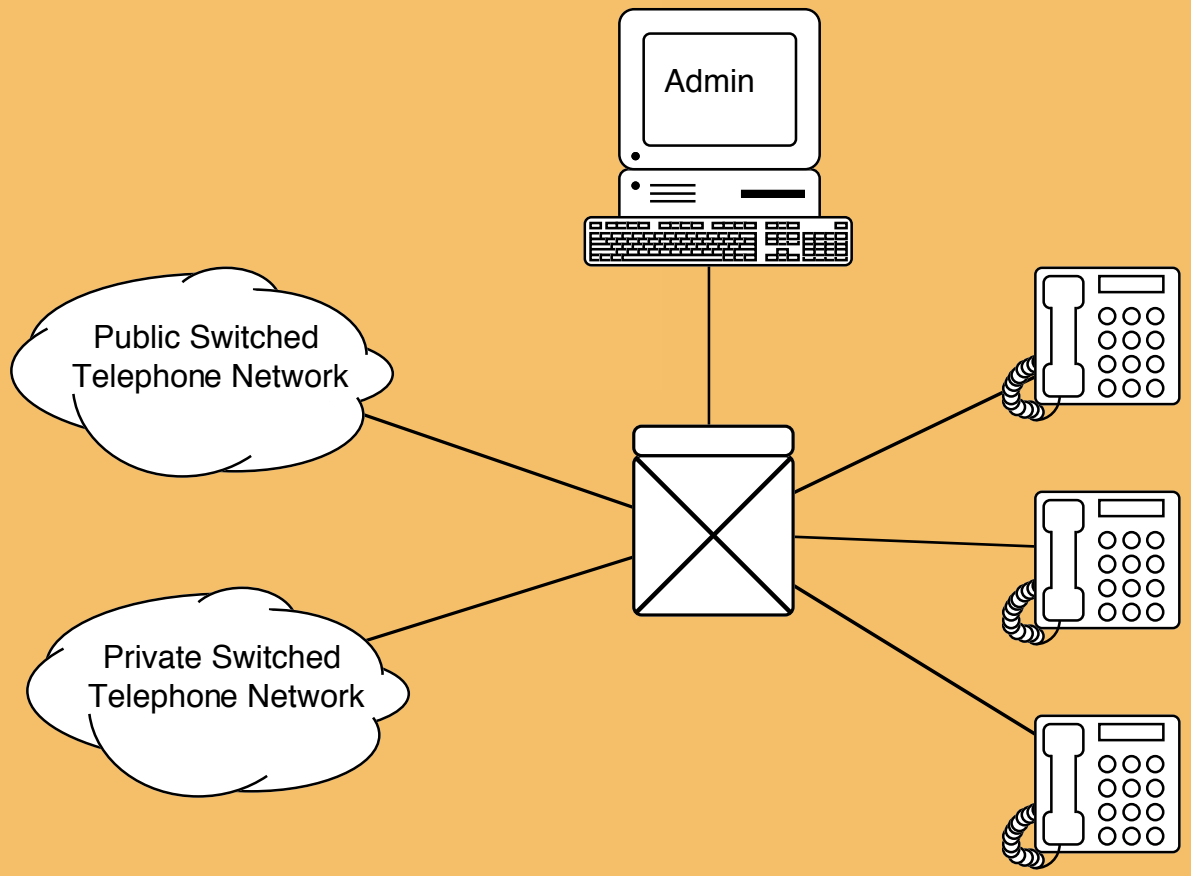
- Call Control
  - Monitoring and directing calls in a telephone system
- Telephone Control
  - Monitoring and controlling features of a telephone set
- Media Binding
  - Relating other communications/telephony functionality to calls in a telephone system

Admin

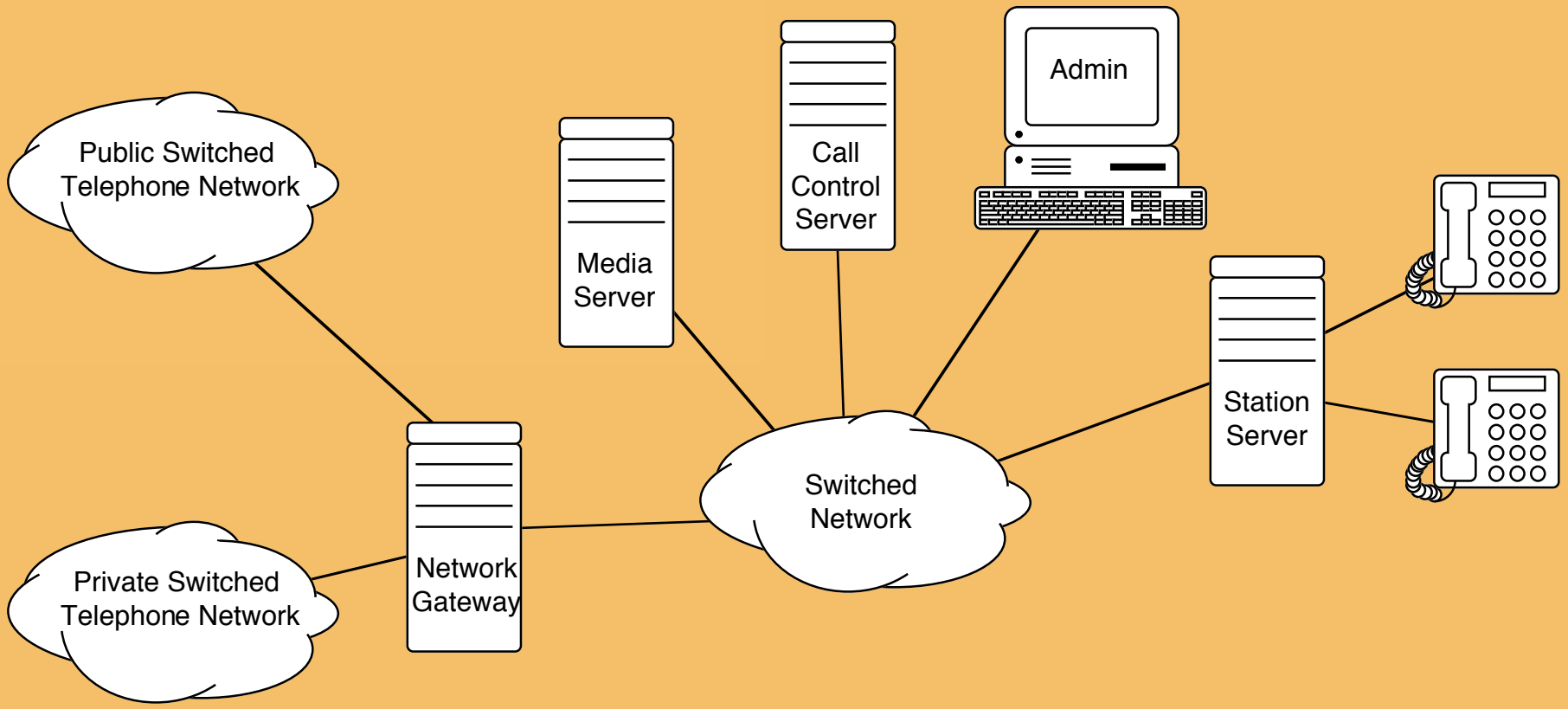


- System configuration
  - System customization
  - Moves / Adds / Changes
- Fault monitoring
- Accounting
- Performance management
- Security

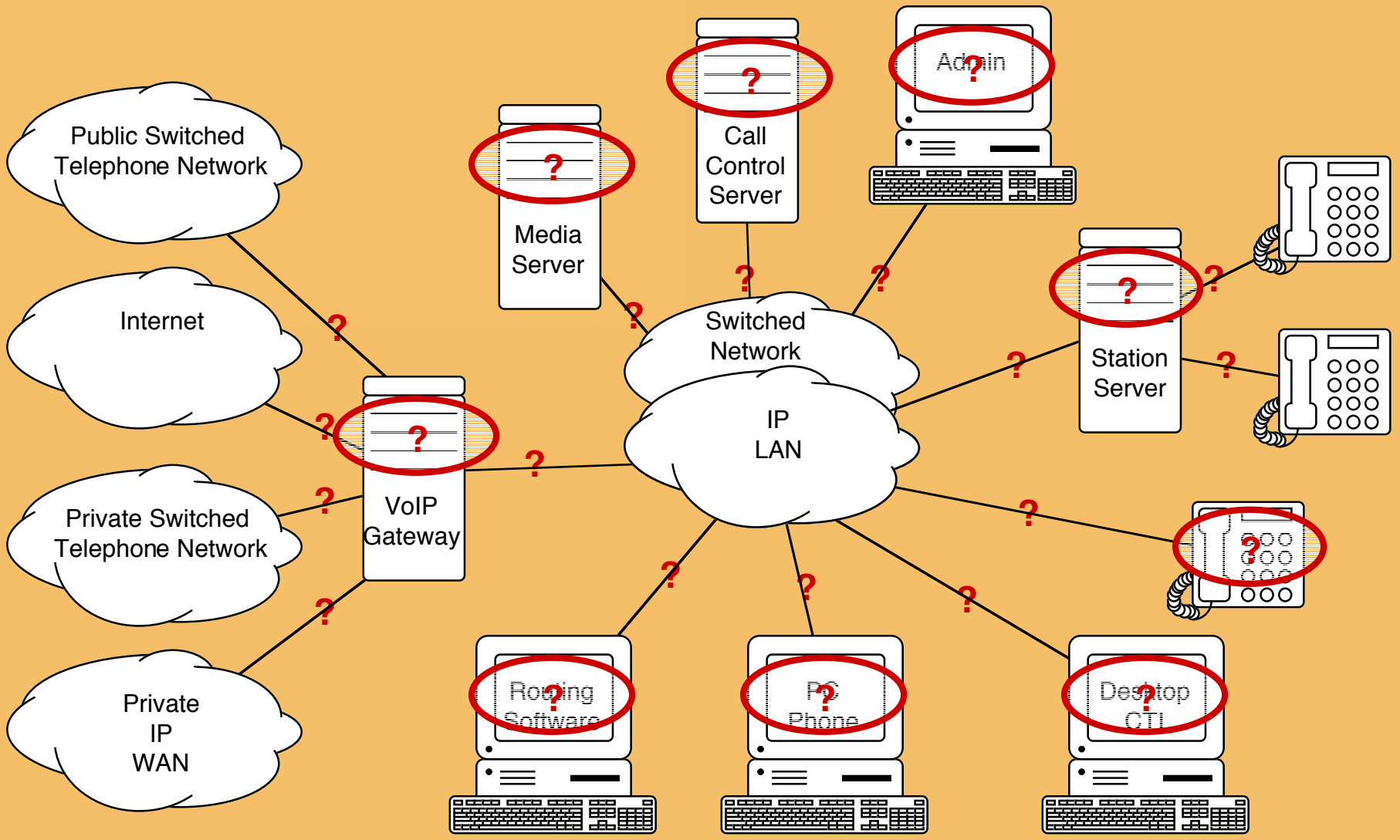
Telephone System Implementation

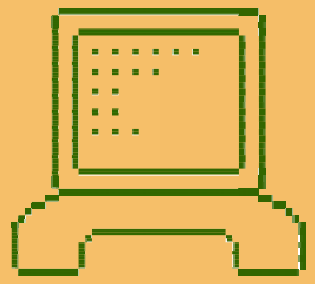


Telephone System Implementation



Telephone System Implementation



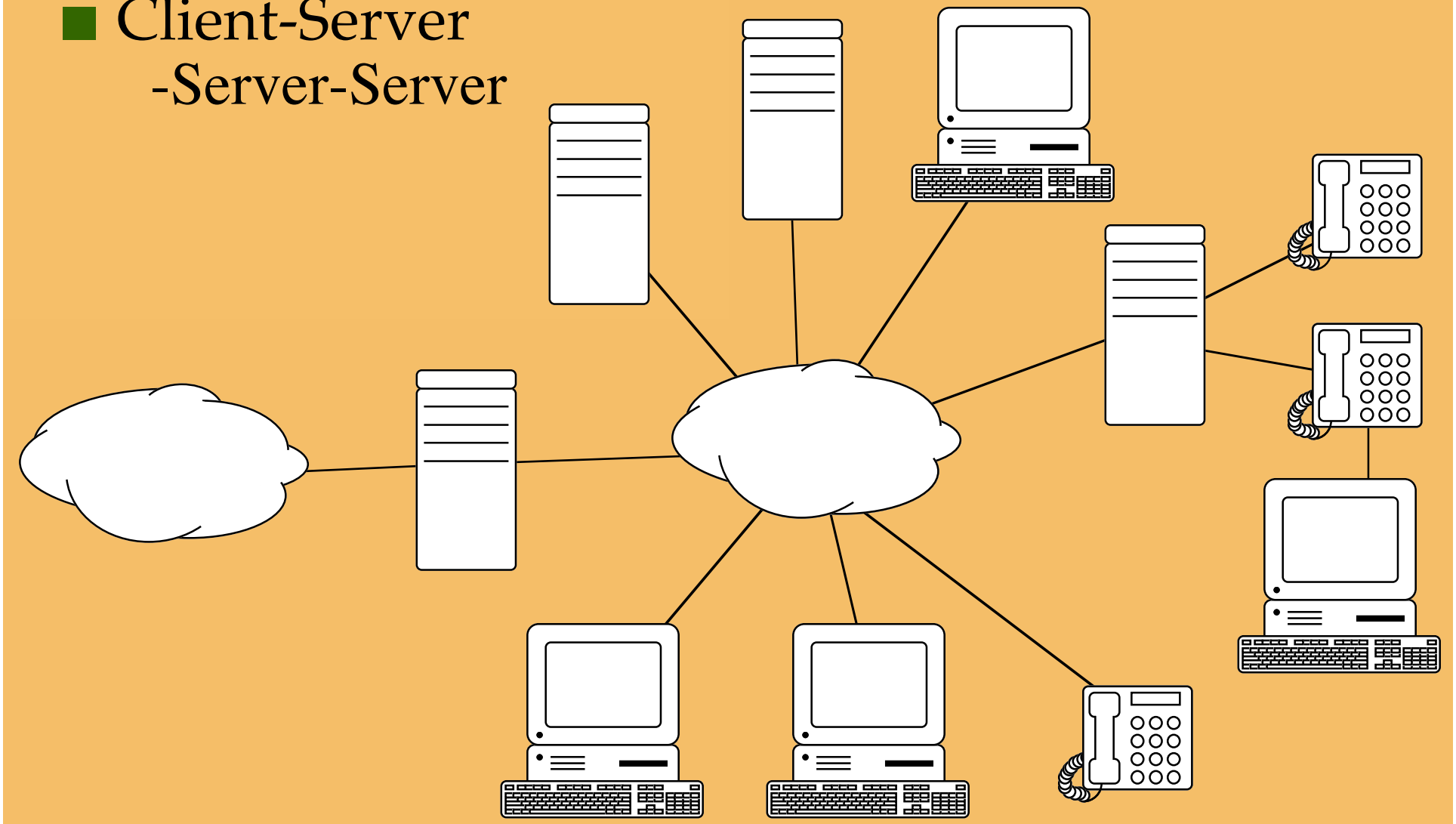


Part 2:

Computer Telephony Specifications and Frameworks

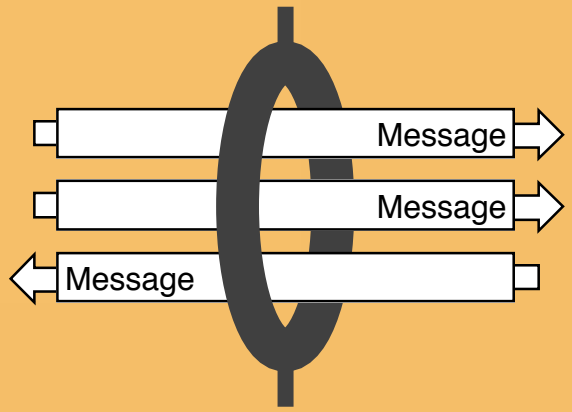
Modular CT Solutions

- Client-Server
  -Server-Server

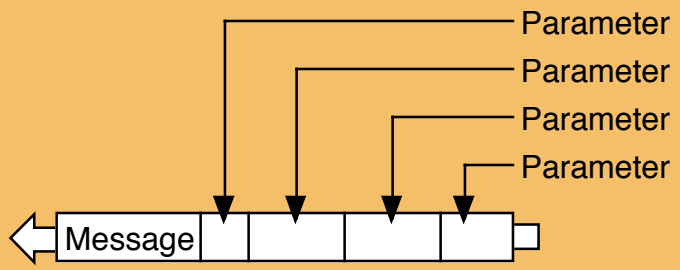


CT Interface

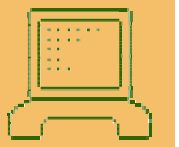
- Mechanism for passing CT messages

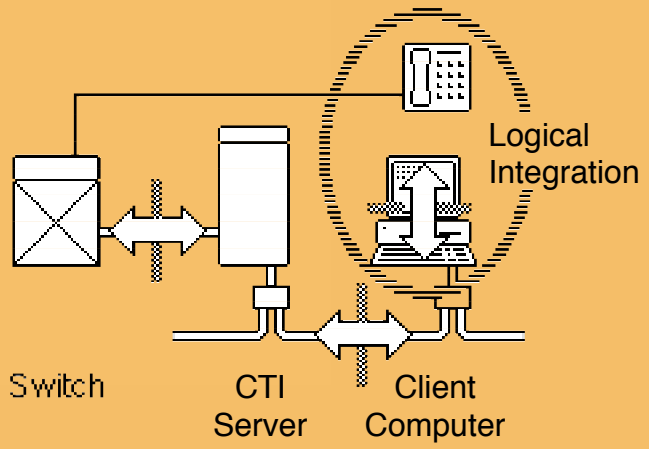


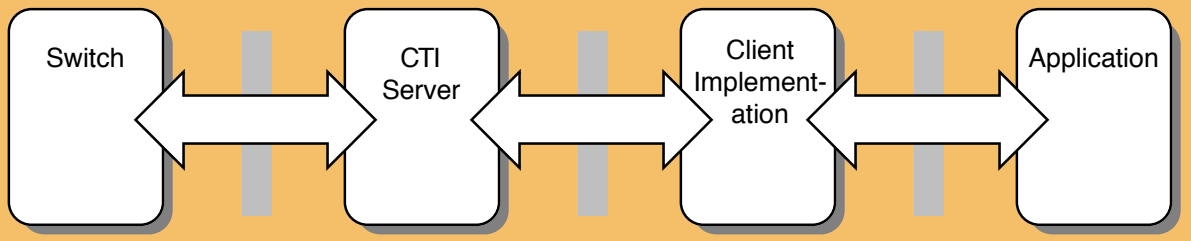
- CT messages parameterize the abstraction



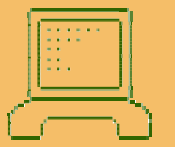
Protocols / Programmatic Interfaces





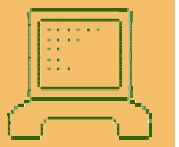


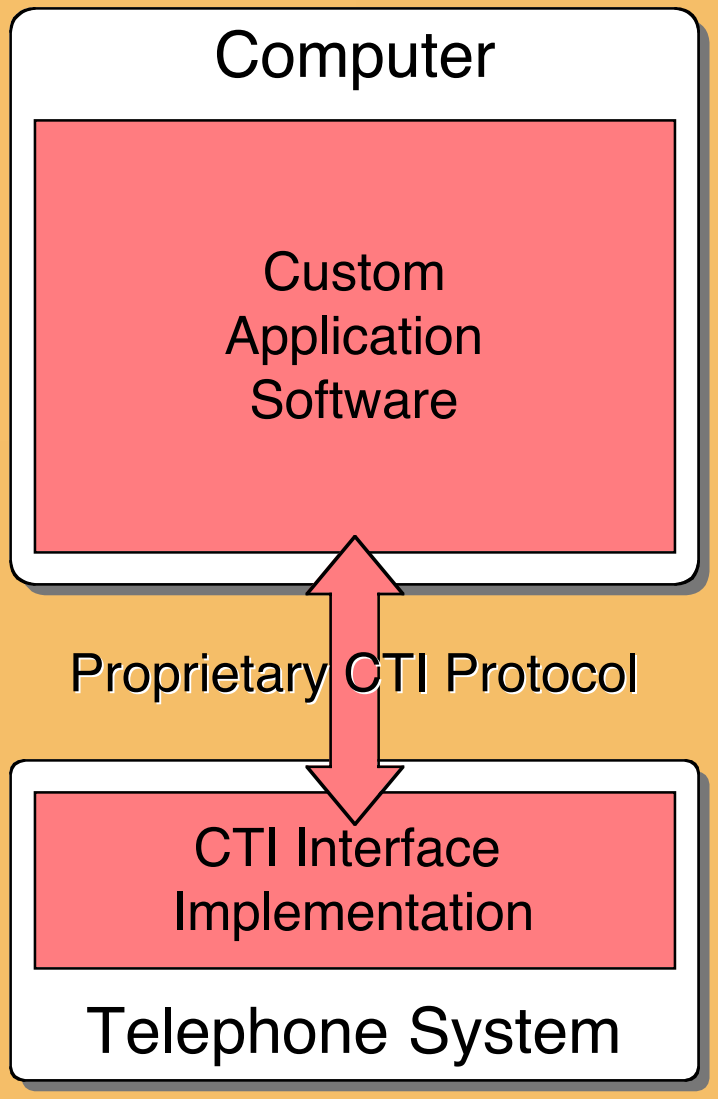
Three Phases of CTI



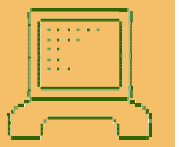
- First Phase of CTI: Custom Systems
- Second Phase of CTI: APIs
- Third Phase of CTI: CTI Protocols

