Achitecture and Signaling

Multimedia in Packet Networks

H.323 & SIP

upf. Universitat Pompeu Fabra Barcelona

Why Packet Networks?

"The rise of the stupid network"

David Isenberg, AT&T Labs, 1997

Assumptions

- Expensive, scarce infrastructure
- Voice generates most traffic
- Circuit-switched, high quality
- Telephone company in control

However

- Decline in infrastructure costs
- Increase in data traffic
- Many data types
- Many communication technologies
- Internet shifted control to the end-user

Why Packet Networks?

- Public Switched Telephone Network

The Good

- Voice is digital (PCM at 64 kbps), but circuit switched
- Signaling using SS7
- High reliability, availability and quality of service

The Bad

- The voice (user) channel is in used continuously during a call
- Even when the call participants are not saying anything
- Operators overprovision their network to accommodate peak demand

The packet networks are taking over

Standards

- Well-defined, detailed standards
- High levels of control
- Quality "circuit-switched" thinking

- "Working code & rough consensus"
- Extendibility, modularity
- Best-effort "packet-switched" thinking

H.323

SIP

Multimedia in Packet Networks

H.323

ITU-T Recommendations

A	Organization of the work of ITU-T
B	Means of expression: definitions, symbols, classification
C	General telecommunication statistics
D	General tariff principles
E	Overall network operation, telephone service, service operation and human factors
F	Non-telephone telecommunication services
G	Transmission systems and media, digital systems and networks
H	**Audiovisual and multimedia systems**
I	Integrated services digital network
J	
K	
L	
M	
N	Maintenance: international sound programme and television transmission circuits
O	Specifications of measuring equipment
P	
Q	
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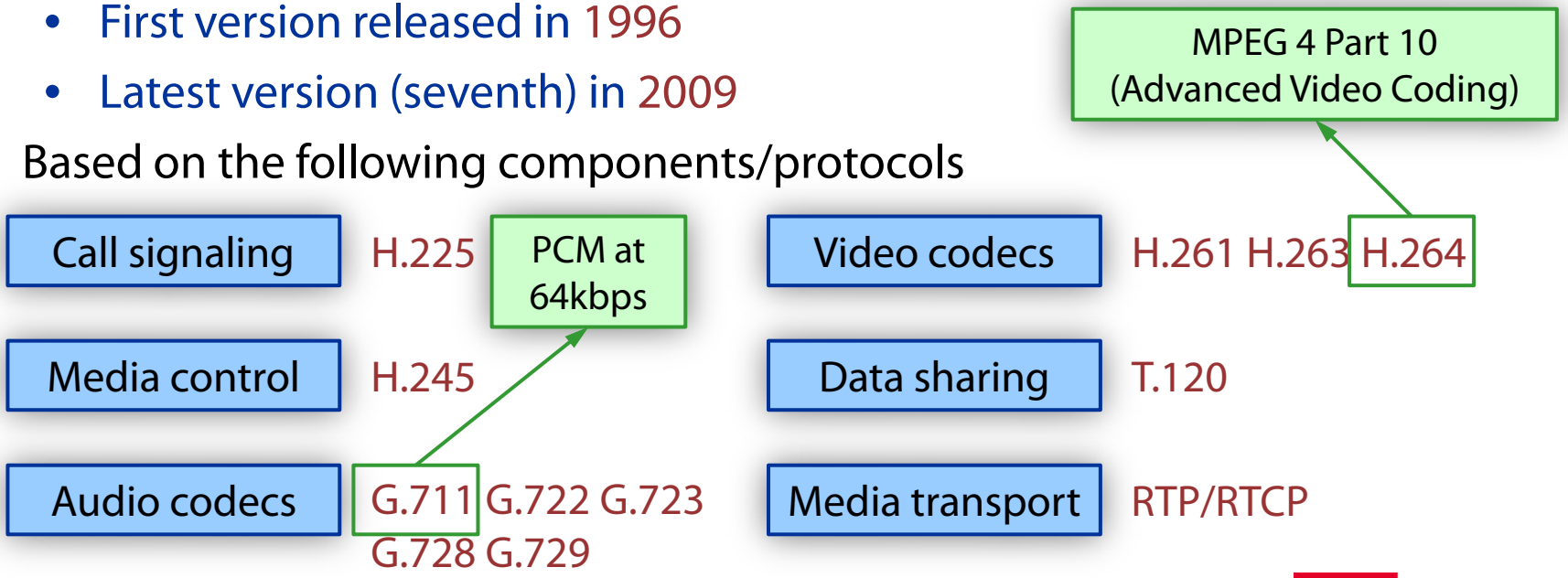
H.300-H.349 Systems and terminal equipment for audiovisual services