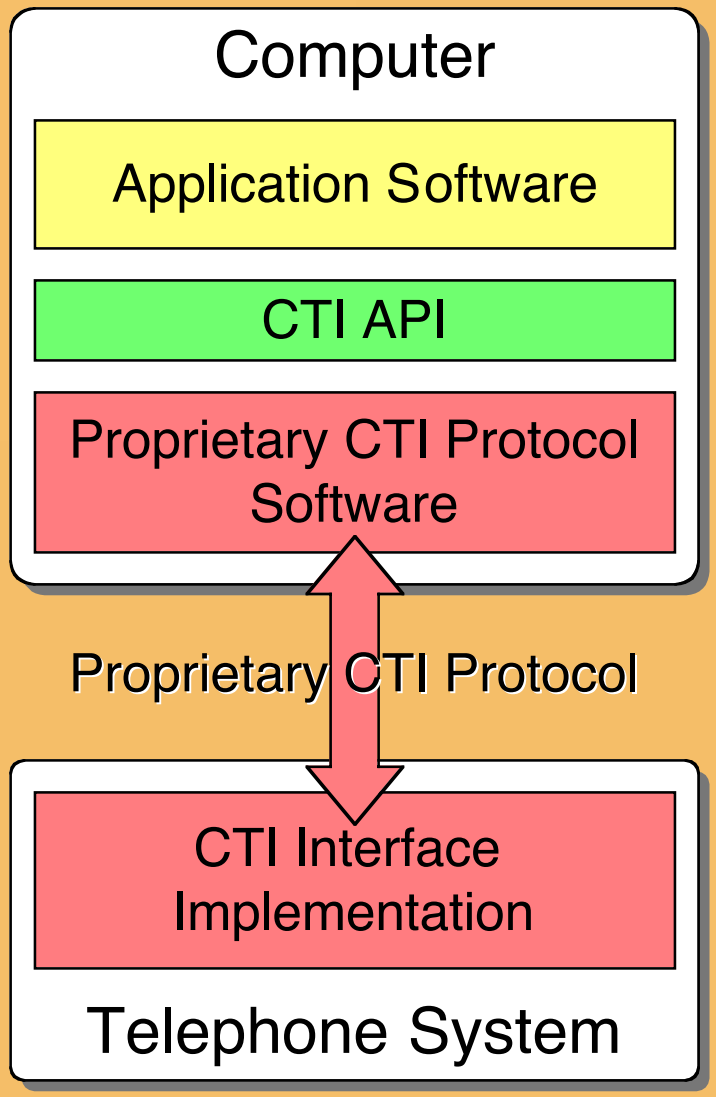
First Phase of CTI: Custom Systems



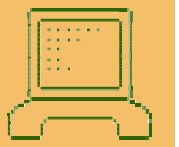


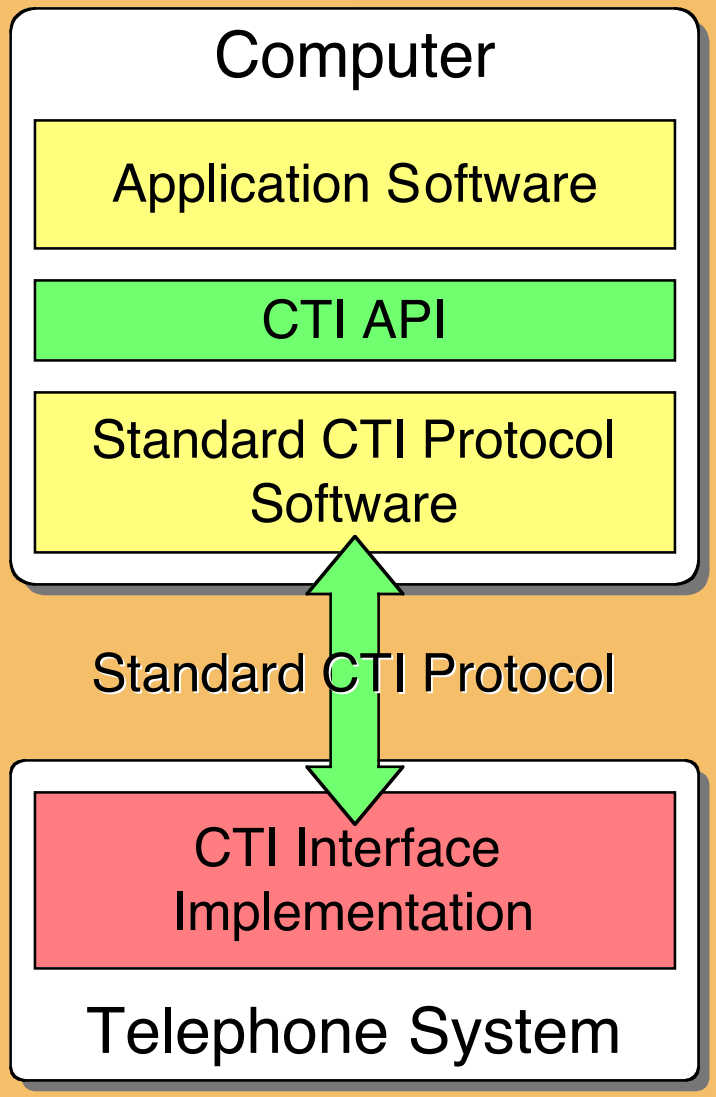
Second Phase of CTI: APIs



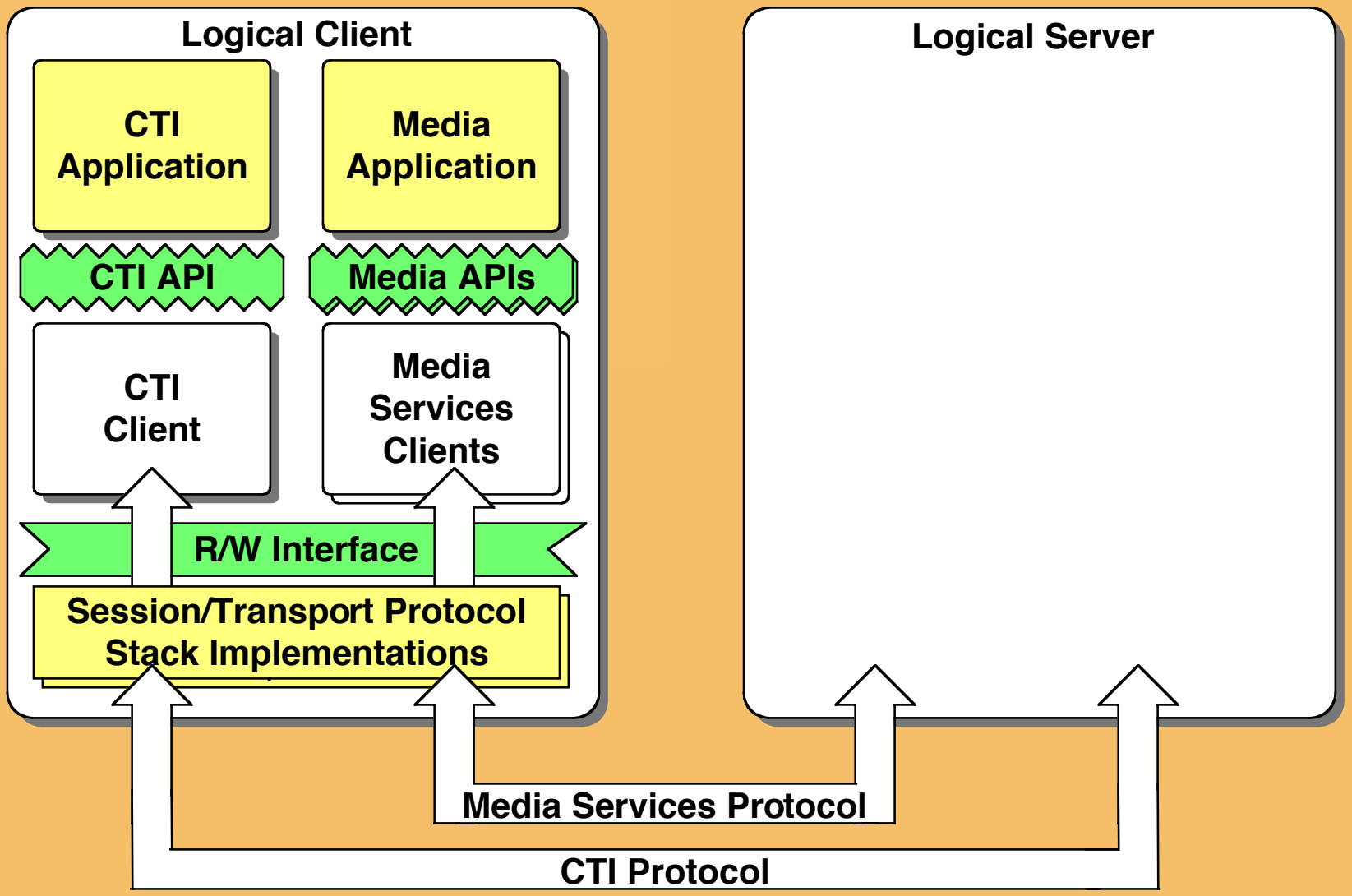


Third Phase of CTI: CTI Protocols



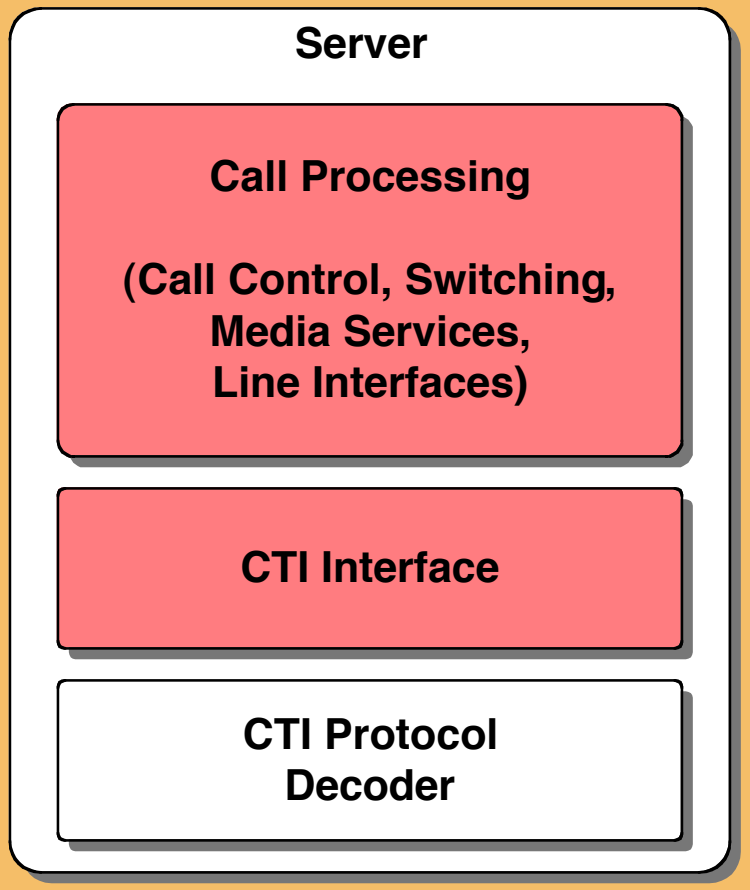


Logical Client and Server

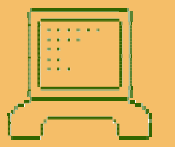


Monolithic Server

- Modem
- CT Server
- PBX

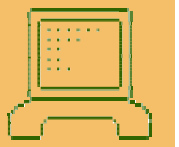


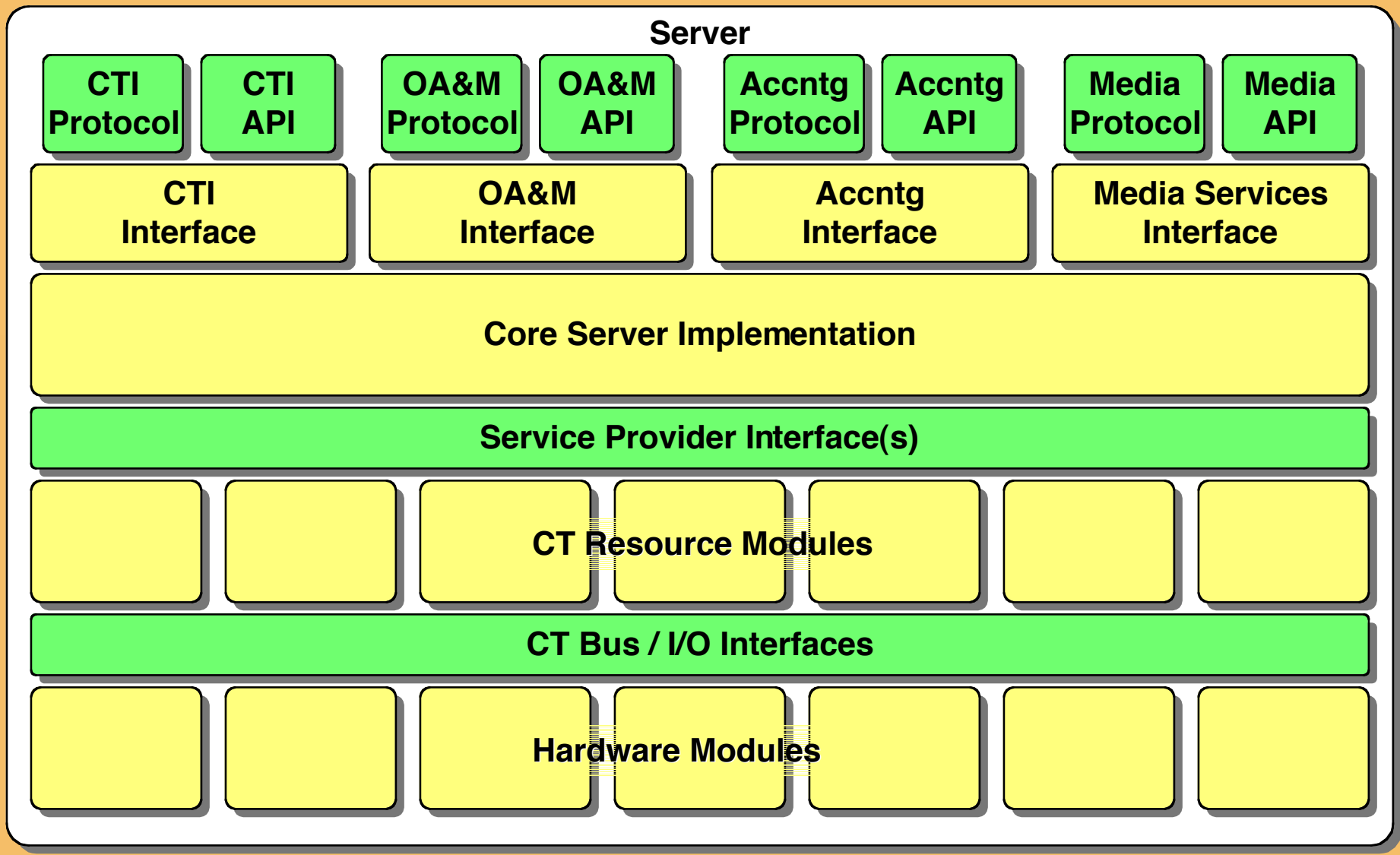
Generic CT Server



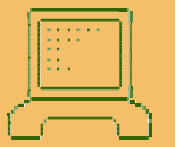
- All components are modular
- Server can be scaled and enhanced as required
- Server can interoperate with other servers and clients
- Server supports local applications

Generic CT Server



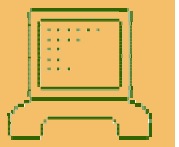


CT Frameworks

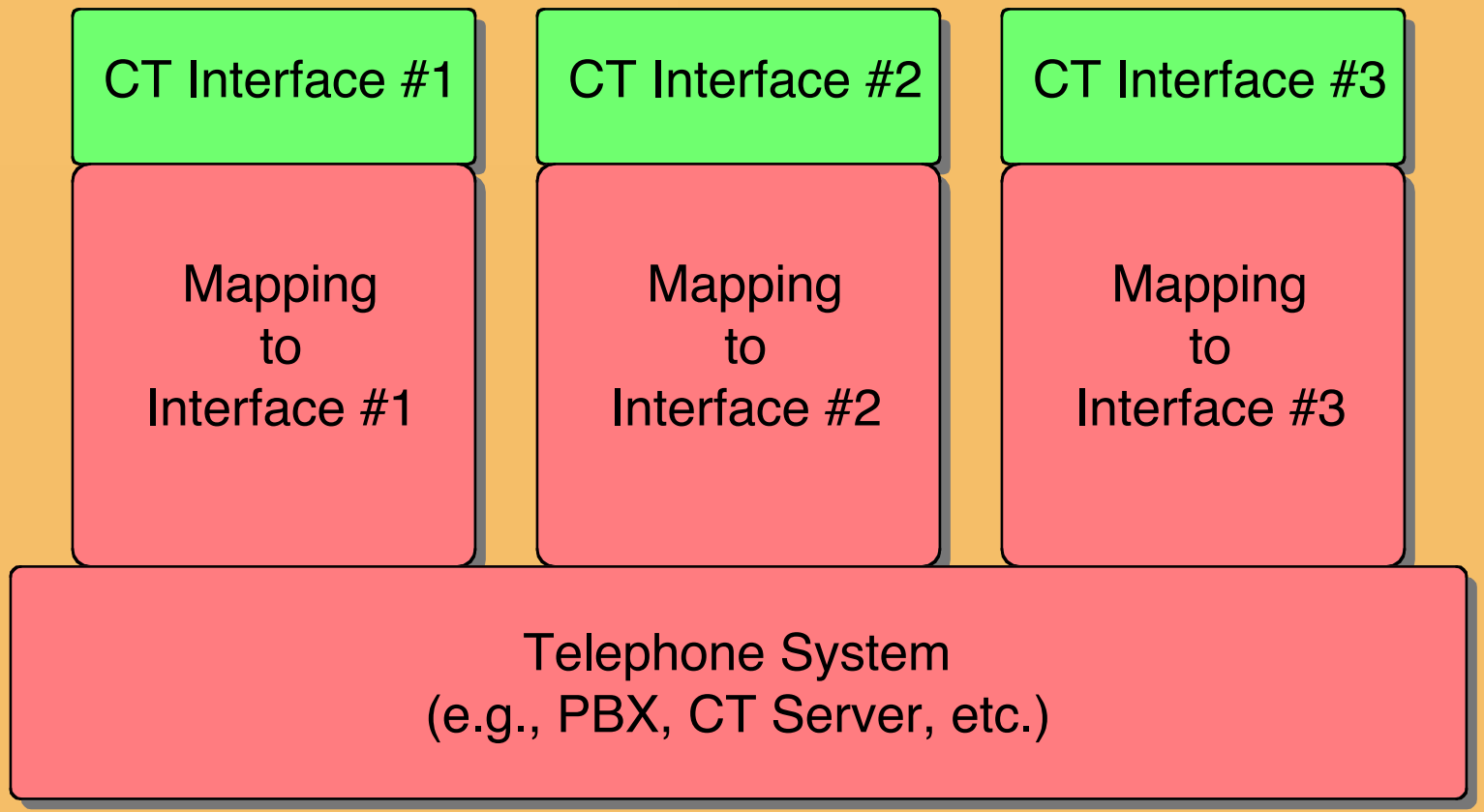


- Everyone has to talk the same language before they can discuss interoperability

Traditional Development Approach

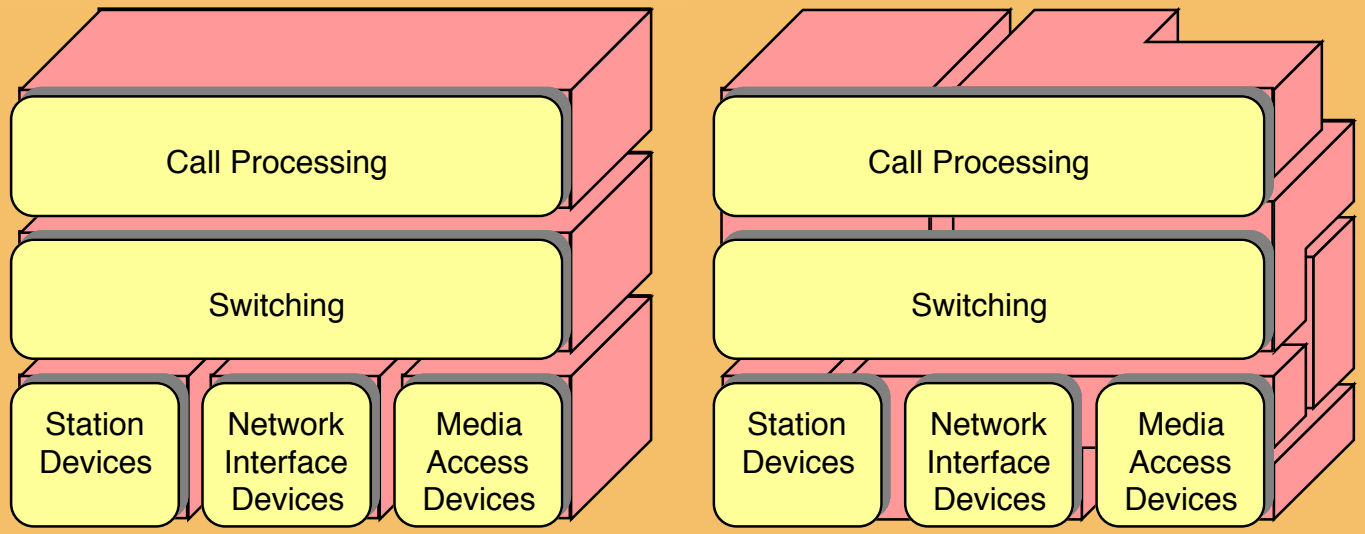


- Independent, "stove-pipe" development projects



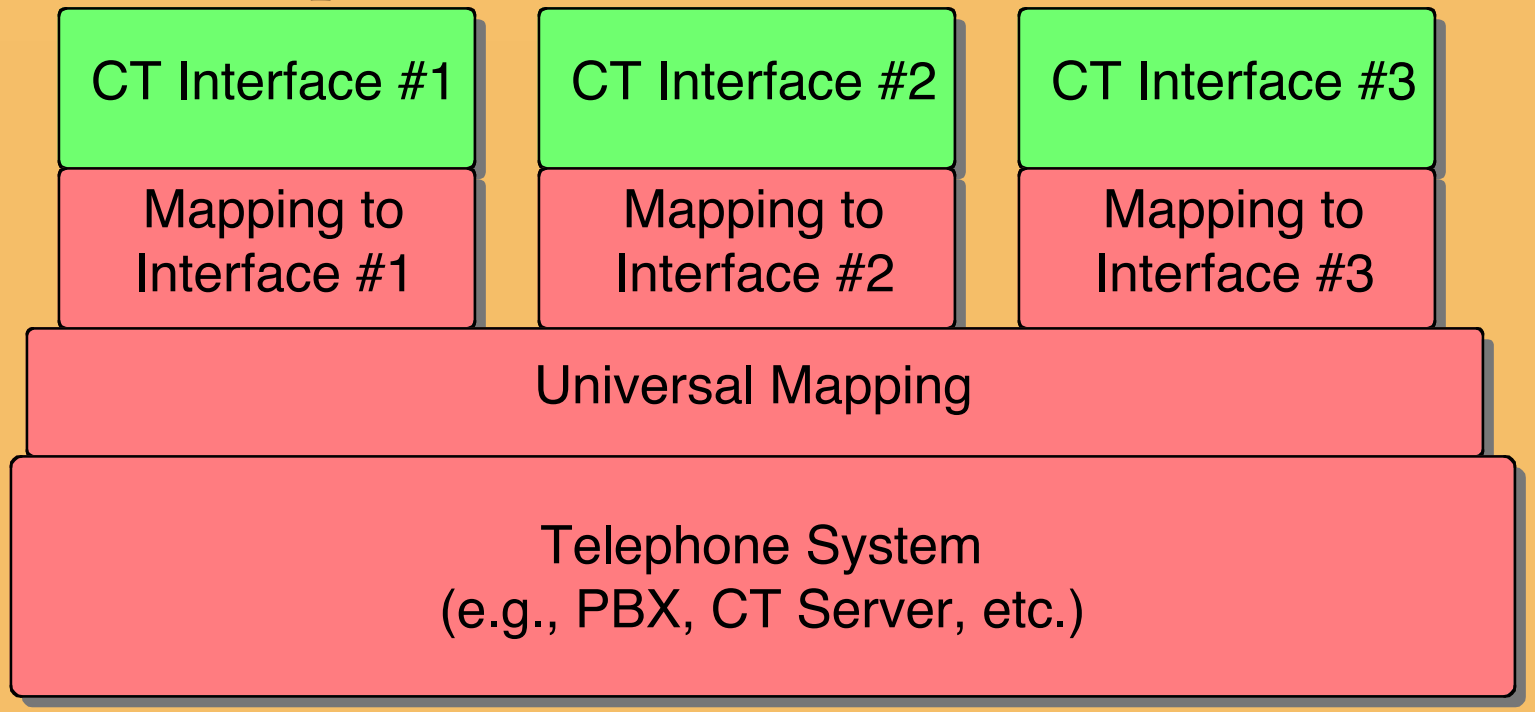
Facade Concept

- Implementations vary dramatically, but...
- The same abstraction can be applied universally

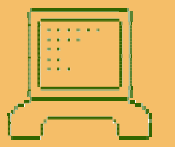


New Development Approach

- Universal abstraction simplifies and improves implementation of interfaces
- Delivers behaviorial consistency between interface implementations



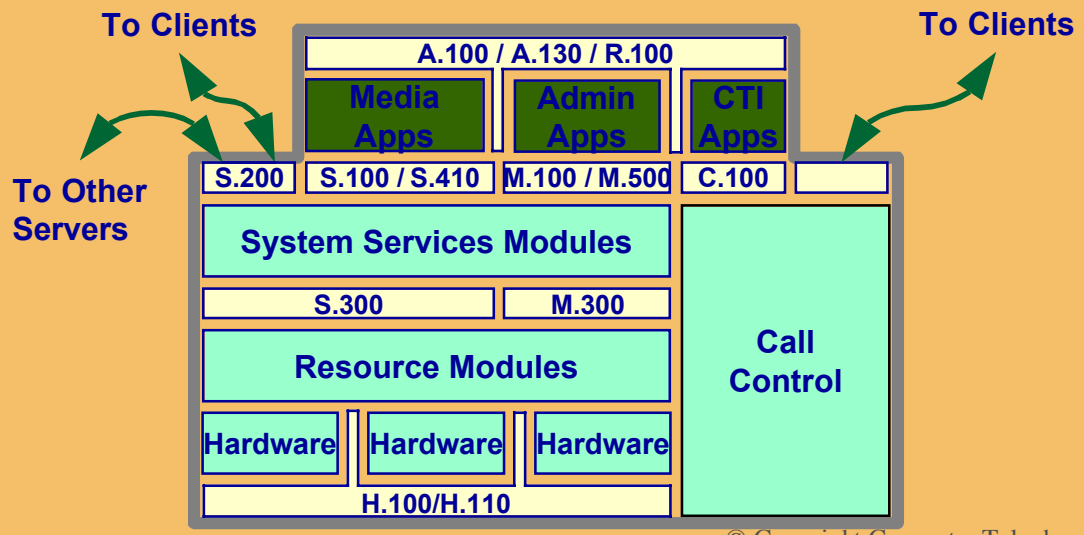
Specifications and Standards



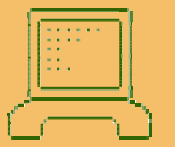
- Individual Vendors
  - Apple
  - Microsoft
  - Lucent/Novell
  - Sun
- Standards Bodies
  - ECMA
- Industry Organizations
  - Versit
  - ECTF

ECTF Framework

- Architecture Framework
  - Architecture for CT services
  - ECTF view of CT systems evolution
  - Framework for developing interoperability agreements
  - Drives ECTF technical working groups

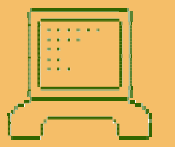


ECTF Framework and Specifications

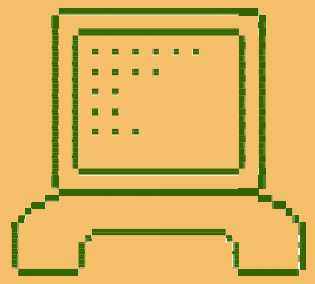


- Application Interoperability
  - A.001, A.100, A.130
- Call Control
  - C.001, C.100
- Hardware
  - H.100, H.110
- Administration
  - M.001, M.100, M.500
- Media Services
  - S.100, S.200, S.300, S.410

ECTF Status



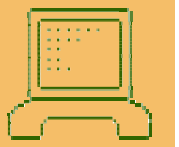
- Published:
  - A.001, C.001, H.100, H.110, M.001, M.100, S.100, S.200
- Nearing completion:
  - A.100, A.130, C.100, M. 500, S.300, S.410, R.100
- Products available and under development
- Many more task groups hard at work



Part 3:

Switching Fabric

Switching Fabric



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  - Analog (POTS) and digital (T-1, ISDN, proprietary) telephony circuits
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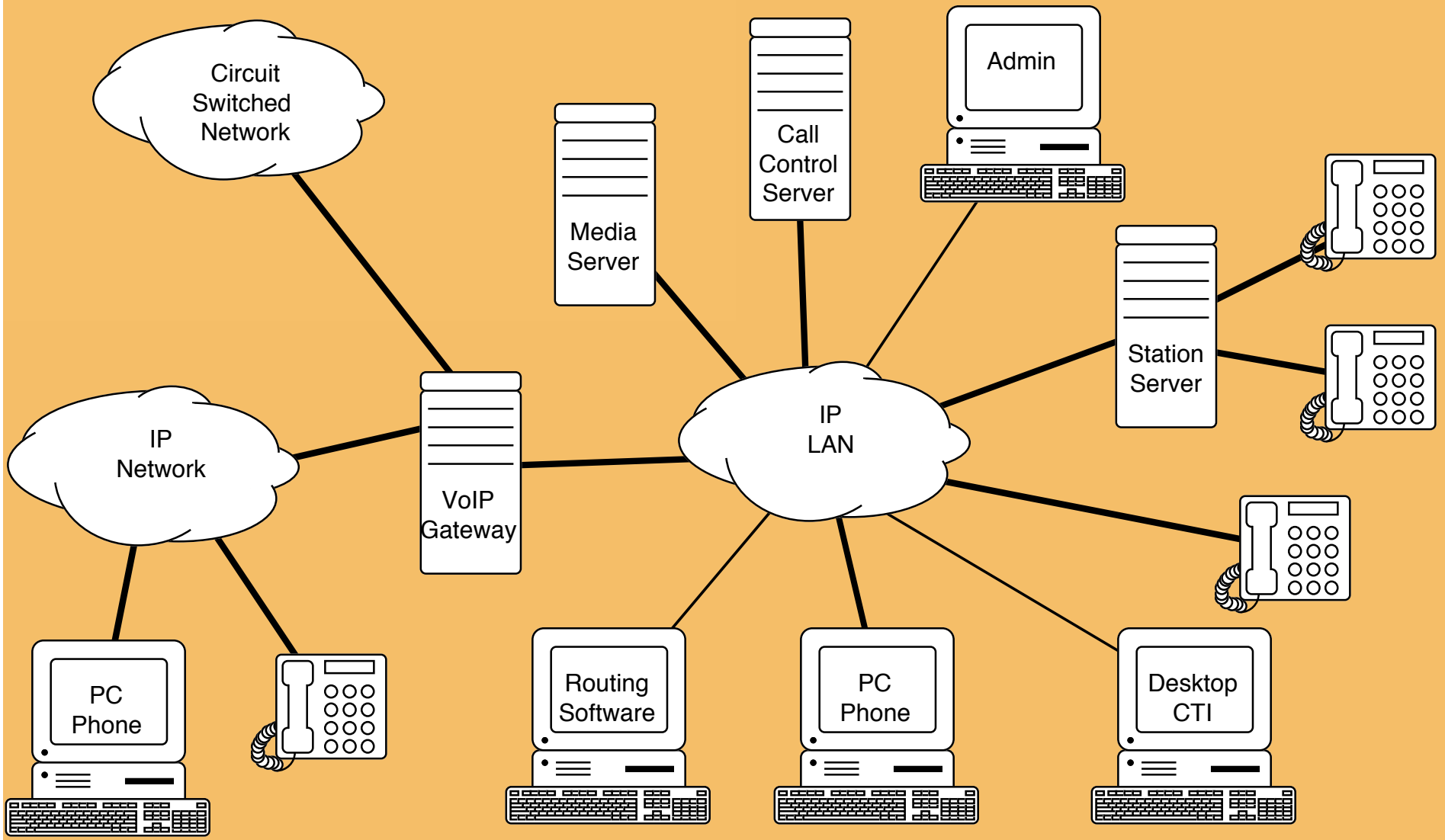
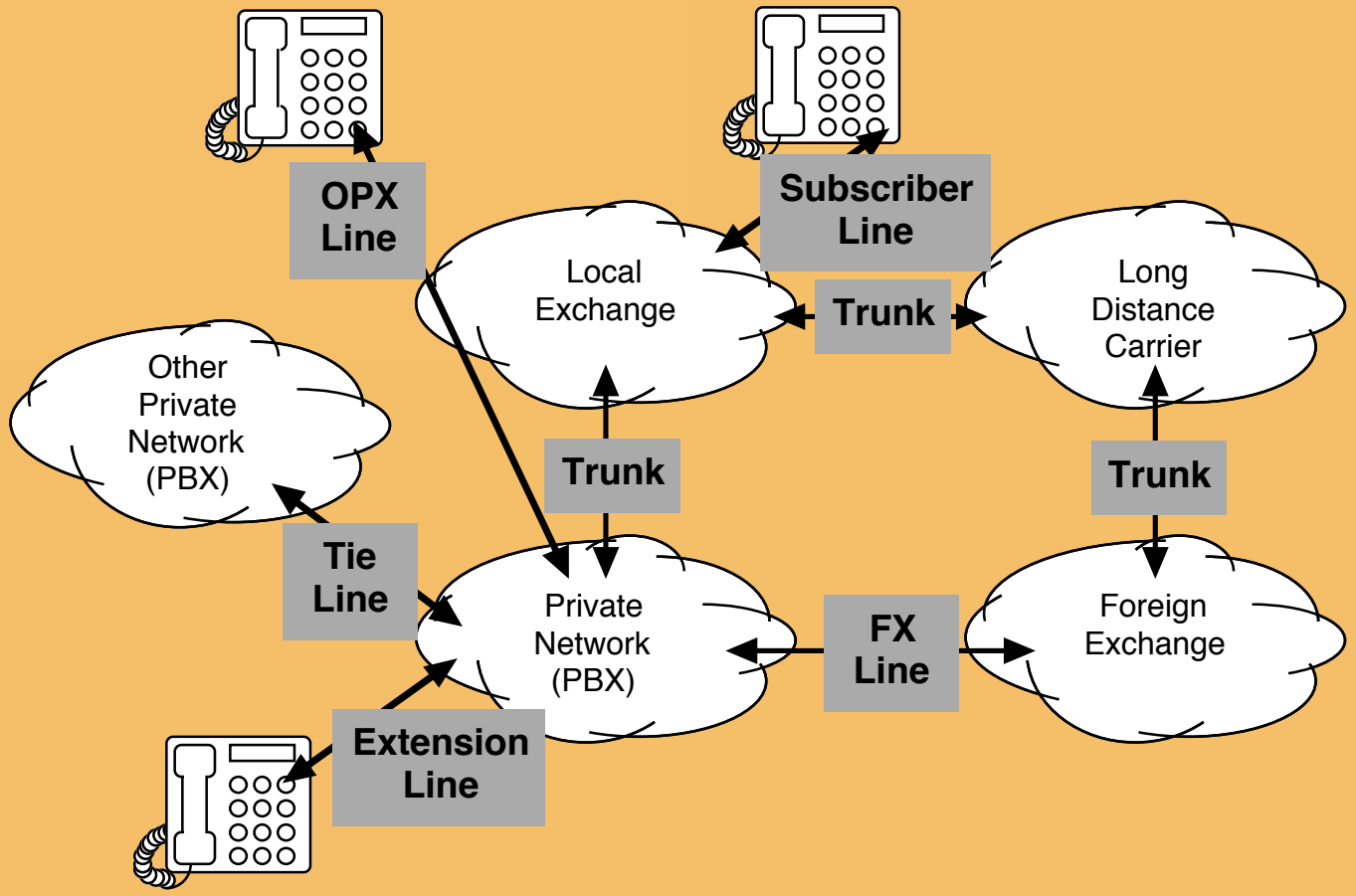
Switching

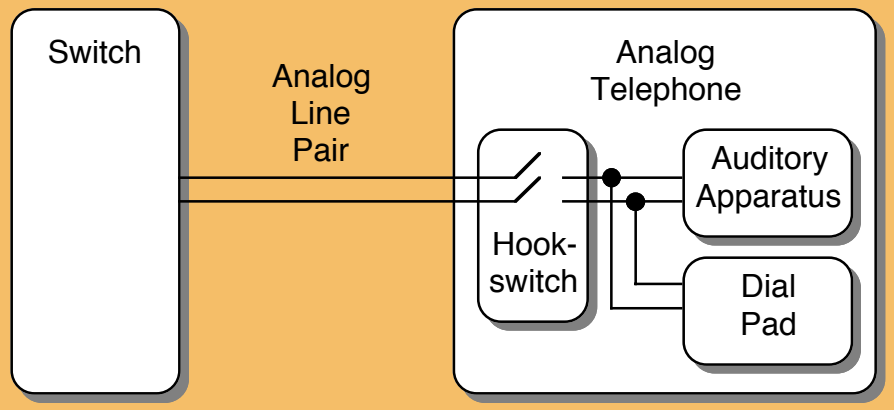


Telephony Circuits



Plain Old Telephone Service (POTS)

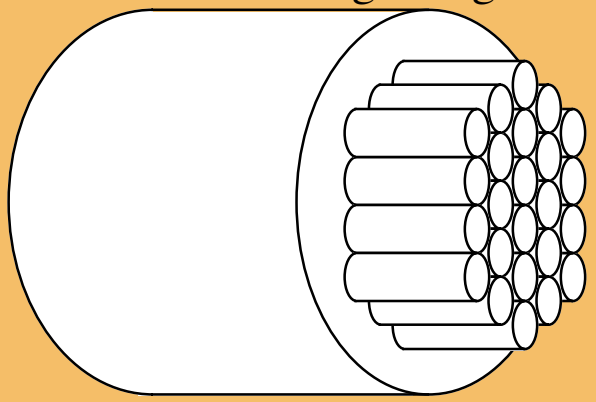
- aka Analog
- aka Tip and Ring
- DTMF or Pulse for command signaling
- AC voltage for call presentation
- Ground start/Loop start/Wink start



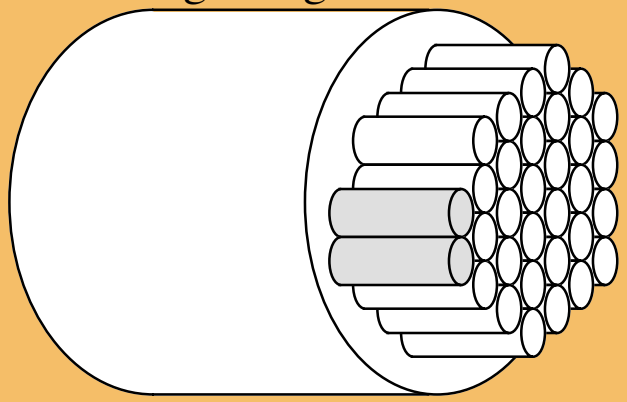
Time Division Multiplexed Circuits

- Four wire (send pair / receive pair) or fiber
- 64kb (DS0) bearer channel equivalent to analog circuit

T-1
1.544 Mbps
24 bearer channels
robbed bits signaling

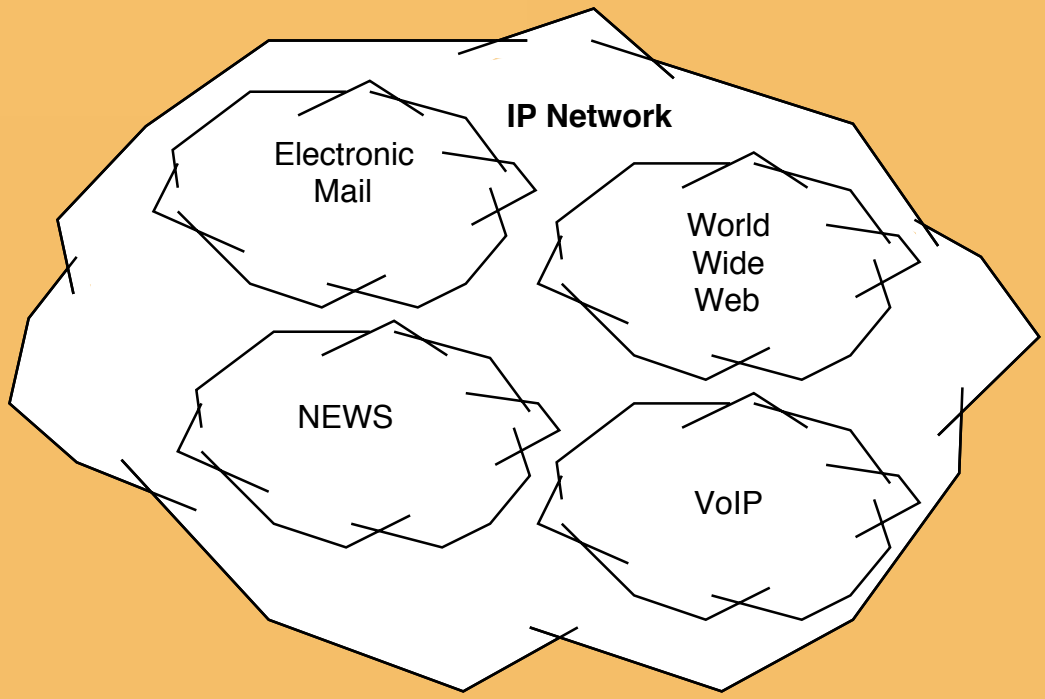


E-1
2.048 Mbps
30 bearer channels
2 signaling channels



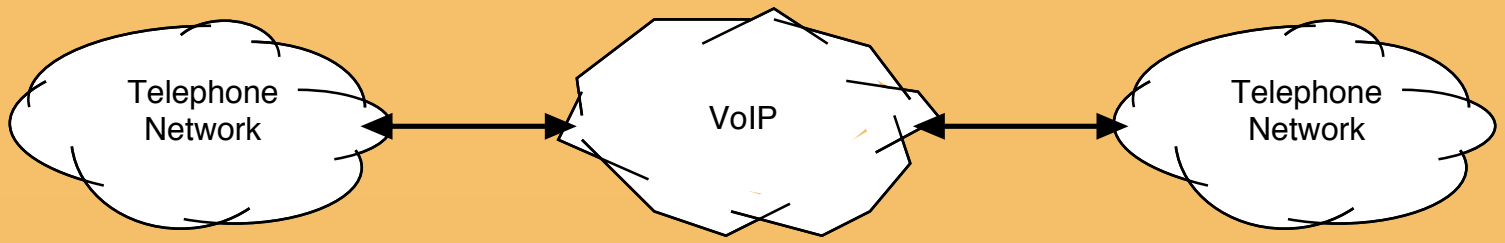
VoIP

- IP is a packet-oriented network fabric
- Voice-over-IP is one particular "sub-network"

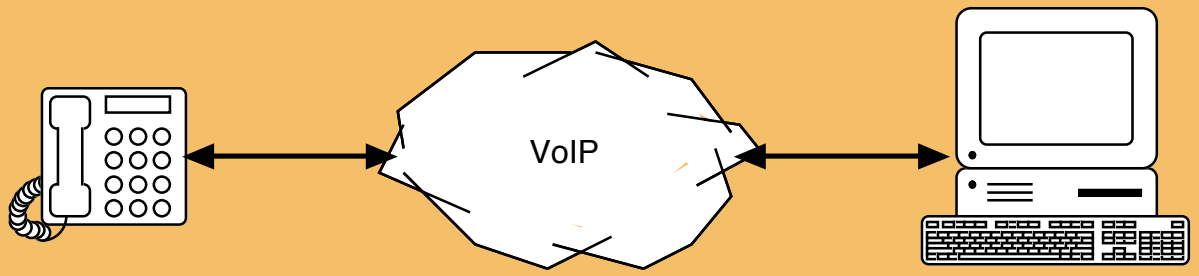


VoIP Usage Models

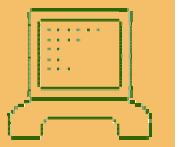
- Switch-to-Switch
  - Connect existing telephone networks



- Subscriber
  - Deliver voice to and from a computer or phone

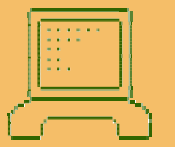


VoIP Specifications



- Media Streams
  - IETF RTP/RTCP
  - ITU CODECs
- Signaling
  - ITU H.323
  - IETF SIP/SAP
- Control
  - ITU H.GCP
  - IETF MGCP

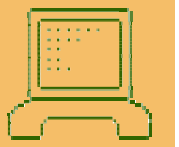
ITU H.323 Family



- Media Stream Channels
  - RTP/RTCP
  - G.711/G.722/G.723/G.728/G.729
- Signaling & Control
  - RAS
  - Q.931
  - H.235
  - H.245
  - H.GCP (under development)

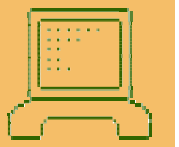
Signaling	Audio Codecs
H.235 H.245 Q.931 RAS	G.711 G.722 G.723 G.728 G.729
	Media Stream Transport RTP RTCP

H.323 Logical Abstractions



- Terminals
  - Station devices
- Multipoint Control Units
  - Provide conferencing capability
  - Made up of multipoint controllers and processors
- Gateways
  - Interconnection to other switching fabrics
- Gatekeepers
  - Access Controls
  - Address Translation
  - Bandwidth Management

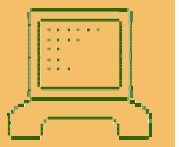
IETF SIP/SAP/RTSP



- Media Stream Channels
  - RTP/RTCP
  - [G.711/G.722/G.728/etc.]
- Signaling
  - SDP
  - SIP
  - SAP
  - RTSP

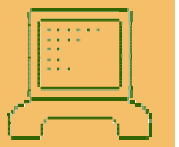
Signaling	Audio Codecs
SDP SIP SAP RTSP	G.711 G.722 G.723 G.728 G.729
	Media Stream Transport RTP RTCP

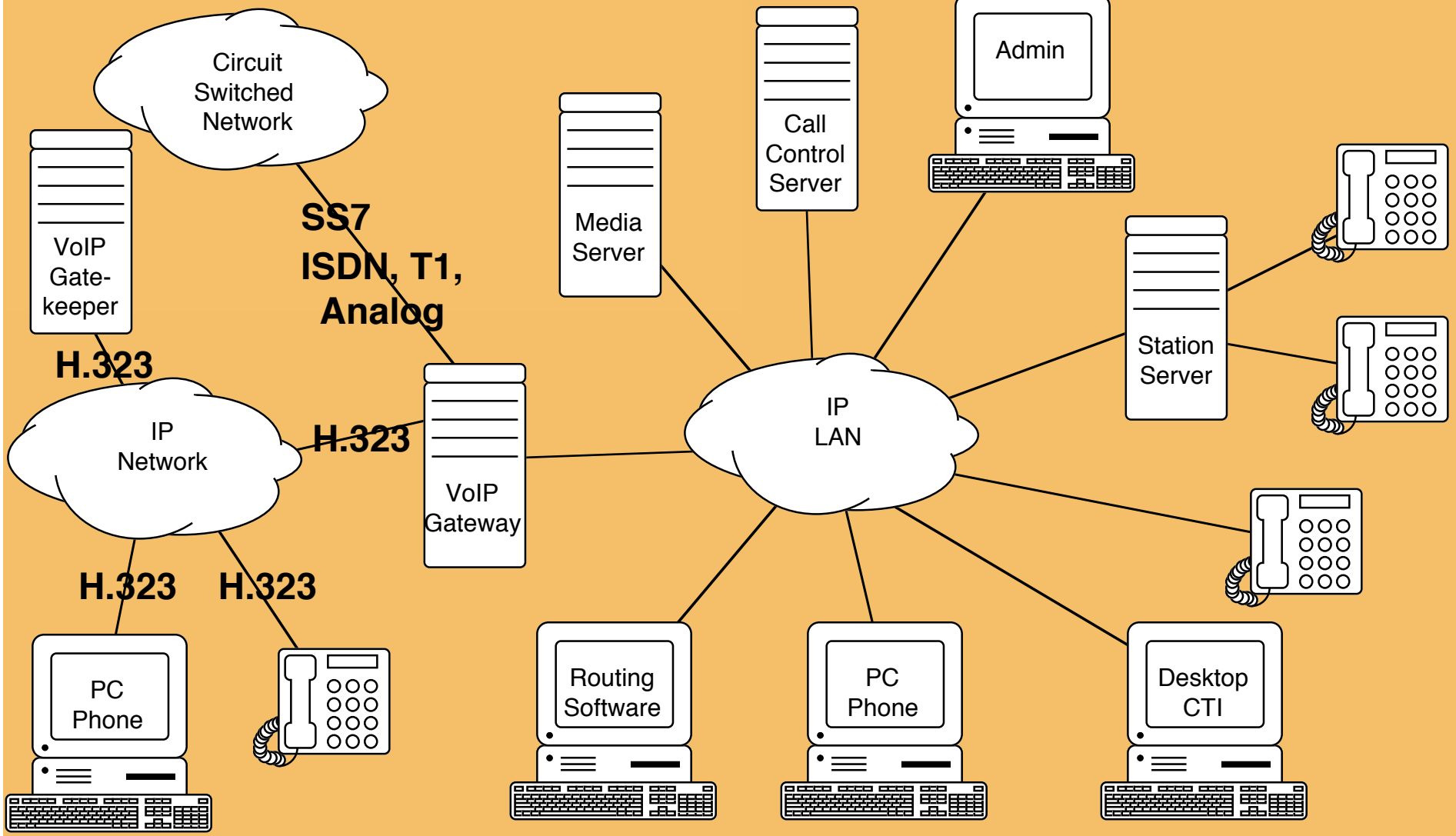
MGCP



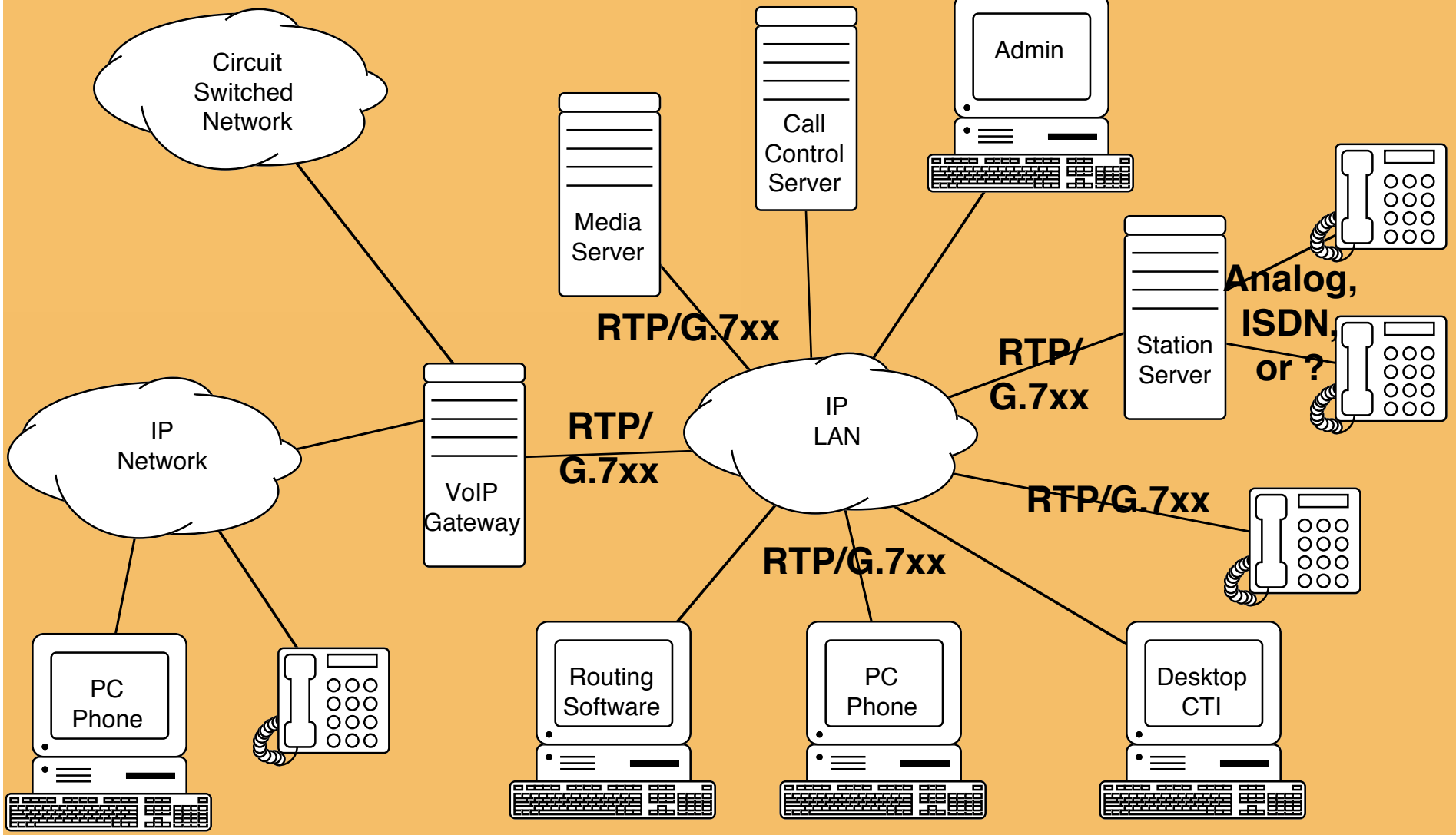
- Multi-media gateway control protocol
- Result of merging IPDC and SGCP
- Provides control of telephony gateways
- Allows “Gatekeeper” function to be independent of “Gateway” function
- Specification in track for IETF adoption