H.310	Broadband audiovisual communication systems and terminals
H.320	Narrow-band visual telephone systems and terminal equipment
H.321	Adaptation of H.320 visual telephone terminals to B-ISDN environments
H.322	Visual telephone systems and terminal equipment for local area networks which provide a guaranteed quality of service
H.323	Packet-based multimedia communications systems
H.324	Terminal for low bit-rate multimedia communication
H.331	Broadcasting type audiovisual multipoint systems and terminal equipment
H.332	H.323 extended for loosely coupled conferences
H.341	Multimedia management information base

What Is It?

H.323 An ITU-T specification for transmitting audio, video, and data across a packet-based network, including the Internet.

- History
  - First version released in 1996
  - Latest version (seventh) in 2009
- Based on the following components/protocols



What Do We Study?

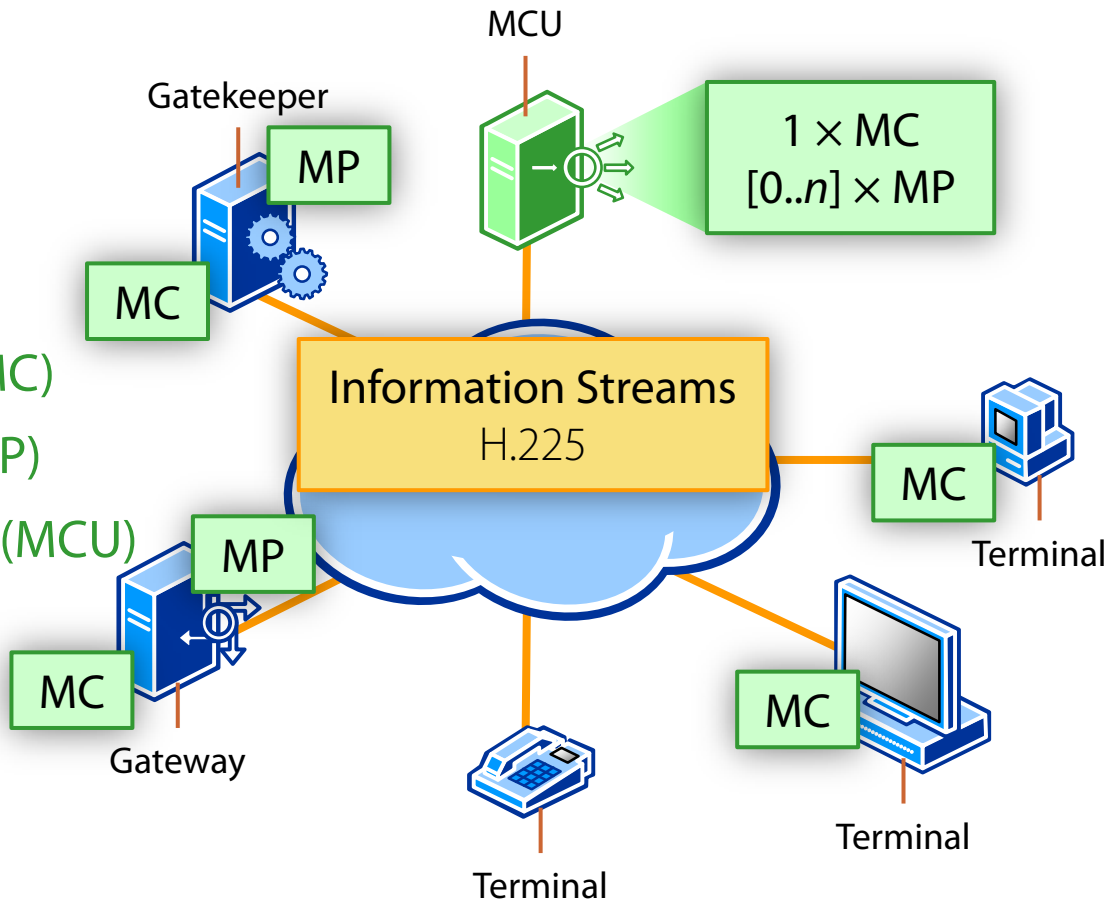
H.323

1. Elements
2. Protocol suite
3. Call flows

H.323 Elements

- We have
  1. Terminals
  2. Gateway
  3. Gatekeeper
  4. Border Element (BE)

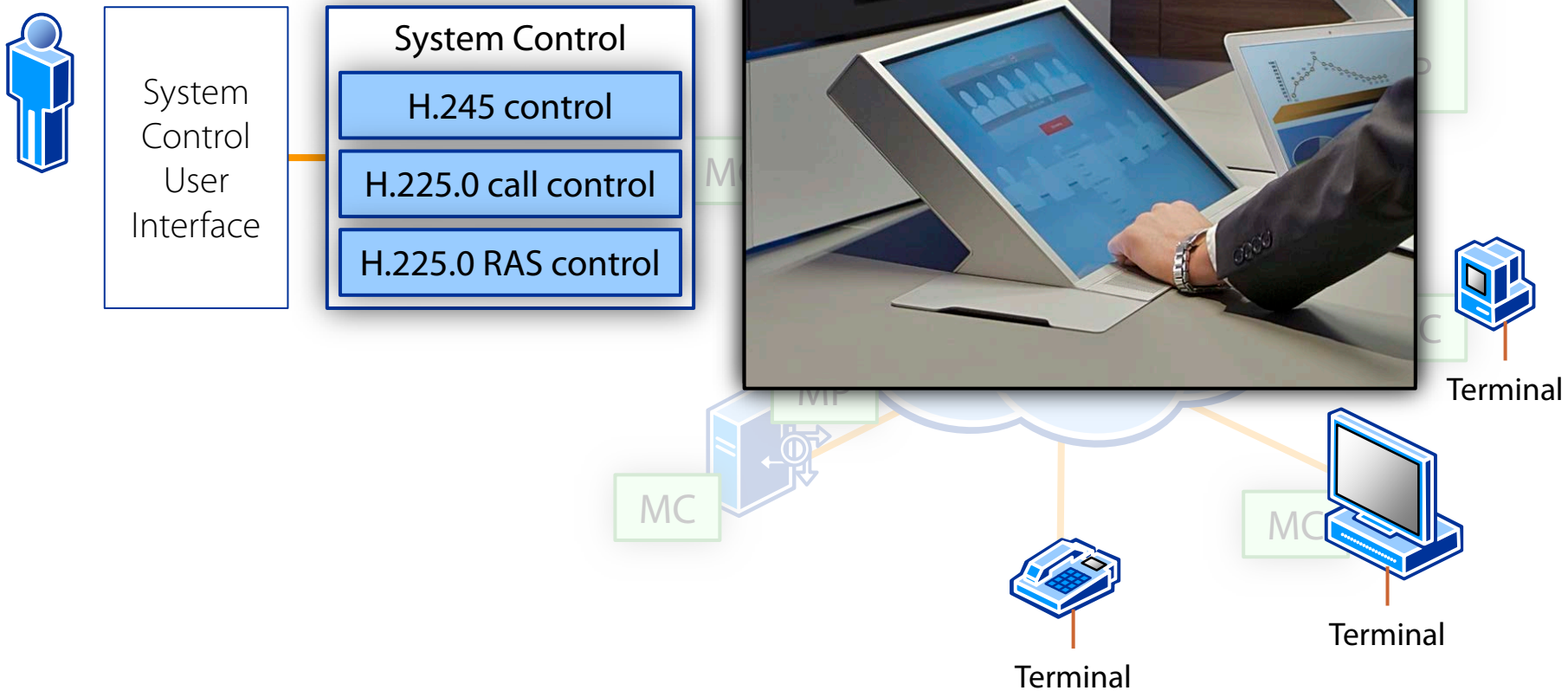
  Conference
  5. Multipoint Controller (MC)
  6. Multipoint Processor (MP)
  7. Multipoint Control Unit (MCU)



The Terminals

Or end-points, support point-to-point and multipoint conferencing for audio, video and data.