Public Network Switching/Signaling

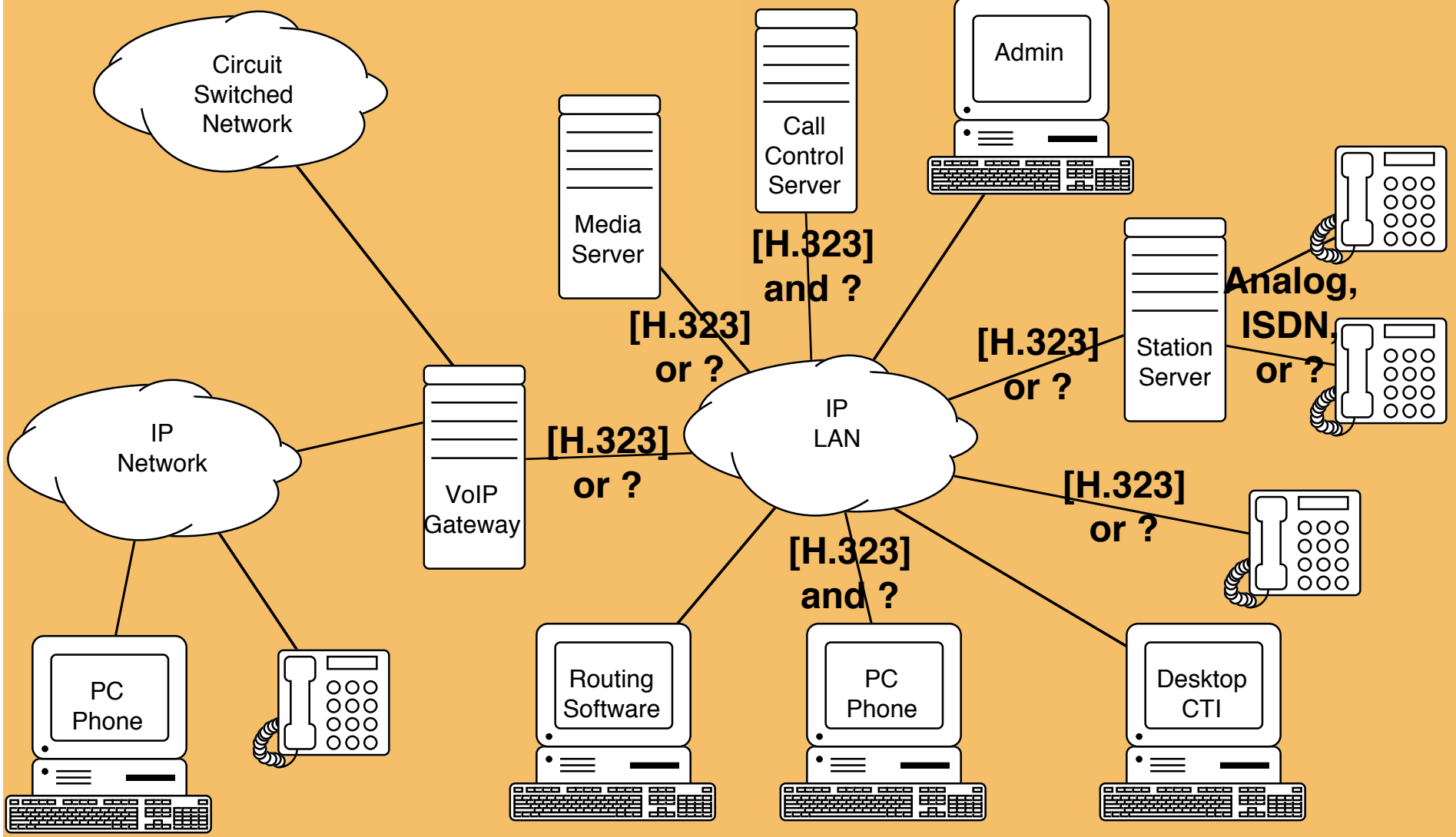




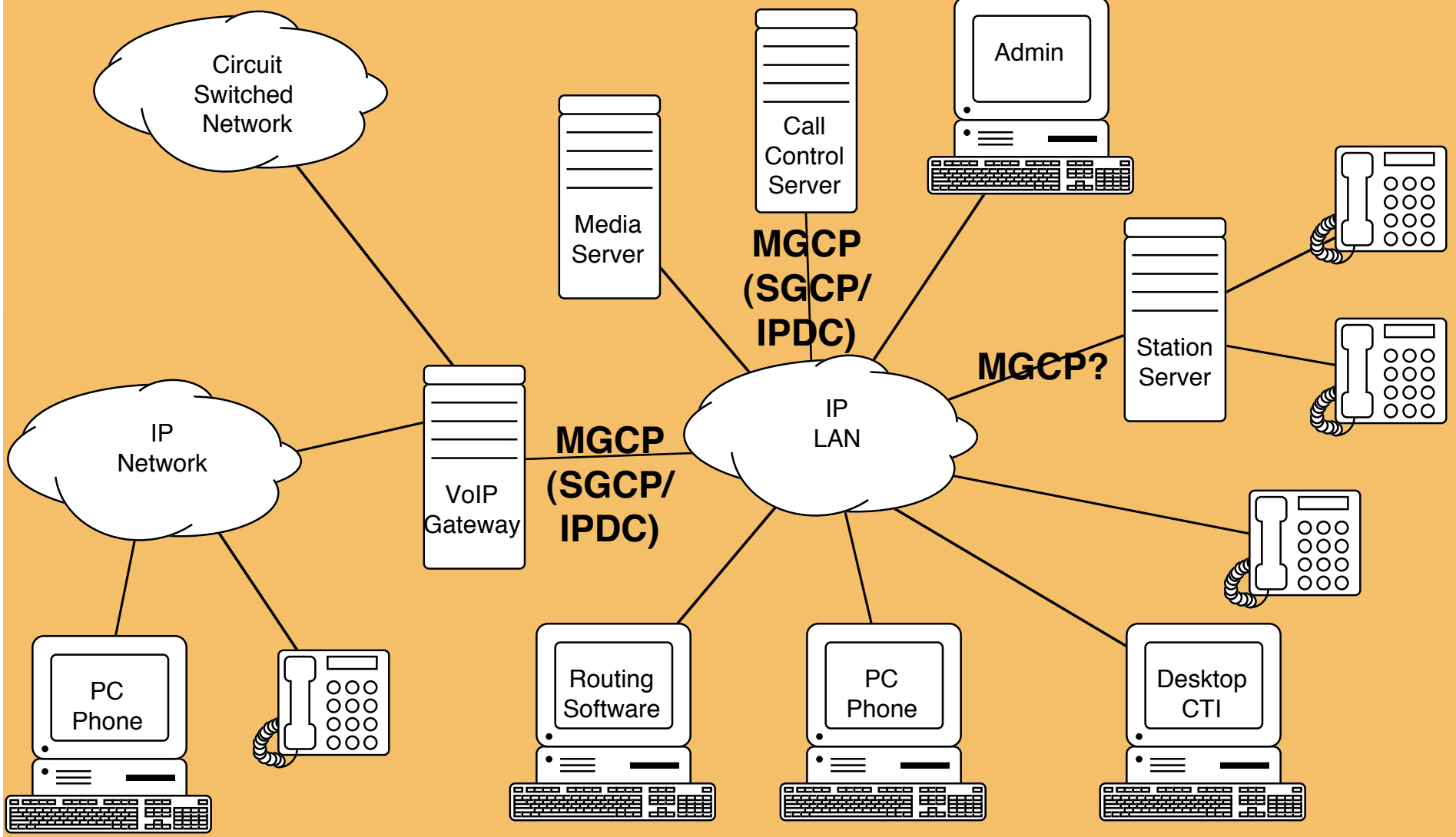
Switching: Media Streams



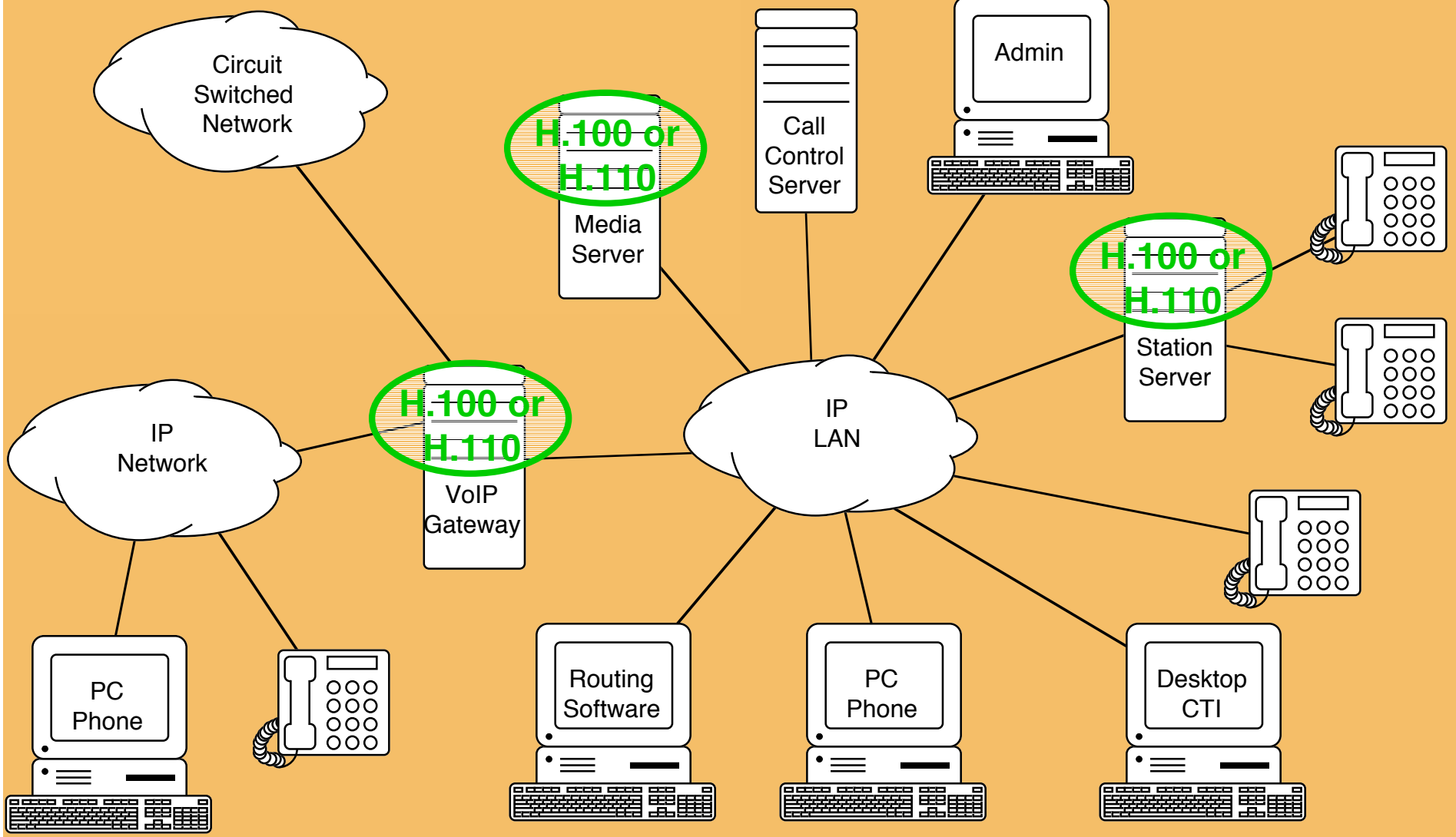
Switching: Signaling



Switching Fabric Control

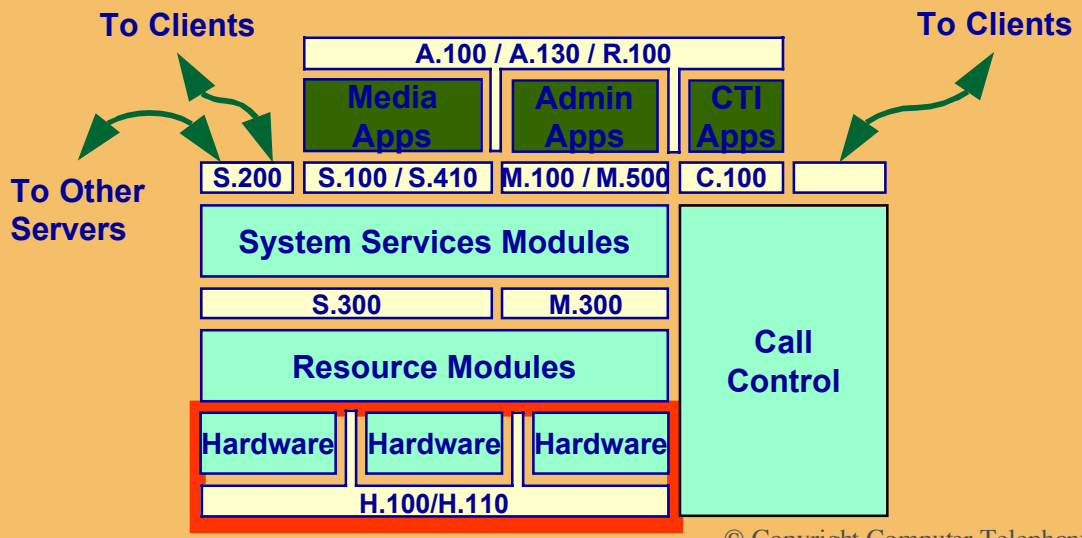


Switching Fabric: TDM Bus



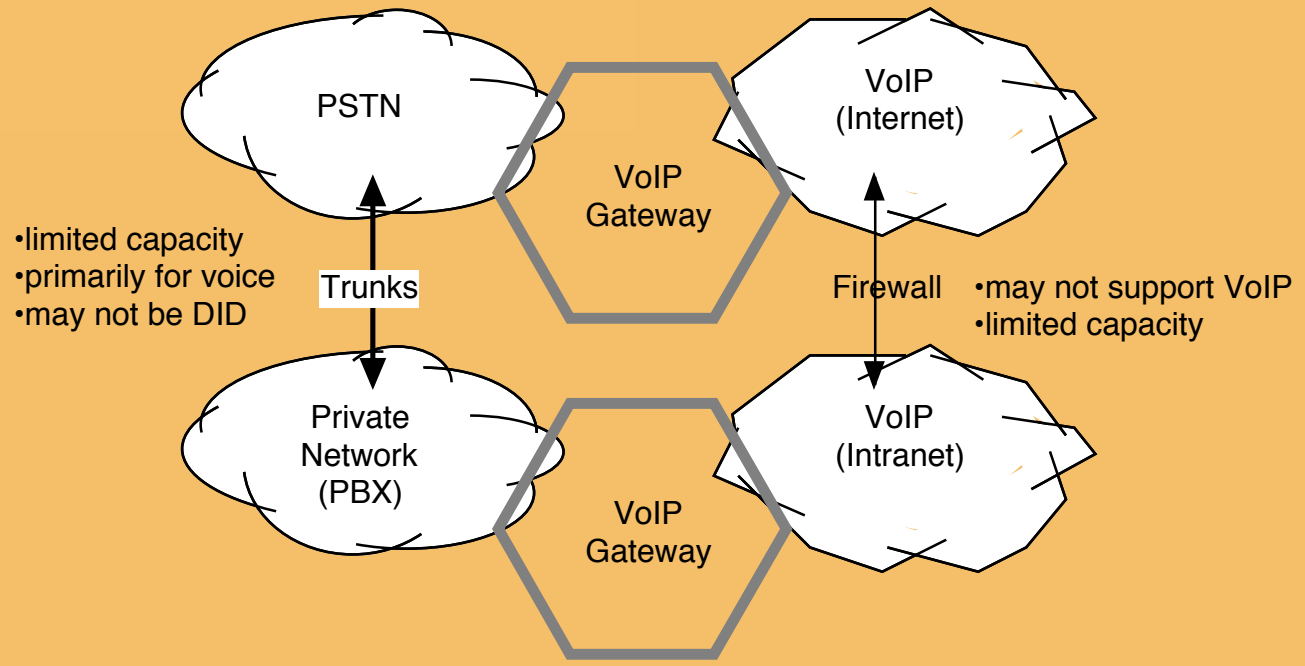
ECTF Framework

- H.100
  - CT Bus for PCI Specification
- H.110
  - CT Bus for Compact PCI Specification

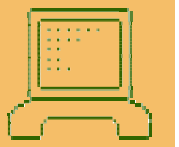


VoIP Media Gateway

- Intranet
- Internet



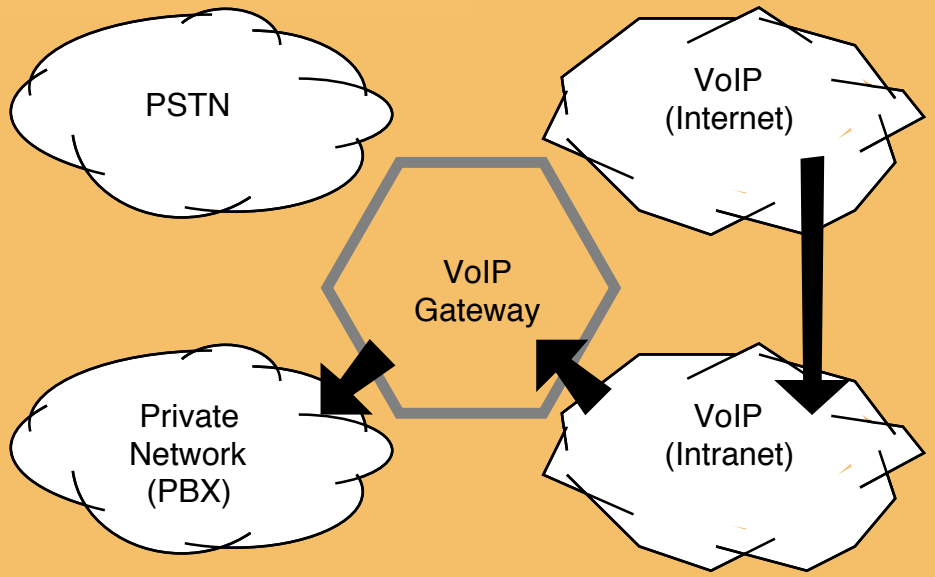
Usage Scenarios



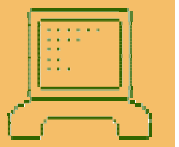
- Alternative Voice Trunking
  - Inbound
  - Outbound
  - Virtual Private Network
- Alternative Voice Extensions
  - Local
  - Outbound
  - Remote
- Conferencing
- Media Access
  - Monitoring
  - Messaging

Alternative Voice Trunking: Inbound

- Augment 1-800/888/900
- Web integration optimizes phone time
- Allows telephony-enhanced web offering



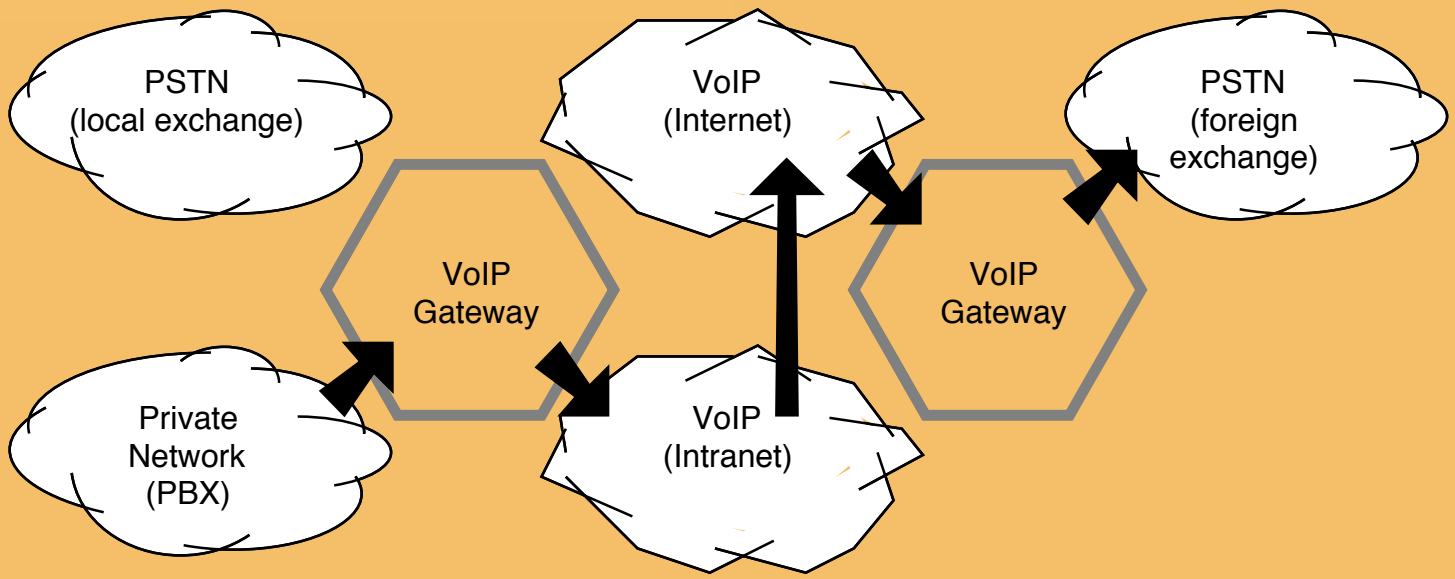
Alternative Voice Trunking: Inbound



- Product sales call centers
- Reservations call centers
- Order tracking
- Customer support escalation
- Registration and use help desks
- Online self-paced training
- Interactive Webcasts
- …and much, much, more…

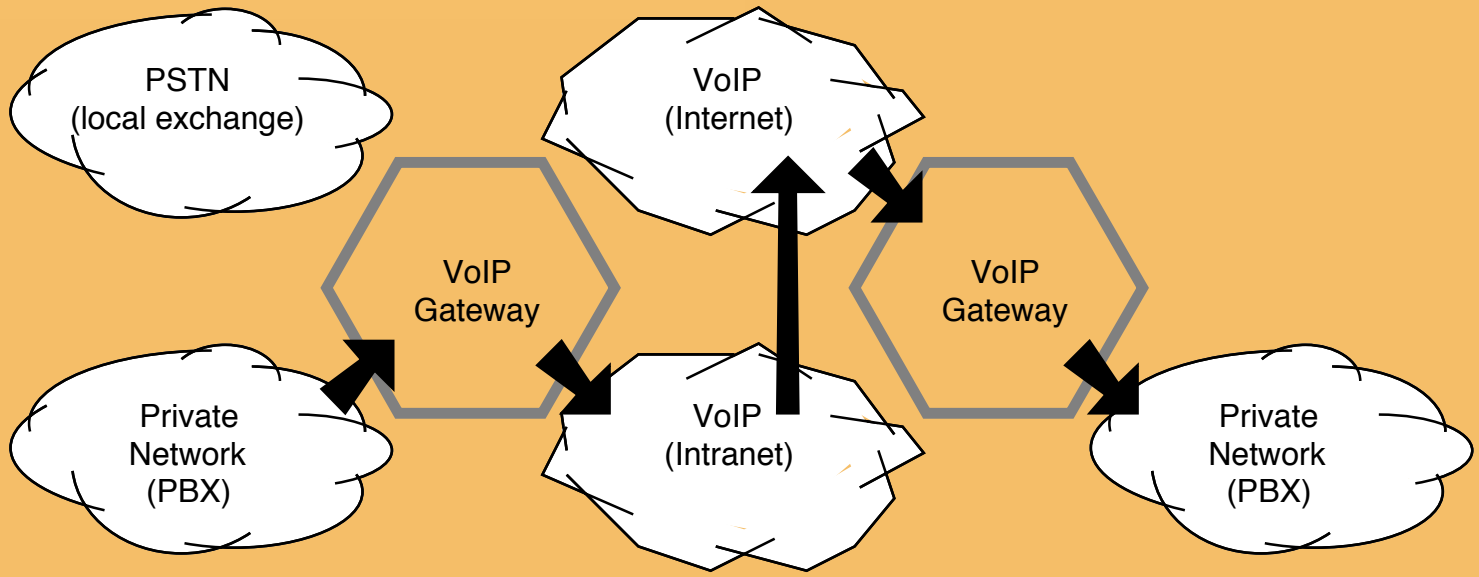
Alternative Voice Trunking: Outbound

- FX Line alternative (via service bureau)
- Toll charge vs quality trade-off



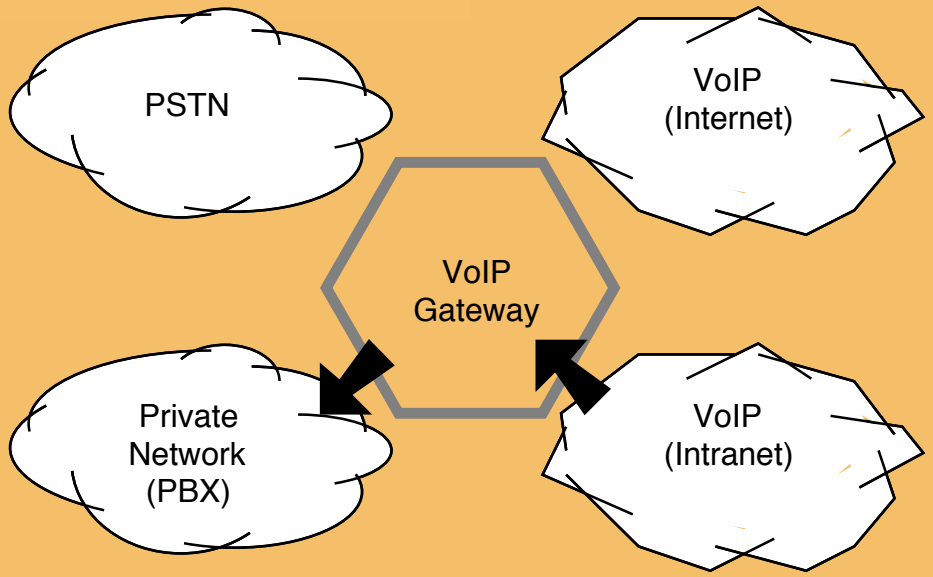
Alternative Voice Trunking: Virtual Private Network

- Tie Line alternative
- Inter- and Intra- organization voice trunking on demand



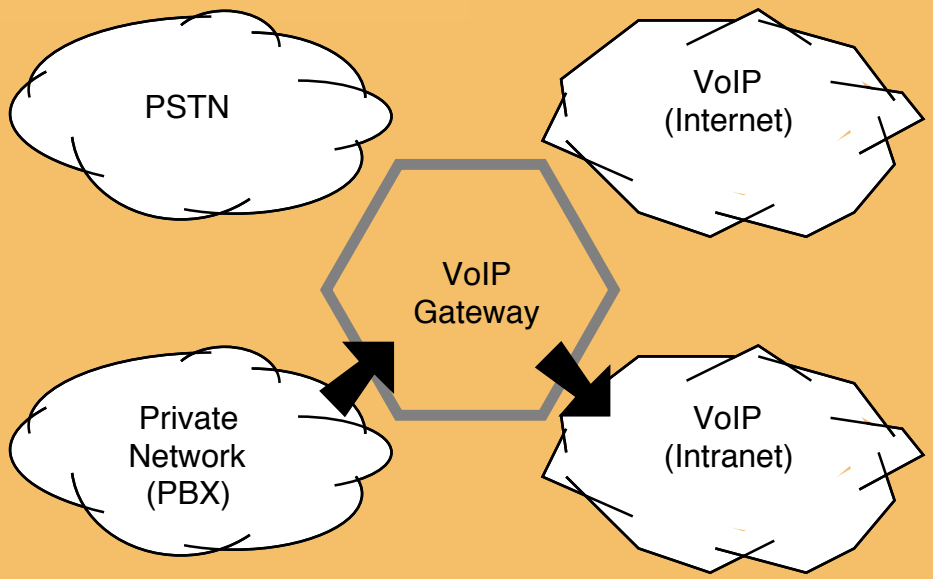
Alternative Voice Extensions: Local/from Intranet

- Help desks
- Phone-poor/computer-rich environments (classrooms, labs, libraries)



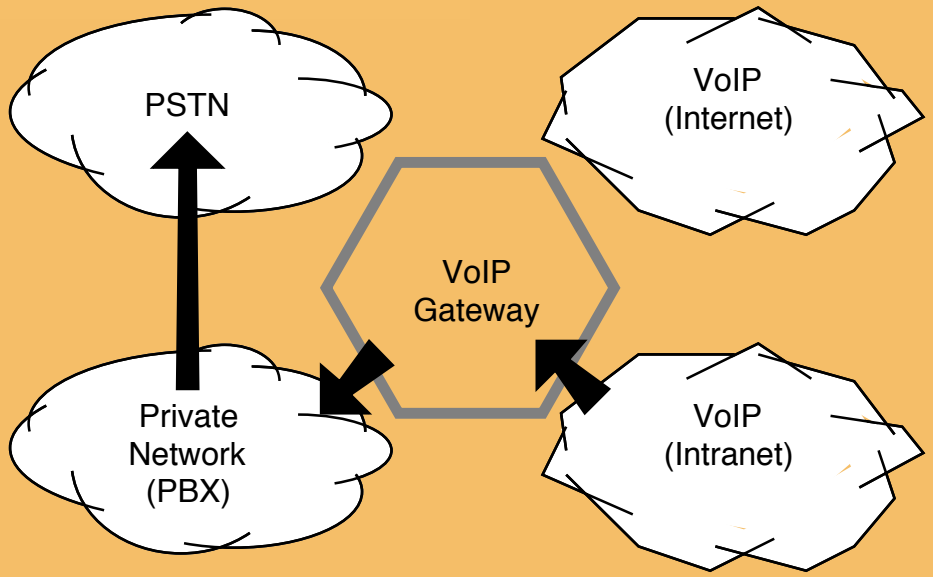
Alternative Voice Extensions: Local/to Intranet

- Intercom
- Auto-attendant Monitoring



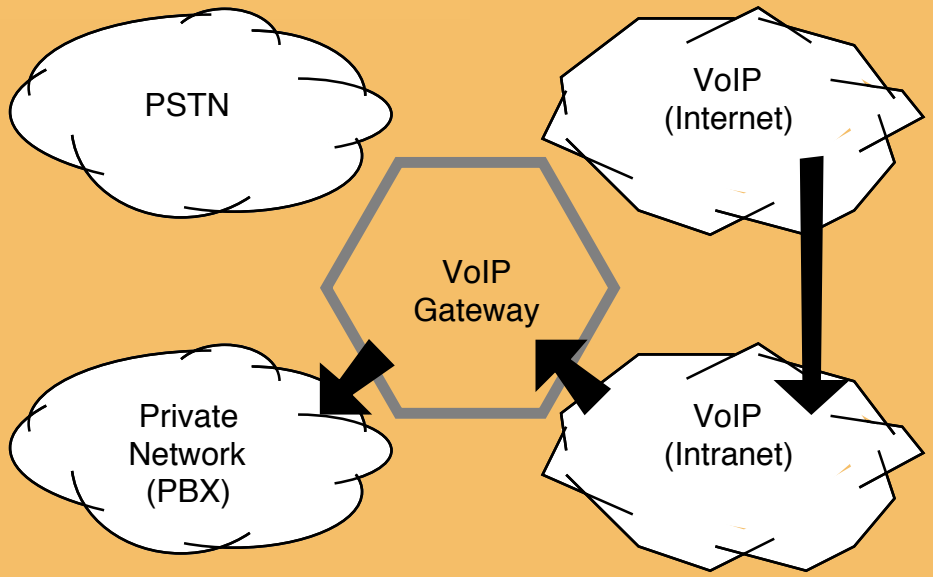
Alternative Voice Extensions: Outbound

- Phone-poor/computer-rich environments (classrooms, labs, libraries)
- Controlled/coached access



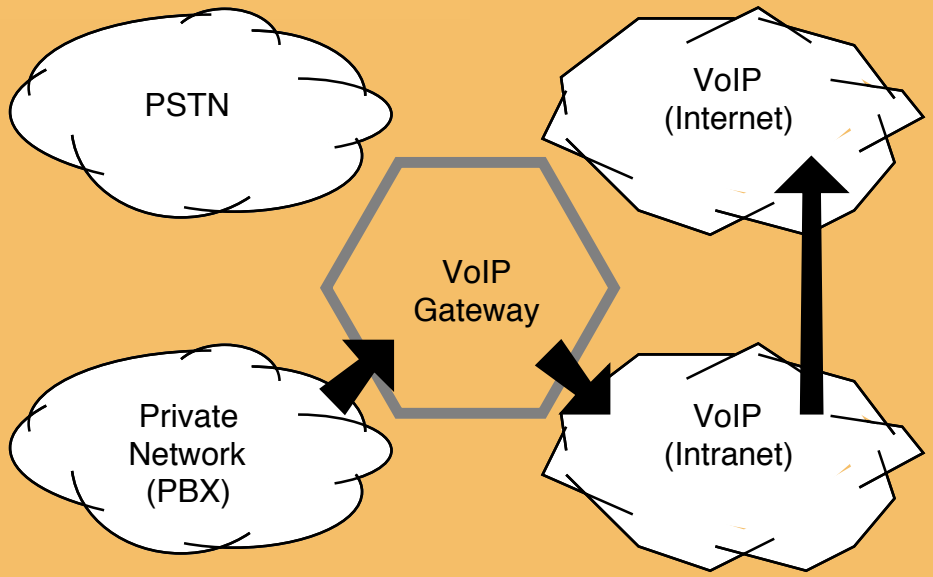
Alternative Voice Extensions: Remote (from home)

- Telecommuting
- Home user has all bandwidth dedicated to internet
- Uses VoIP for phone service



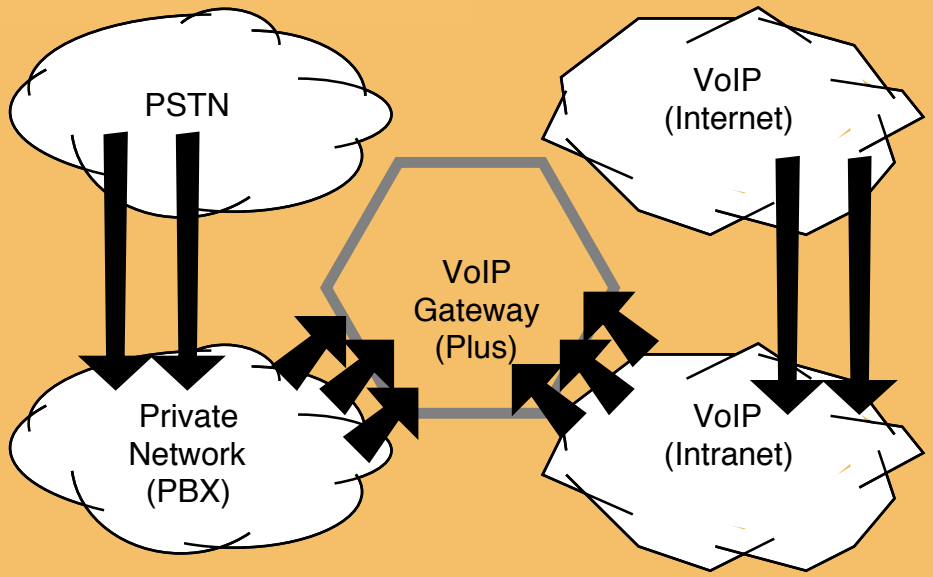
Alternative Voice Extensions: Remote (to home)

- Telecommuting
- Follow-me forwarding for transparency
- Call screening



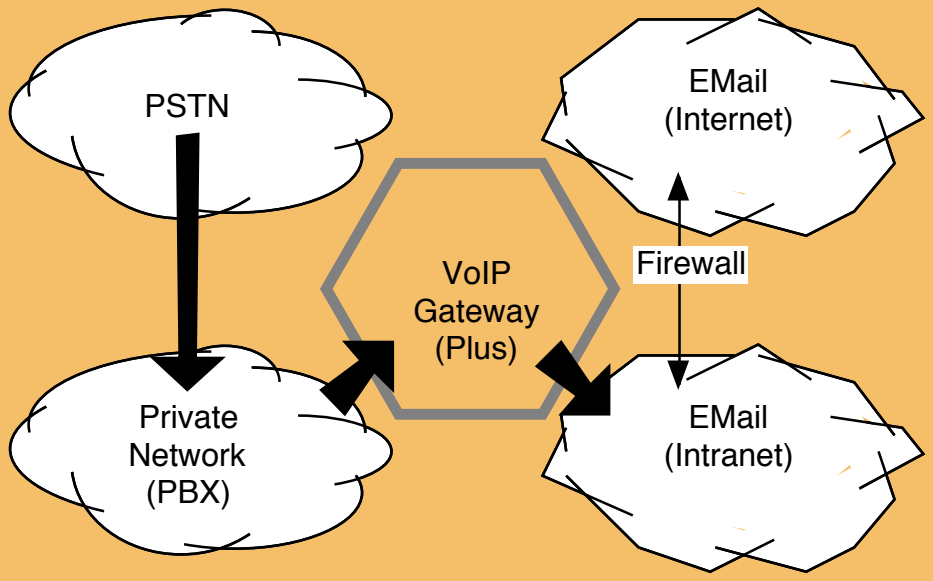
Conferencing

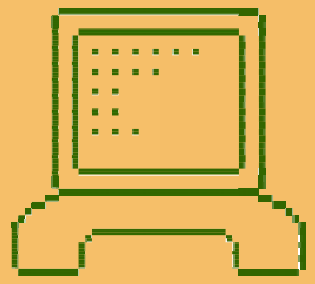
- Basic voice conferencing
- Enhanced with shared documents, etc.
- Participation from all four networks



Media Access:
VoIP VoiceMail

- VoiceMail capture into E-Mail
- Voicemail delivery across the Internet
- EMail retrieval through Text-to-Speech
- Delivery through E-Mail

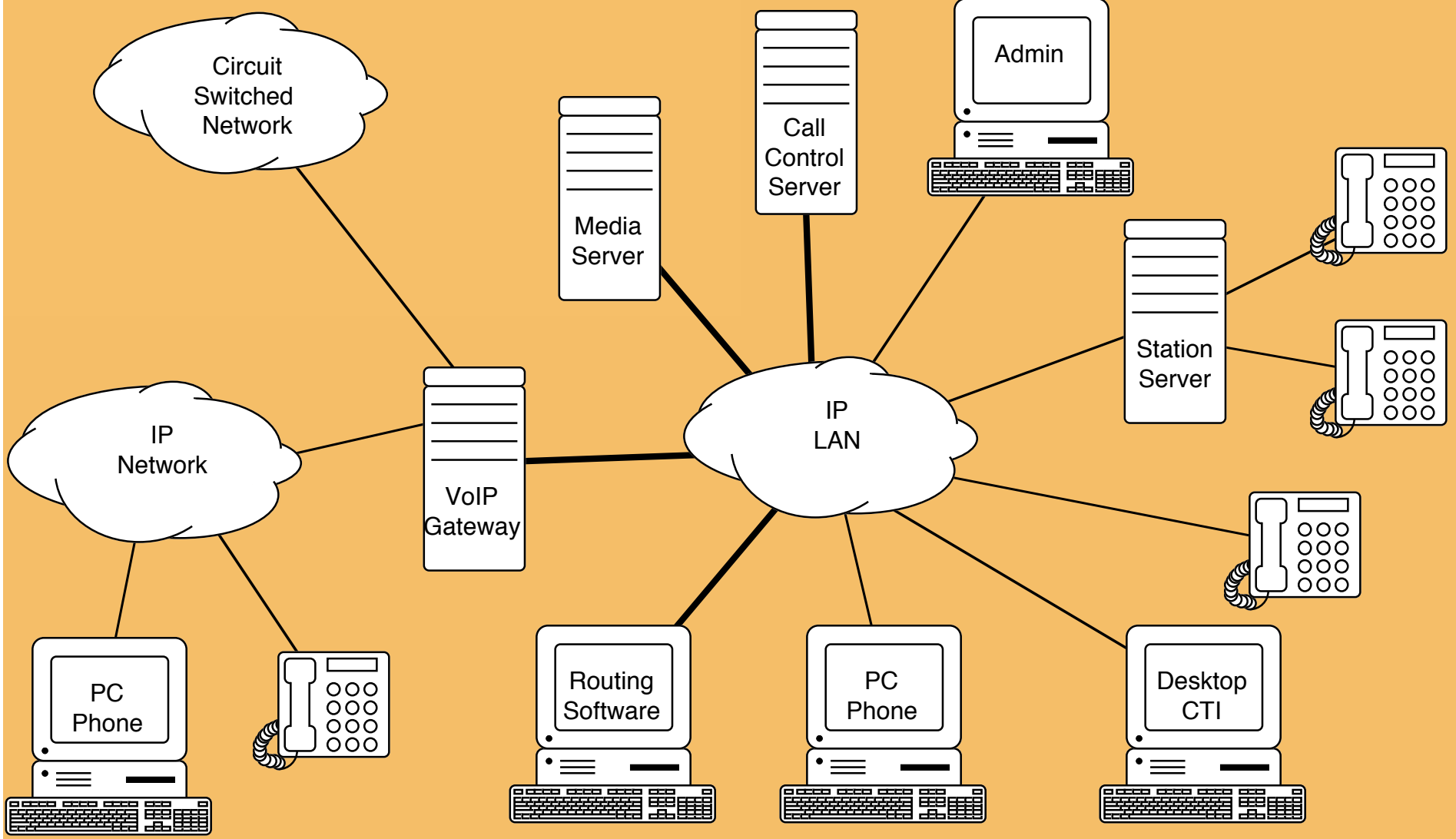




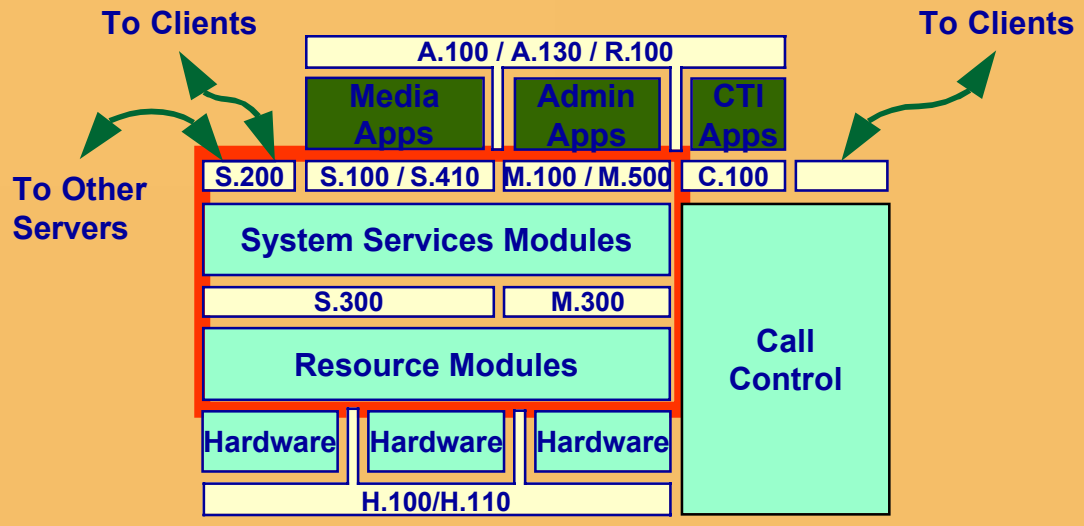
Part 4:

Media Services Interfaces

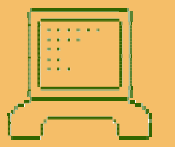
Media Services



ECTF Media Services Framework

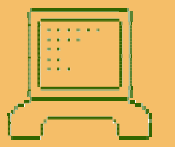


Media Services Specifications



- Framework
  - ECTF S.100
- Protocols
  - ECTF S.200
- APIs/SPIs
  - ECTF S.100
  - ECTF S.300
  - JTAPI Media (ECTF S.410)
  - Windows Telephony

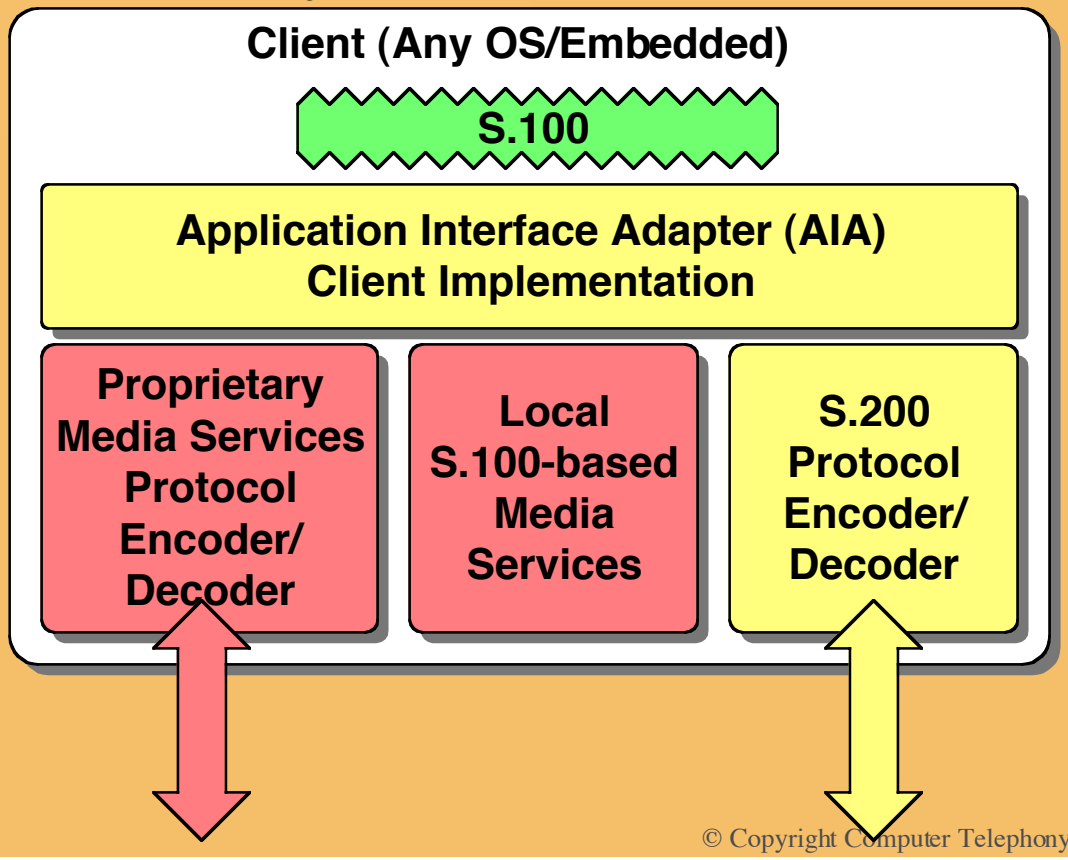
S.100 Concepts



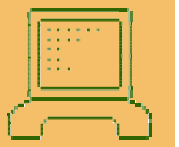
- Client-Server
  - Application Interface Adapter (AIA)
- Resources
- Groups
- Containers and Data Objects
- Extensible name space
- System Call Router (SCR)
- Runtime Control (RTC)

Clients, Servers, and Sessions

- Session represents a single association with local or remote logical server
- Applications may have one or more

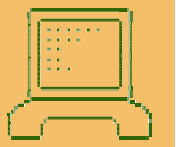


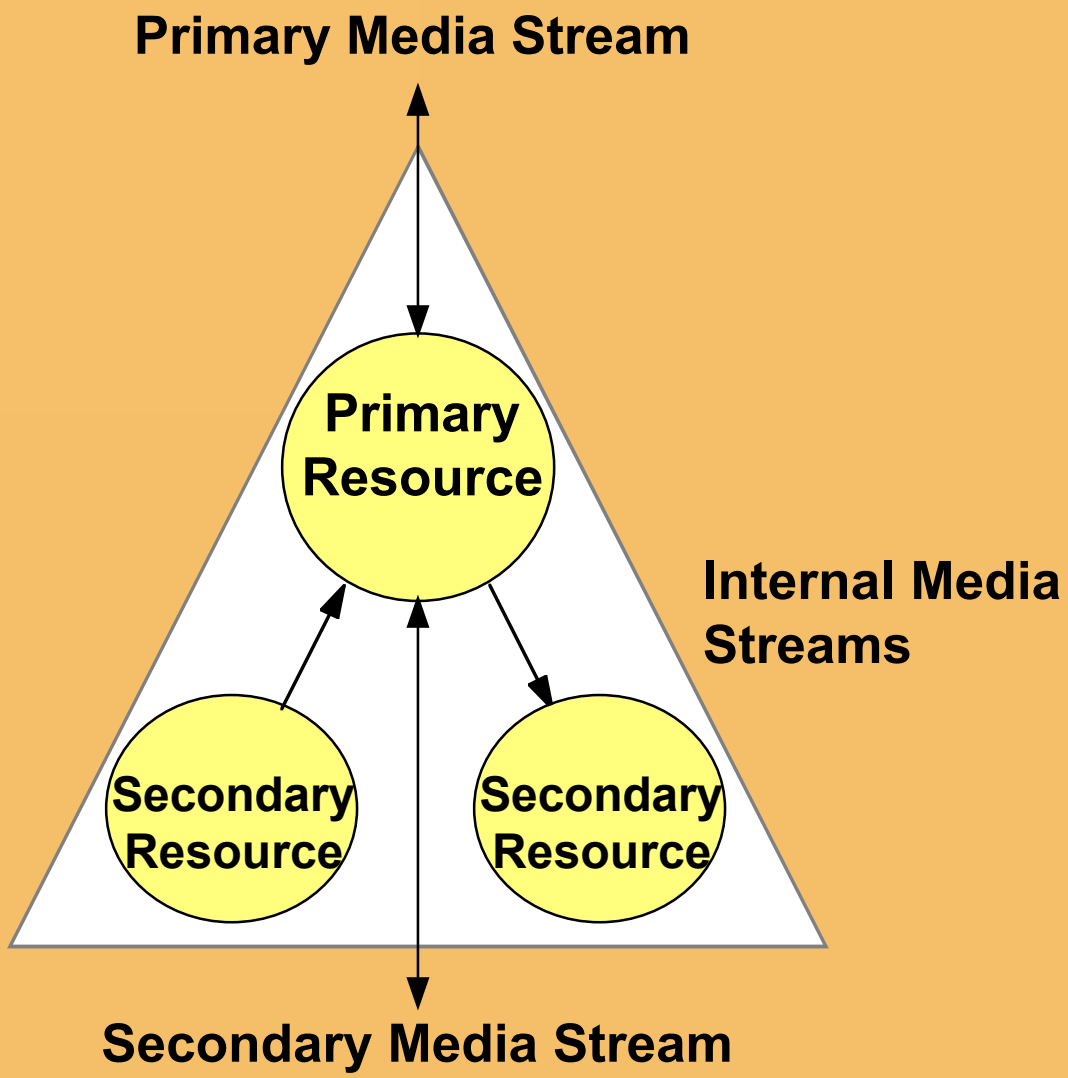
S.100 Resources



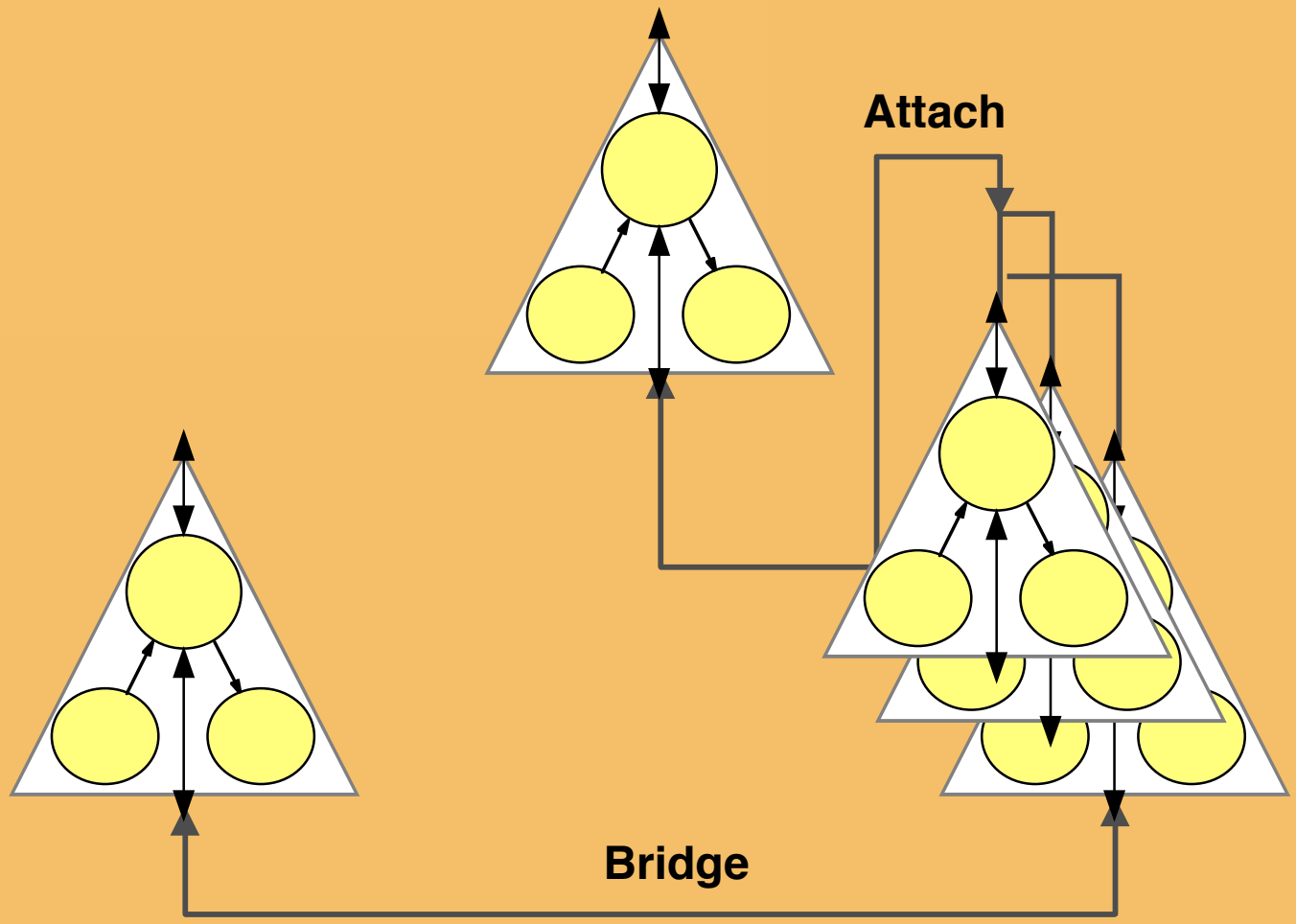
- CCR (Call Channel Resource)
- SPR (Switch Port Resource)
- Player
- Recorder
- Signal Detector
- Signal Generator
- ASR
- TTS (Type of Player Resource)
- Fax

Group Model



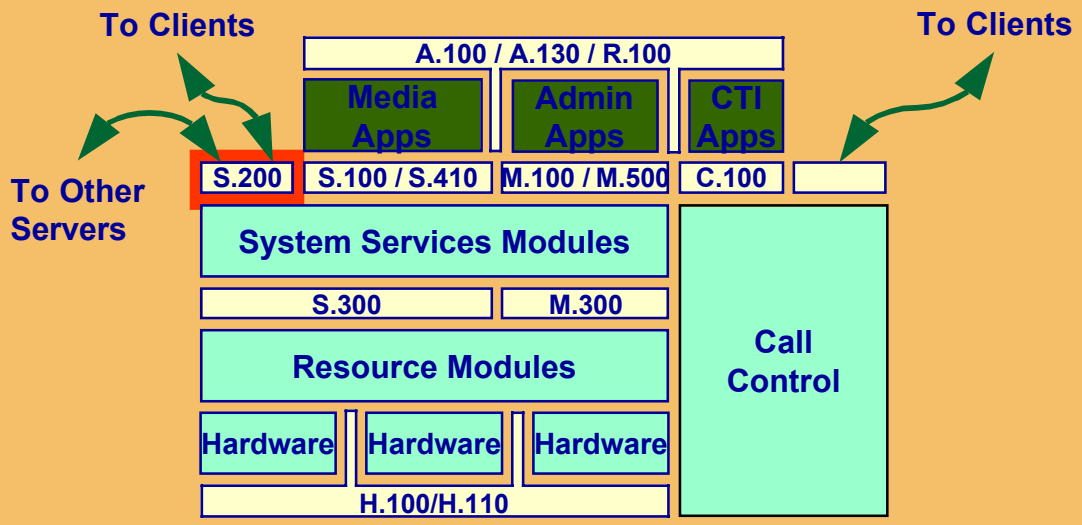


Inter-group Switching

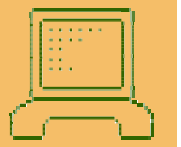


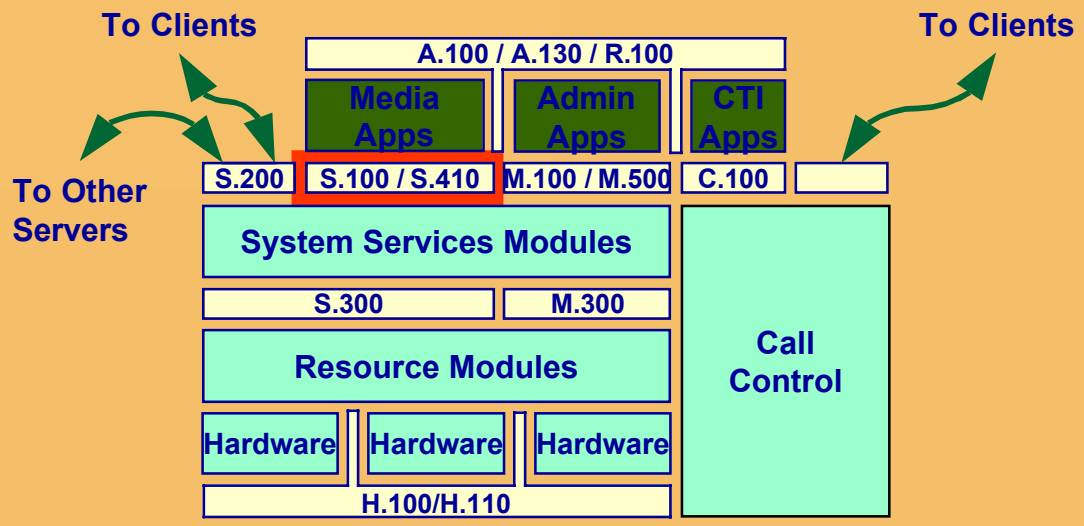
ECTF S.200 Protocol

- Operating-system independent, application-layer protocol complementing S.100 and M.100
- S.100 client AIA software can be developed independent of server vendors

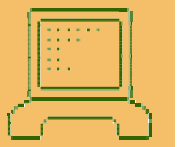


ECTF Media Services APIs



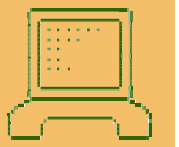


ECTF S.100 Media Services API



- ECTF Media Services “C” API and Framework
- Operating system independent
- Extensible support for new media services
- Multiple applications share location-independent resources and calls
- Location-independent support for modular media resources

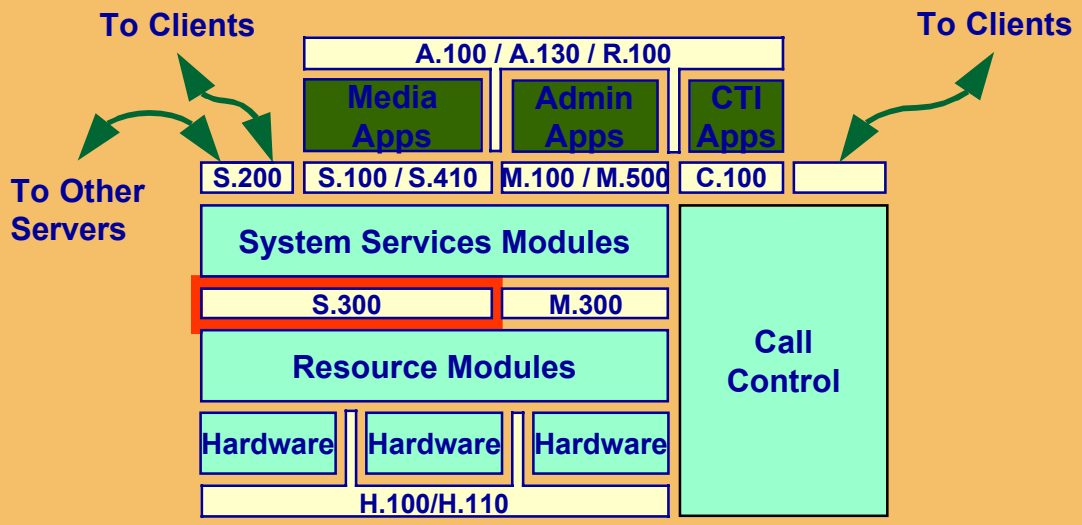
ECTF S.410 JTAPI Media



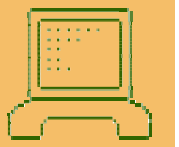
- Java API for computer telephony media services
- Extension to core JTAPI (Optional Package)
- Based on ECTF Architecture and S.100
- Location independent resources

ECTF S.300 Media Services SPI

- Service provider Interface for CT resources
- Enables the mixing and matching of hardware and software resources within a given S.100-based service platform



For More Information



- S.100 R2 and S.200 specifications and the ECTF product directory can be found at:

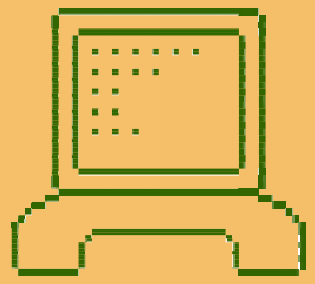
  http://www.ectf.org

- JTAPI information at:

  http://java.sun.com/products/jtapi/index.html

- TAPI information at:

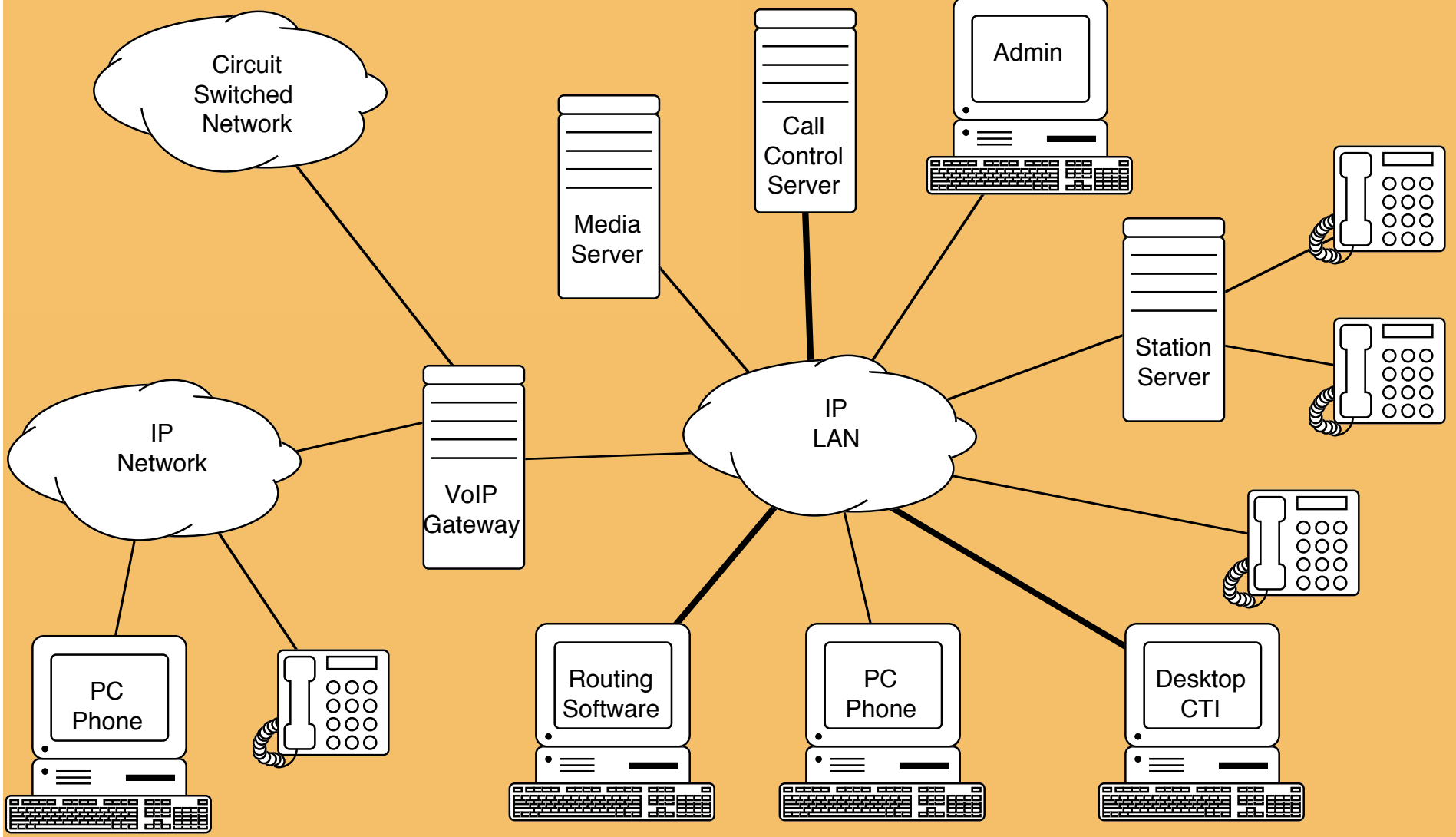
  http://www.microsoft.com/communications/telephony.htm



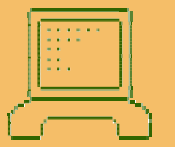
Part 5:

Call Control Interfaces

CTI / Call Control

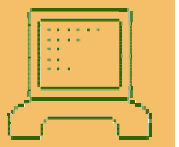


Call Control Specifications



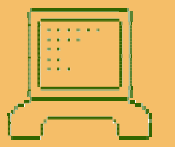
- Universal Call Control Model
  - ECTF C.001 / Versit CTIE / ECMA CSTA
- Protocols
  - Versit / CSTA
- Interfaces
  - TSAPI
  - Java Telephony
  - Windows Telephony

Universal CTI Model



- Everyone has to talk the same language before they can discuss interoperability
- A single model has emerged
  - ECTF C.001 / Versit CTIE / ECMA CSTA

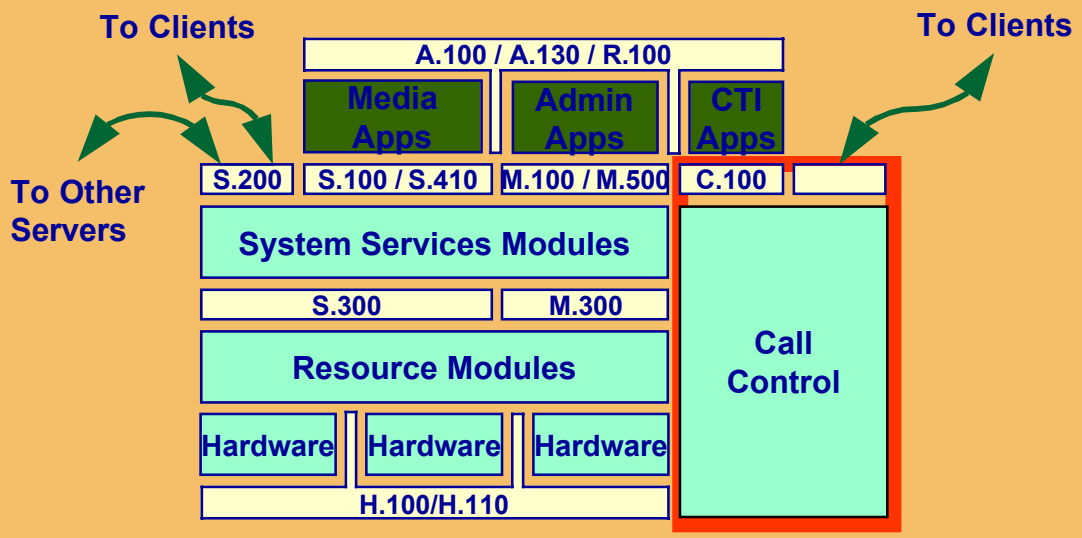
Call Control Specifications



- Universal Call Control Model
  - ECTF C.001 / Versit CTIE / ECMA CSTA
- Protocols
  - Versit / CSTA
- Interfaces
  - TSAPI
  - Java Telephony
  - Windows Telephony

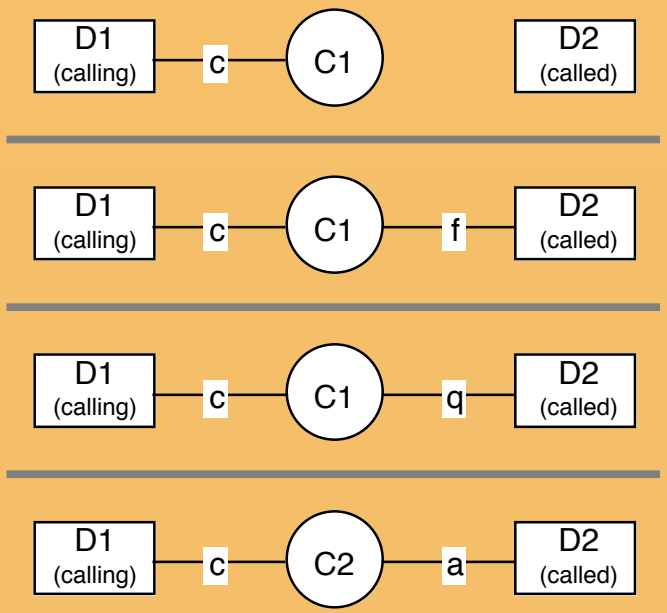
Universal Call Control Model

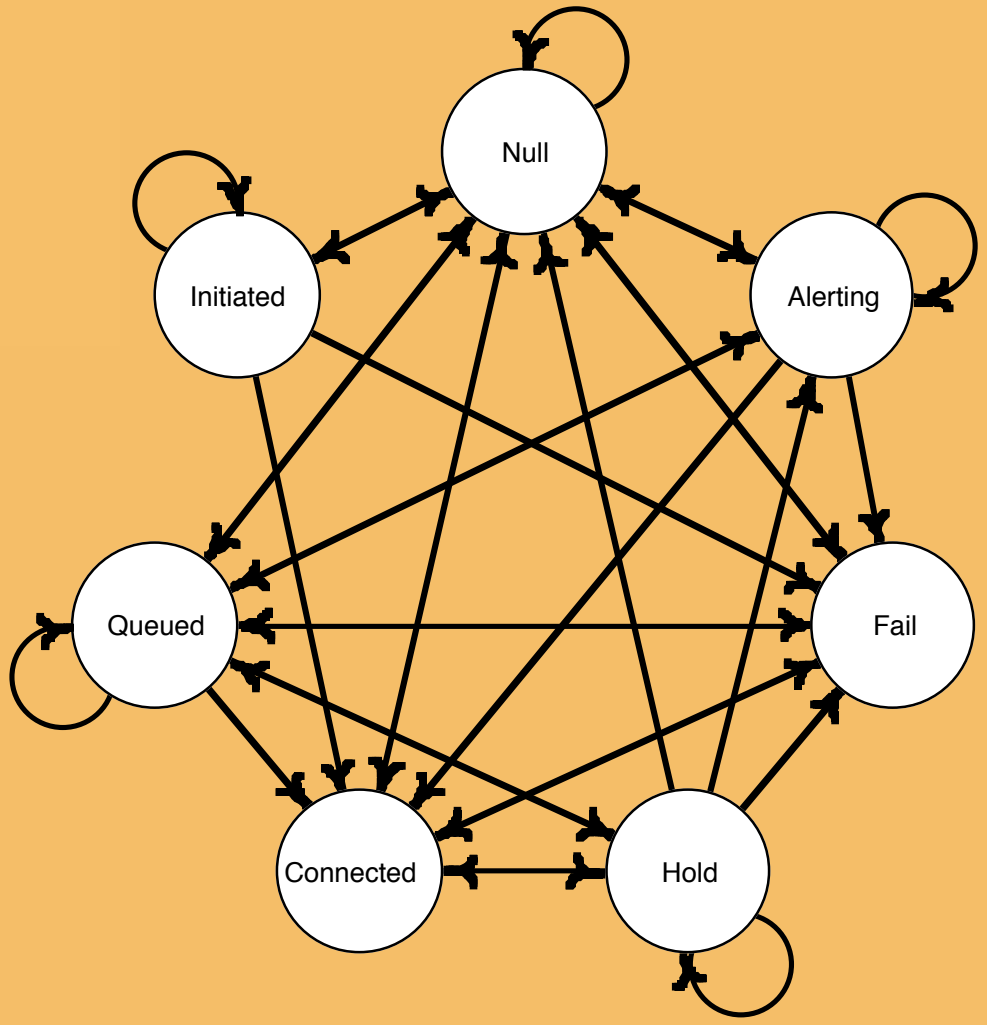
- Everyone has to talk the same language before they can discuss interoperability
- A single model has emerged
  - ECTF C.001 / Versit CTIE / ECMA CSTA



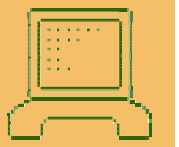
ECTF C.001 / Versit / CSTA

Connection State Model





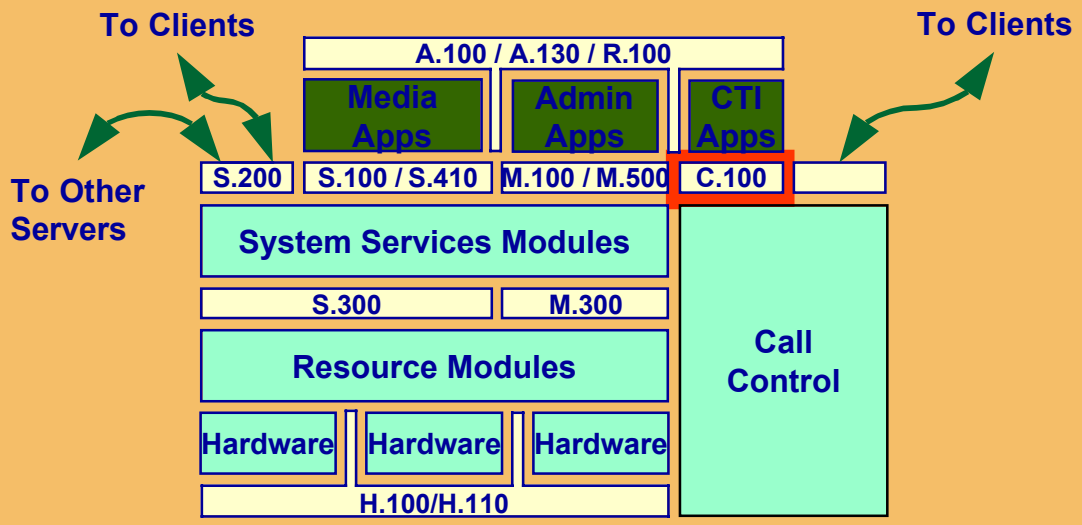
CTI Protocols



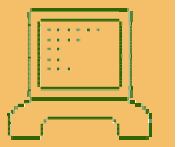
- Versit protocols have the same functionality but vary in their encoding
- Versit Protocol 1
  - Intended for switch-server streams
- Versit Protocol 2
  - Optimized for client-server streams
- Versit Protocol 3
  - Optimized for direct-connect streams
- CSTA Phase III Protocol
  - Variant of Versit Protocol 1

ECTF Framework

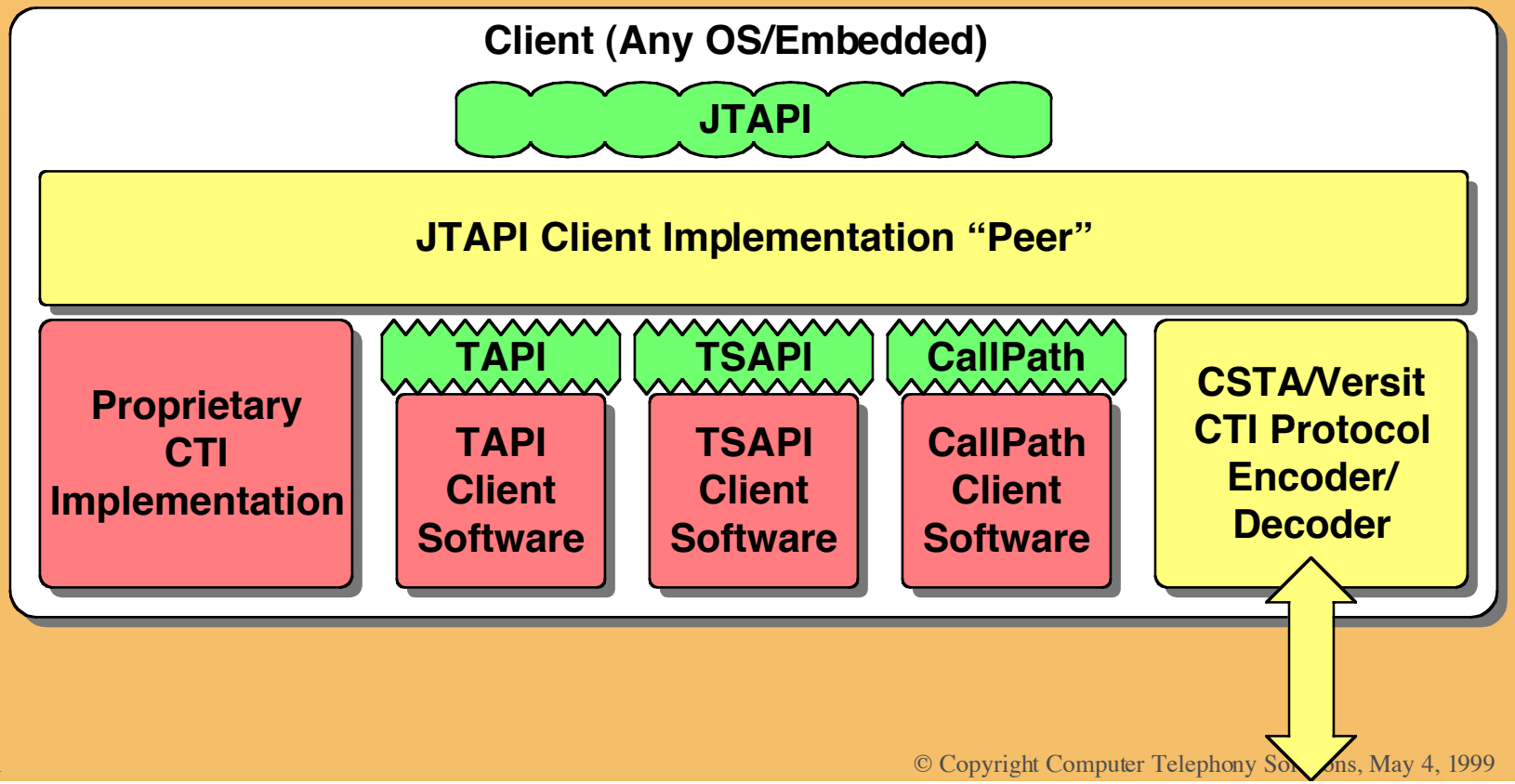
- C.100 Call Control API
  - Allow portability of applications between platforms and call control implementations.



JTAPI 1.3 (Any Java Virtual Machine)

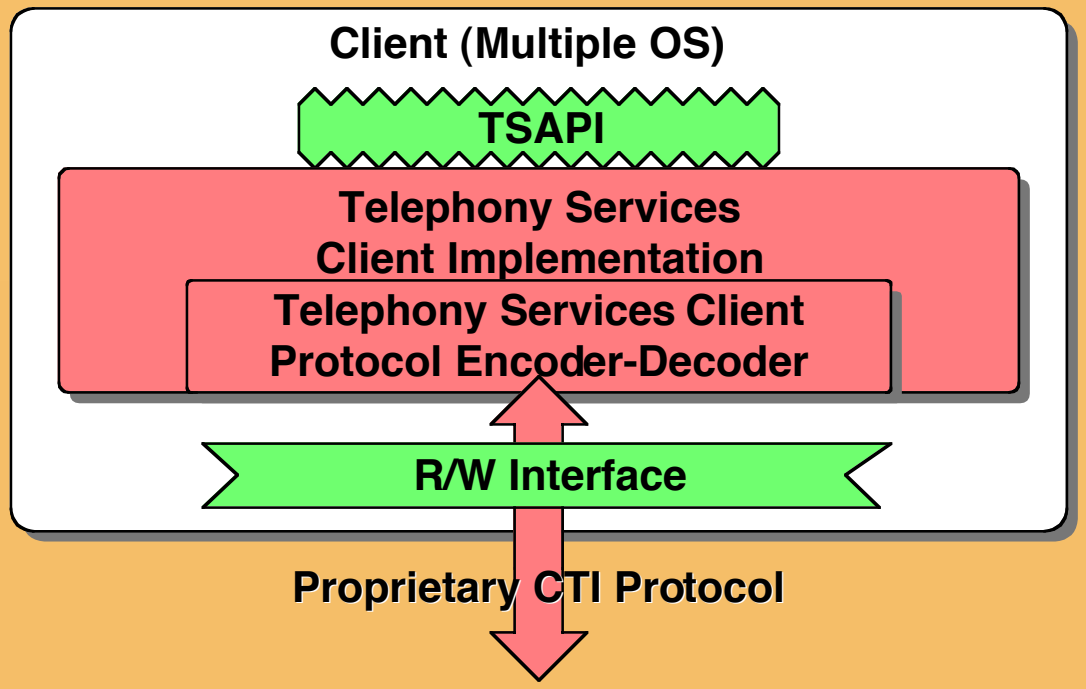


- ECTF C.100
- Designed to be layered over CTI APIs, or Protocols, or directly over implementations



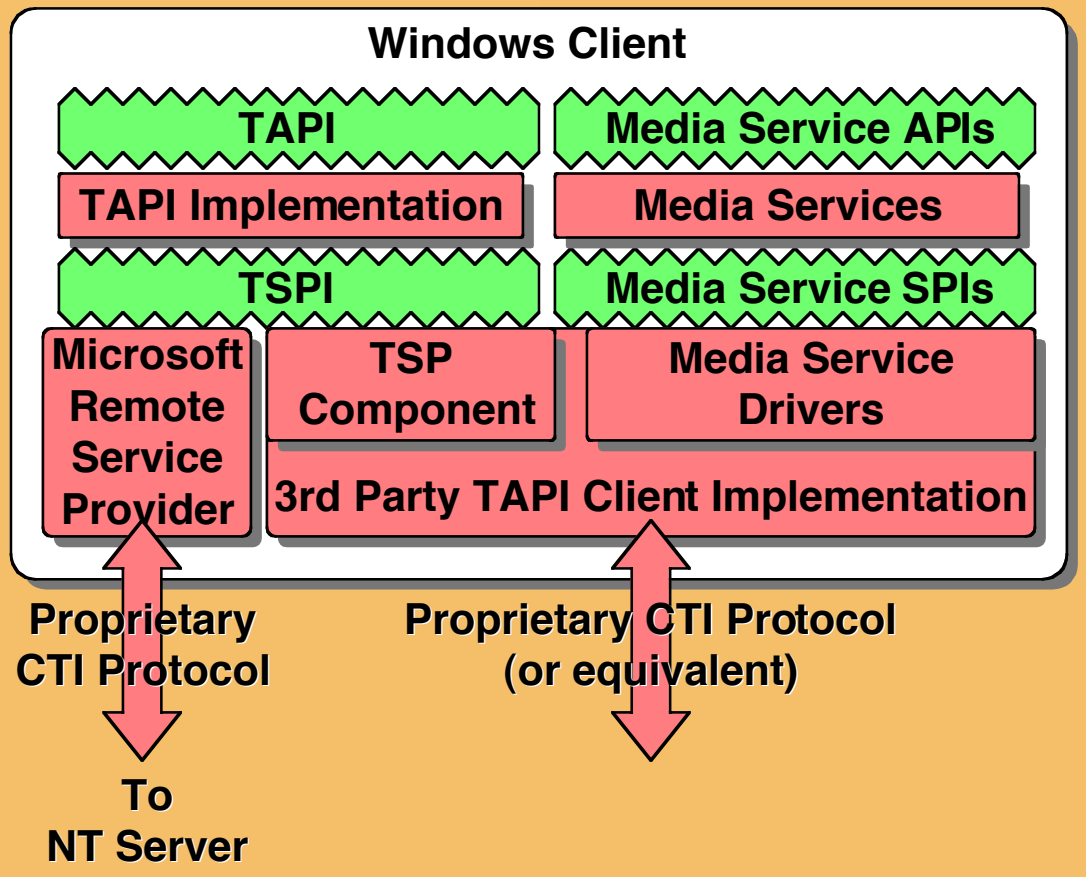
TSAPI (MacOS, Unix, Windows, etc.)

- Shipping versions:



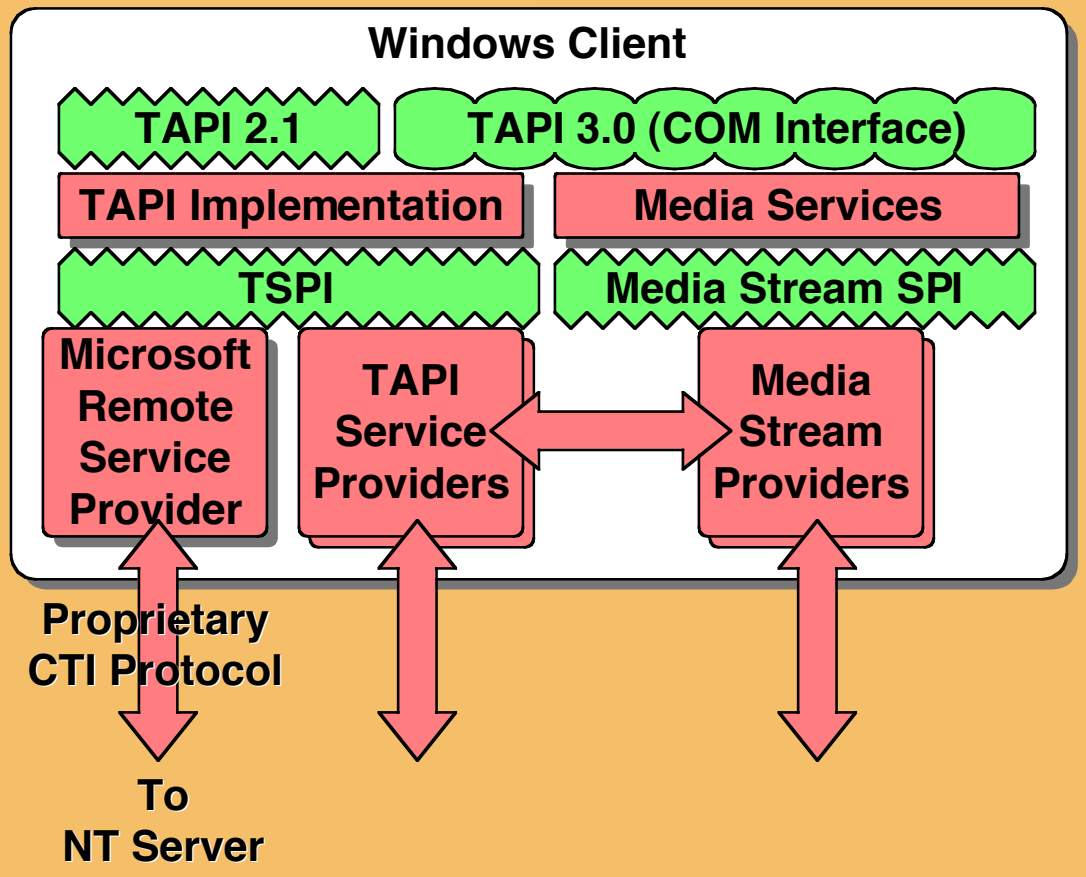
TAPI 2.1 (Windows 9x/NT)

- Windows Telephony

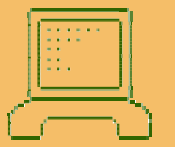


TAPI 3.0 (Windows 98/2000)

- Architecture

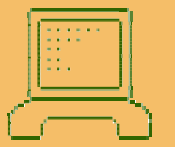


High-Level Interfaces



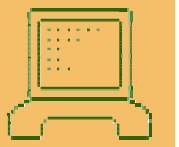
- Windows
  - DDE (implementation specific)
  - ActiveX (implementation specific)
  - Other proprietary mechanisms
- Mac OS
  - Telephony Apple Events

CTI Applications



- Screen-based Telephones (SBTs)
- Programmed Telephony
- Telephony-Aware applications

For More Information



- C.001 specifications and Versit CTIE:

  http://www.ectf.org

- Lucent TSAPI information at:

  http://www.lucent.com/enterprise/who/docs/product11.html

- Novell TSAPI information at:

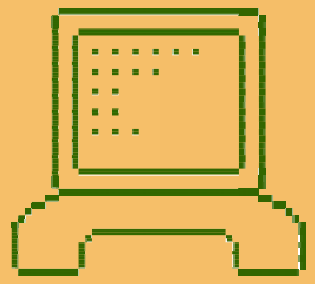
  http://www.novell.com/catalog/qr/sne24310.html

- JTAPI information at:

  http://java.sun.com/products/jtapi/index.html

- TAPI information at:

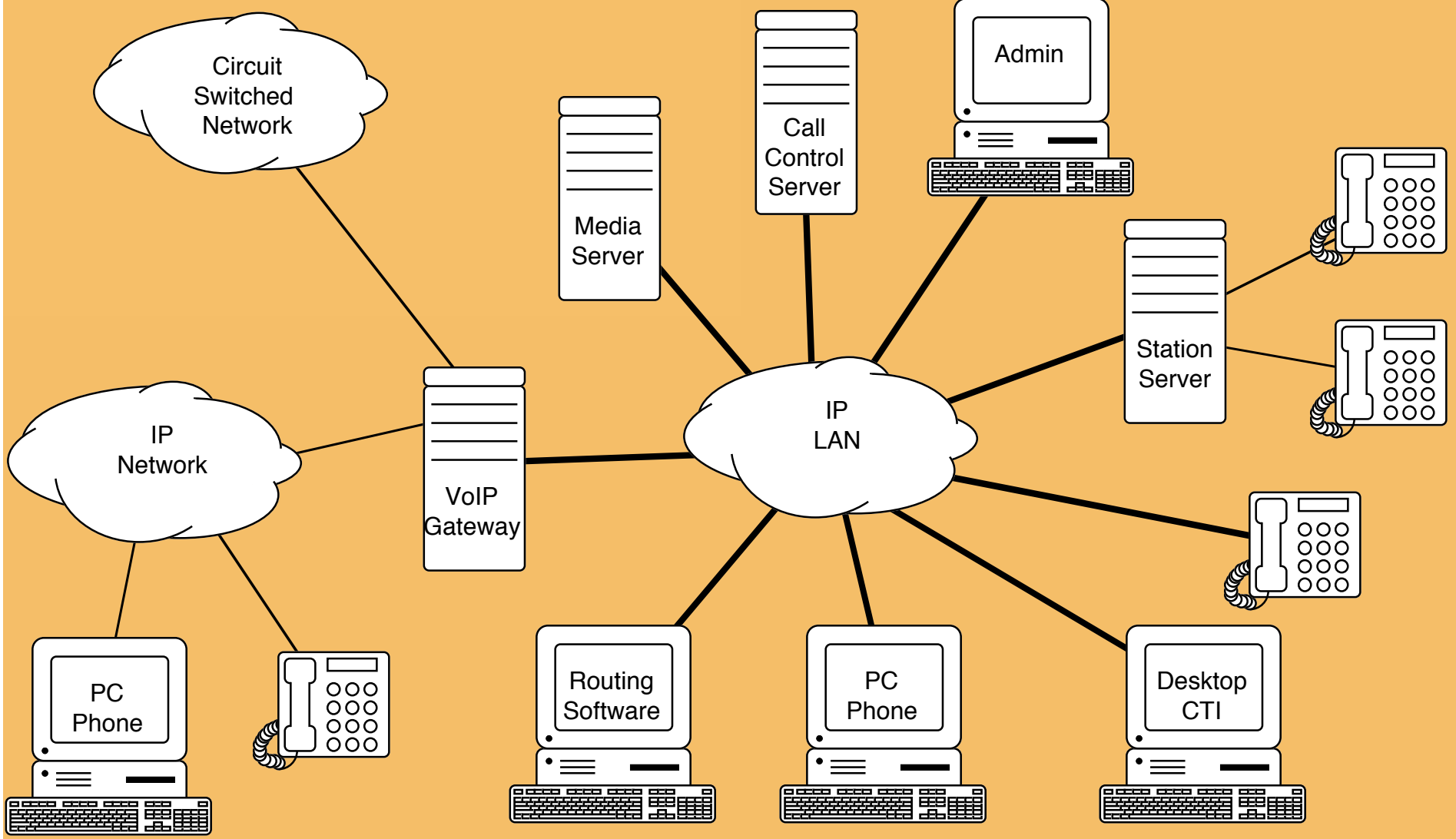
  http://www.microsoft.com/communications/telephony.htm



Part 6:

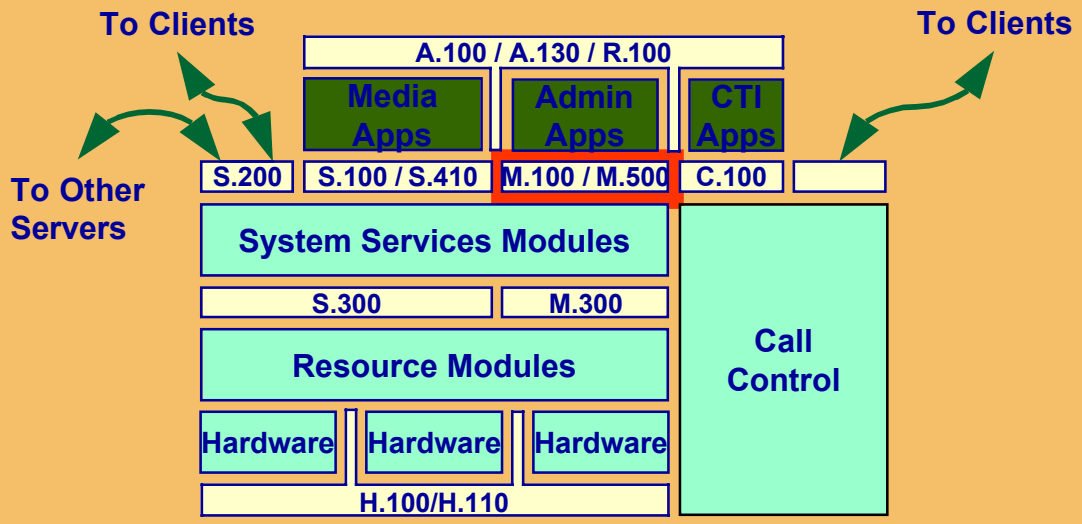
Other Interfaces

Administrative Services



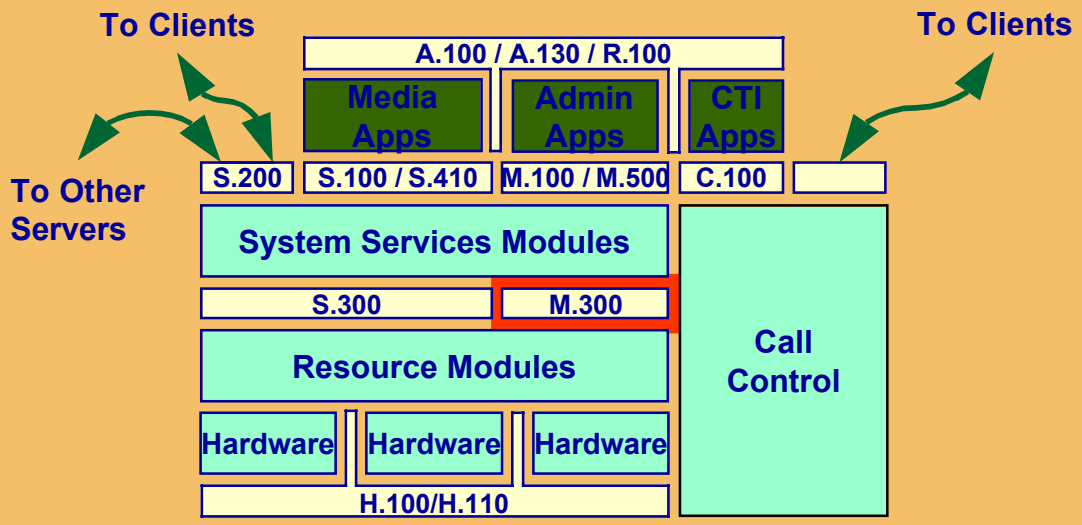
M.100

- Management API for CT Services
- Supports management of:
  - configuration data
  - safe startup and shutdown of CT servers
  - service provider information
  - application profiles



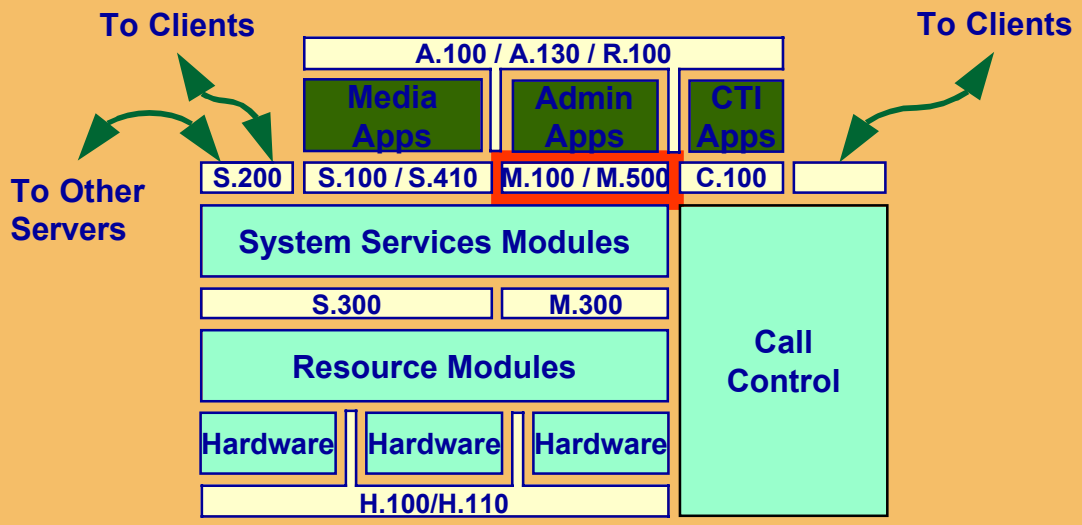
M.300 Management SPI

- Service Provider Interface corresponding to M.100
- Allows management of S.300-based resources



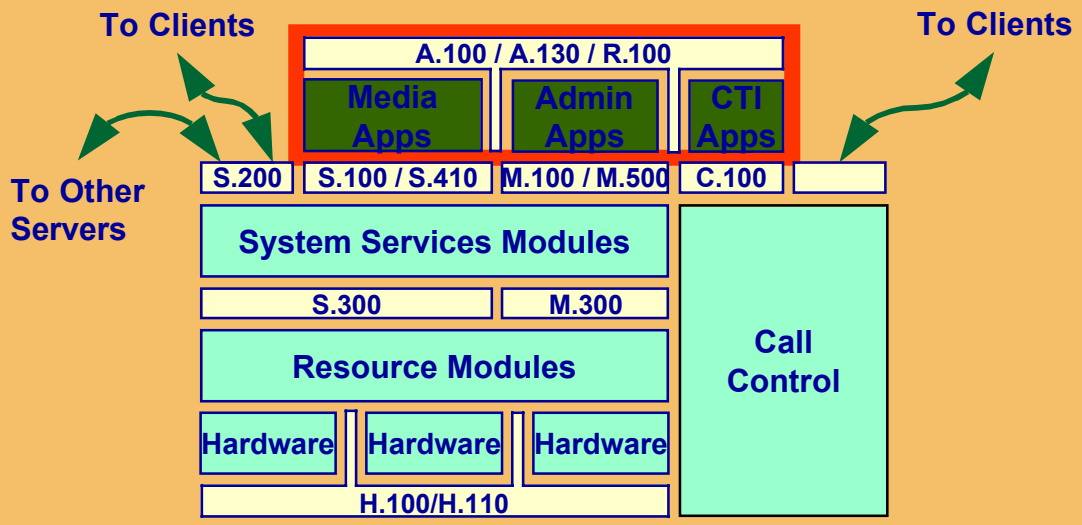
M.500 SNMP MIB

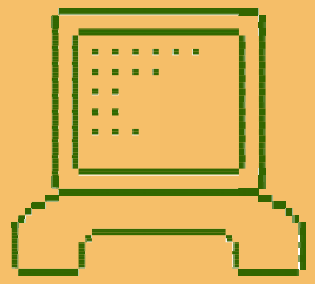
- SNMP Management Information Base for computer telephony servers
- Defines information made available to SNMP monitoring tools



ECTF Framework

- A.100 Application Interoperability
  - Requirements for call handling, hand-off, and accepting calls in S.100 environments
- A.130 Shared Data Specification
  - Data types for application interoperability

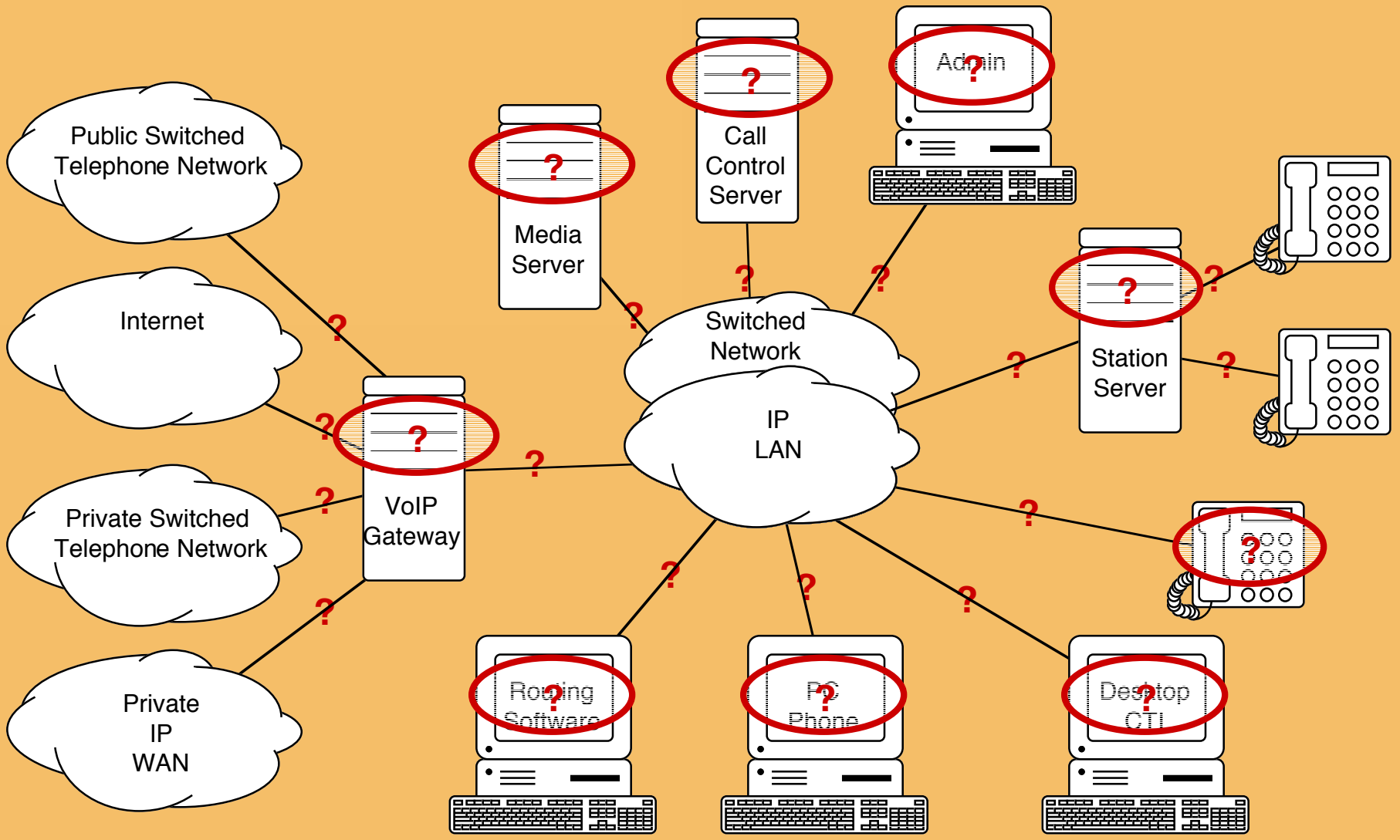




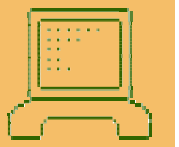
Part 7:

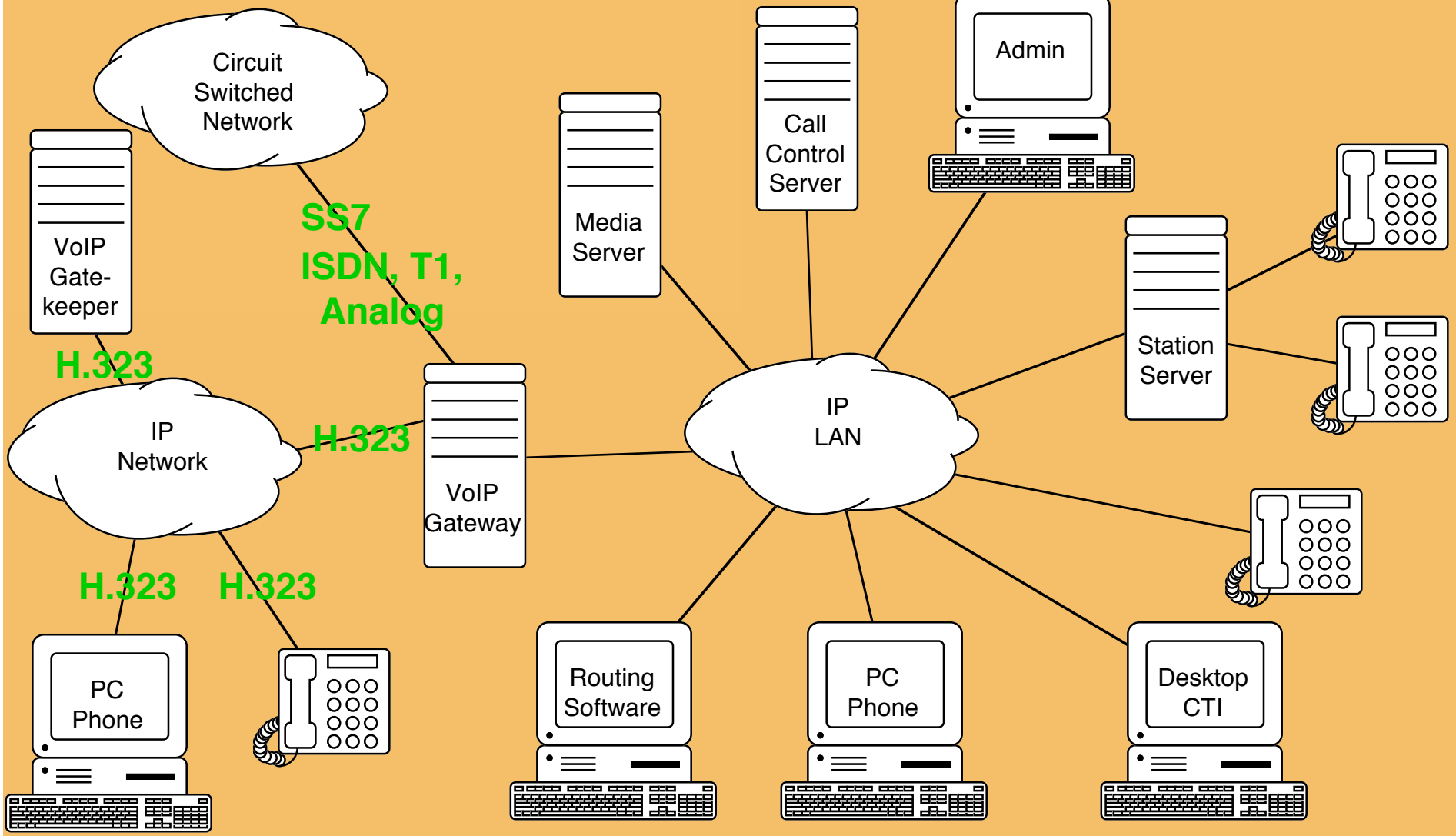
Putting It All Together

Telephone System Implementation

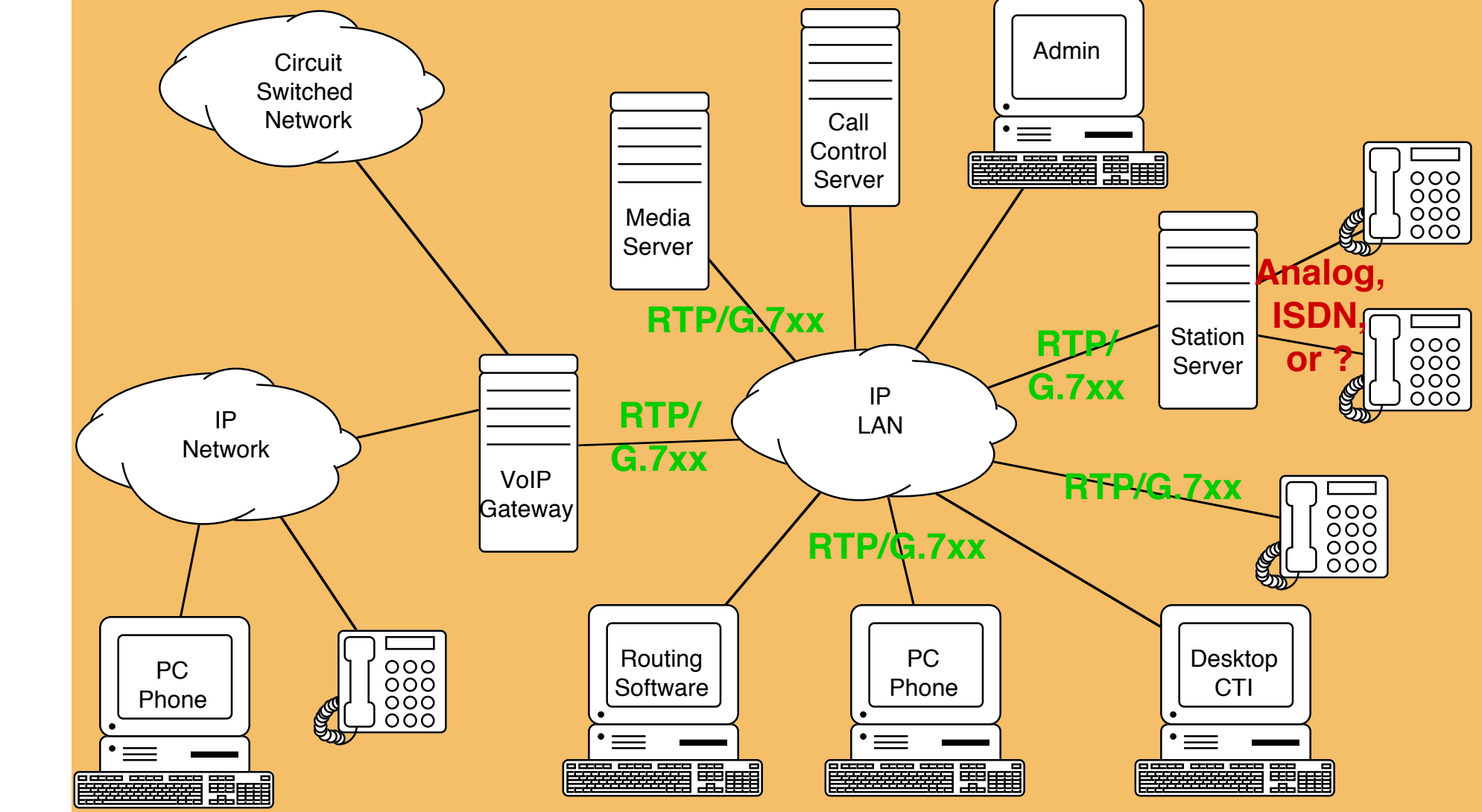


Public Network Switching/Signaling

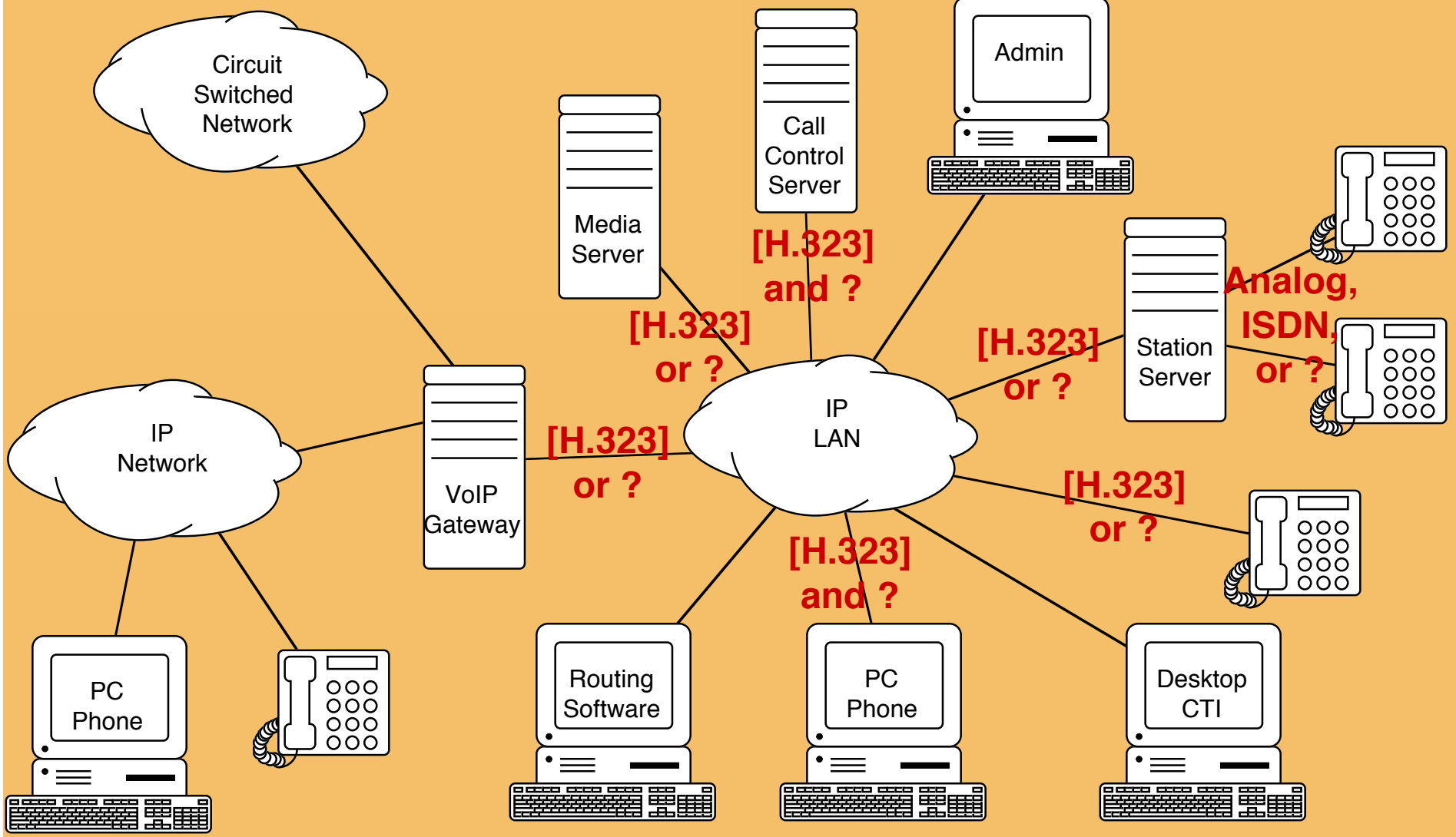




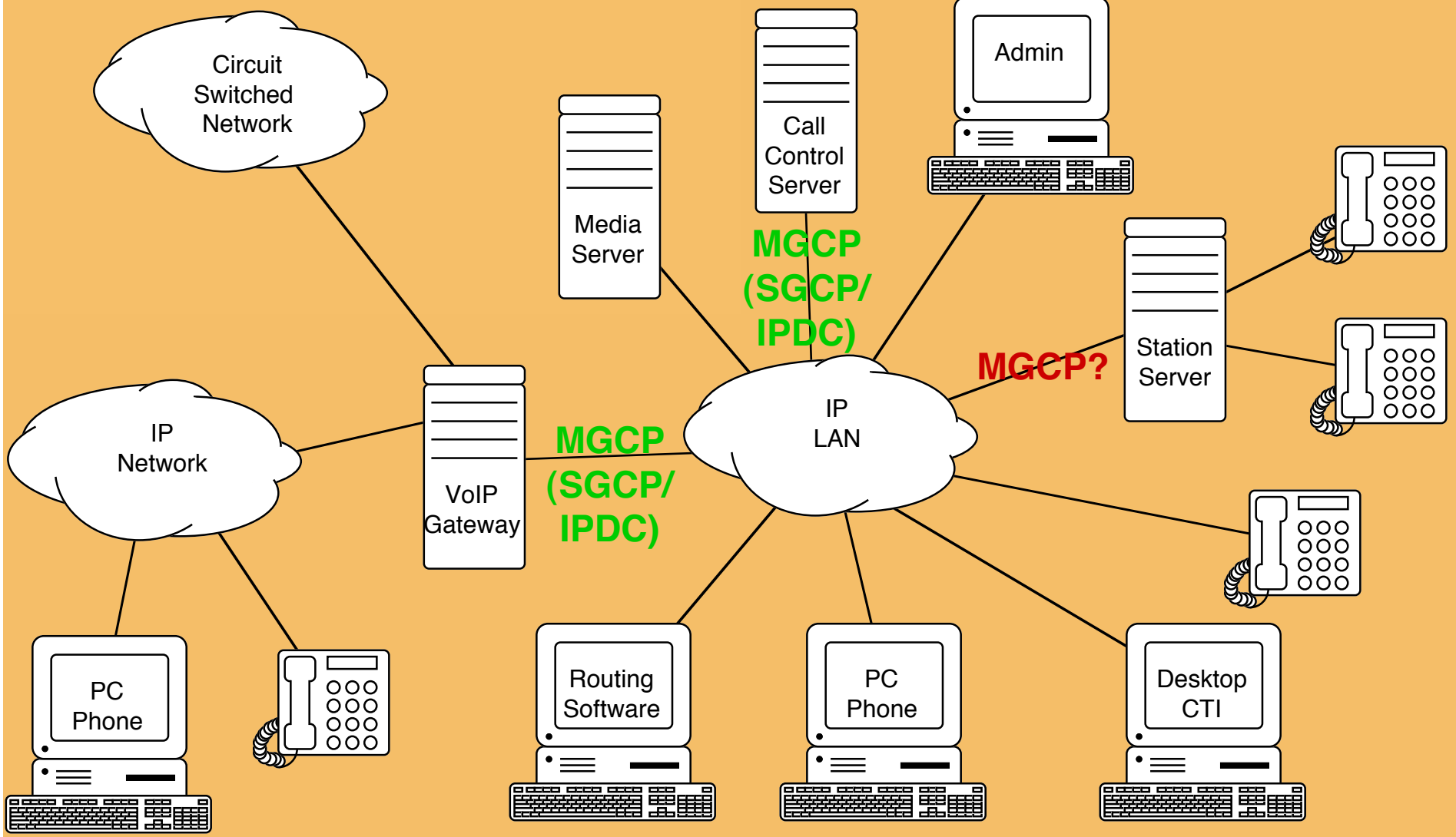
Switching: Media Streams



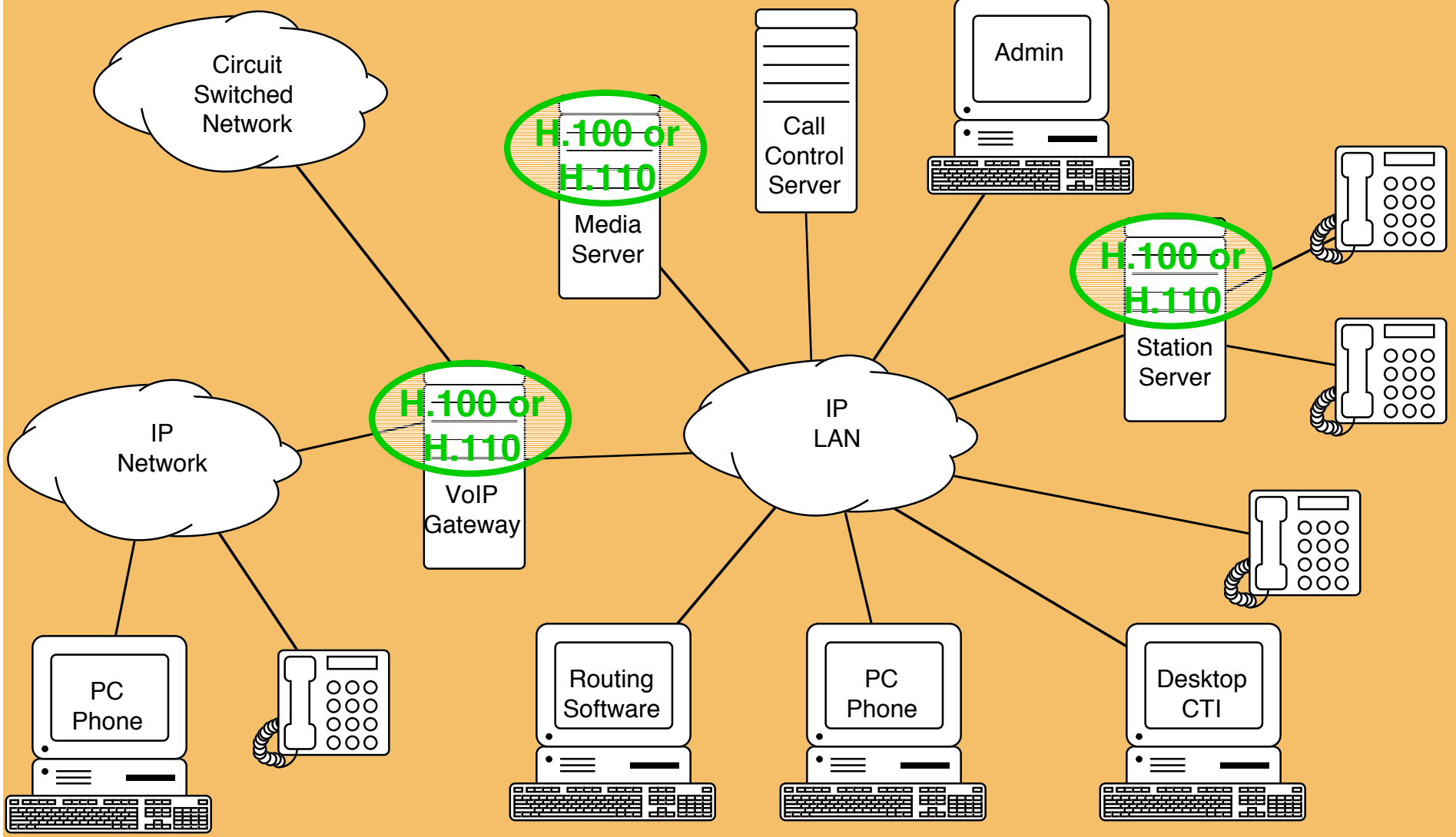
Switching: Signaling



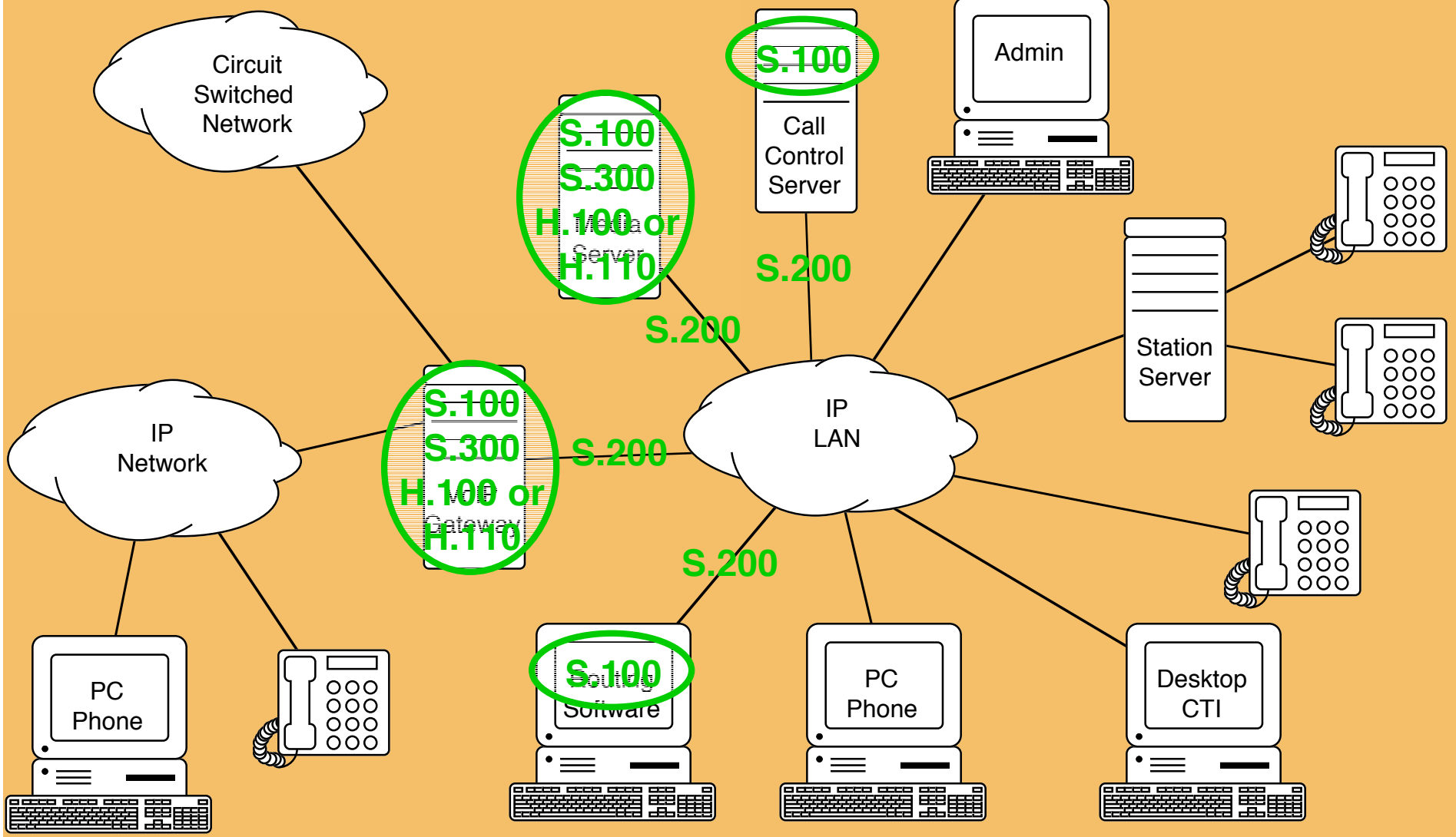
Switching Fabric Control



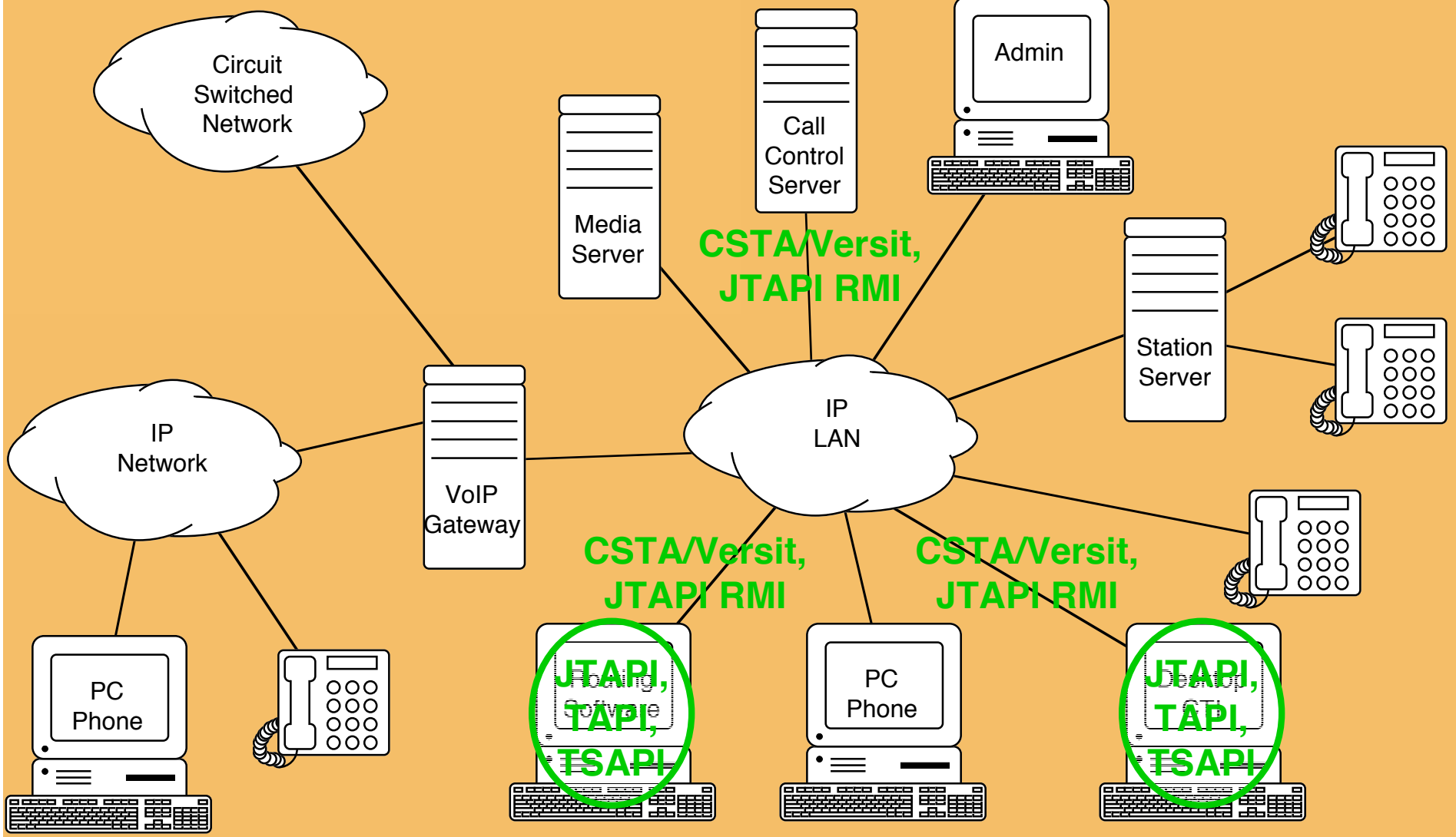
Switching Fabric: TDM Bus



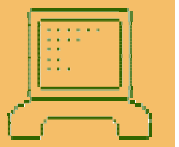
Media Services

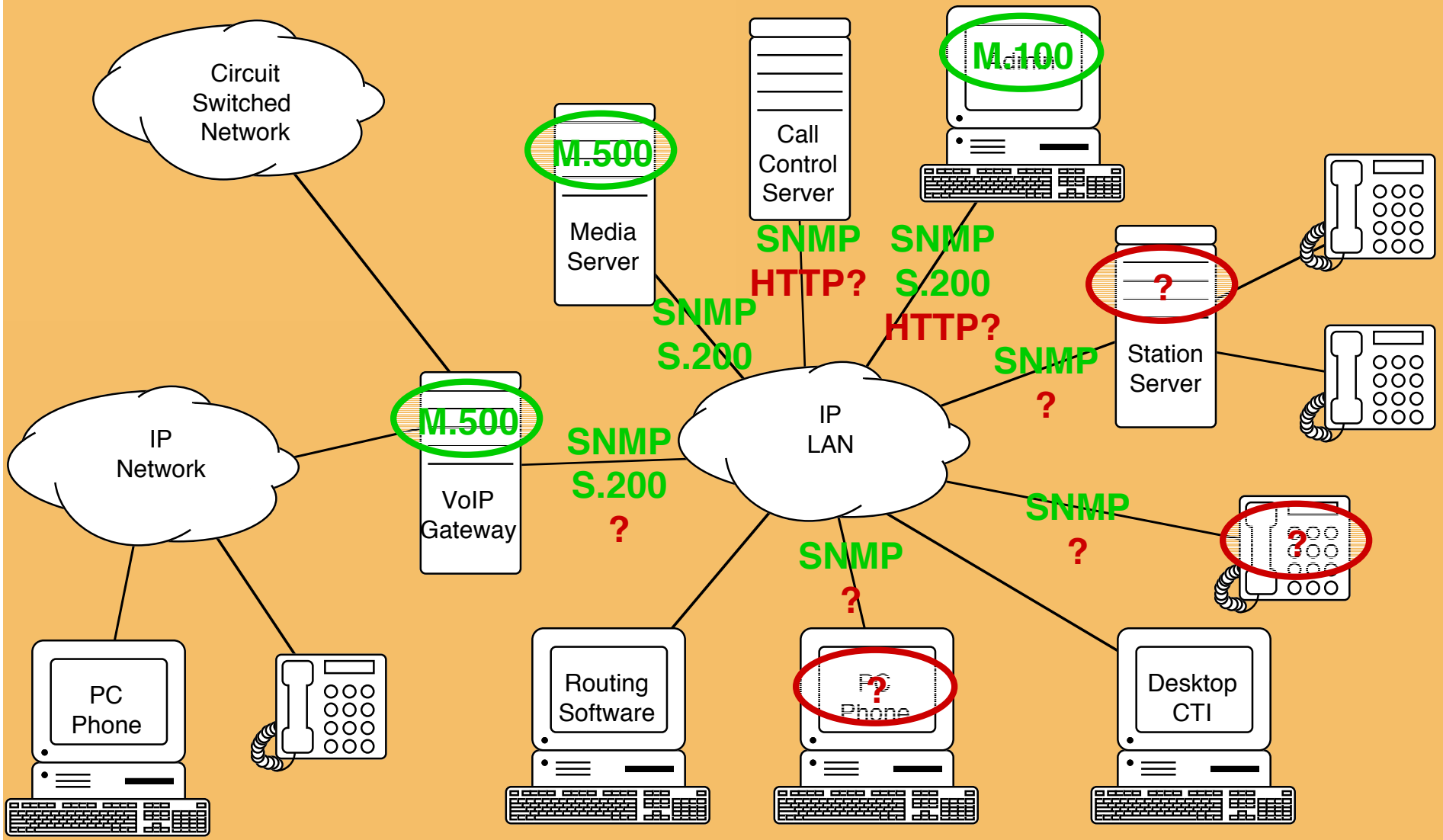


CTI / Call Control

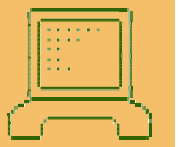


Administrative Services



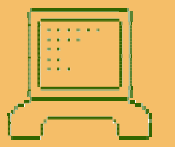


Maturity Checklist



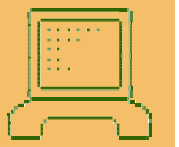
- Framework
- Published APIs
- Published Protocols
- Reference Implementations
- Plug & Play Products

Conclusions



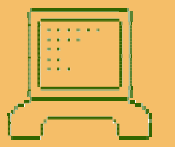
- Call Control
  - Universal framework has emerged
  - Newest generation of APIs are/will be functionally rich
  - CTI Plug & Play dependent upon adoption/completion of Versit/CSTA Phase III protocols

Conclusions



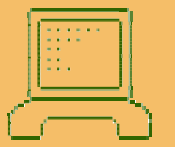
- Media Services
  - ECTF framework is the focus
  - Availability is a function of vendor adoption

Conclusions



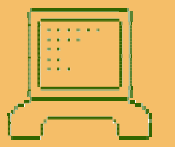
- Admin
  - M.100, M.300, M.500 are a solid suite for management and fault monitoring
  - HTML/HTTP is a good bet for configuration interfaces
  - Interfaces/protocols are still required for accounting (e.g., CDR)
  - Watch for standard directory schemas for call control configuration (MAC, CoS, etc.)

Conclusions

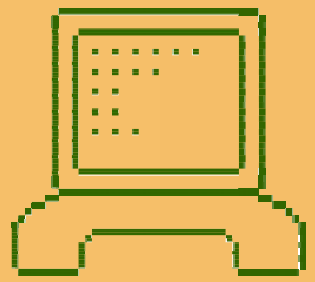


- Switching
  - TDM backplanes are here to stay in one form or another
  - H.100 and H.110 are the way to go for PCI and cPCI
  - H.323 for media streams
  - MGCP for gateway signalling
  - Significant outage is the lack of a standard station control protocol for Internet Telephones

What should you be doing?



- Regardless of your place in the value chain, you should:
  - Ask your vendors what they are doing
  - Encourage your vendors to implement and ship standards-based products (not just talk about it)
  - If appropriate, defer purchases or invest in products that will help you migrate to standards
  - Develop in a modular fashion by taking advantage of interoperability specifications wherever possible



Q&A

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