- An H.323 terminal:



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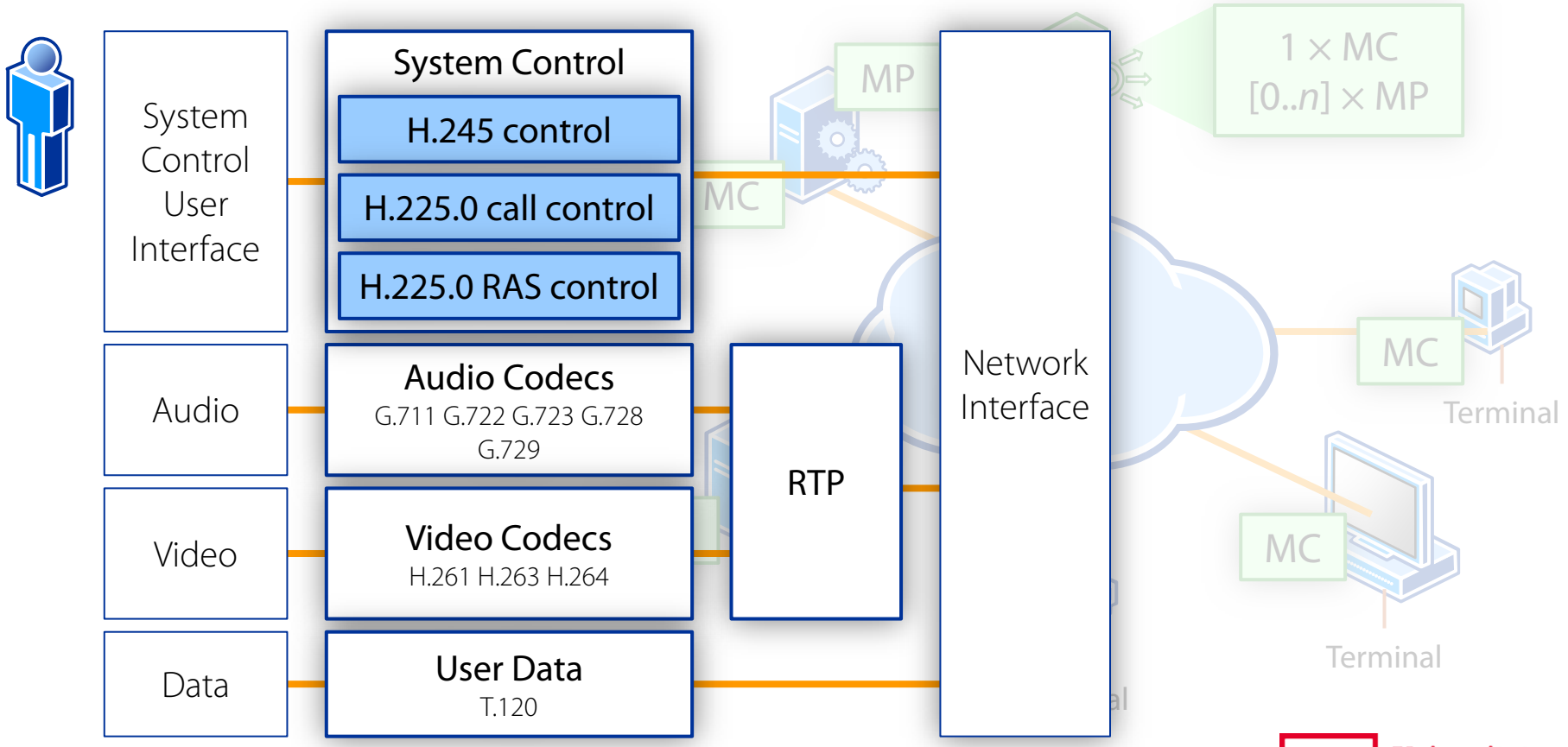
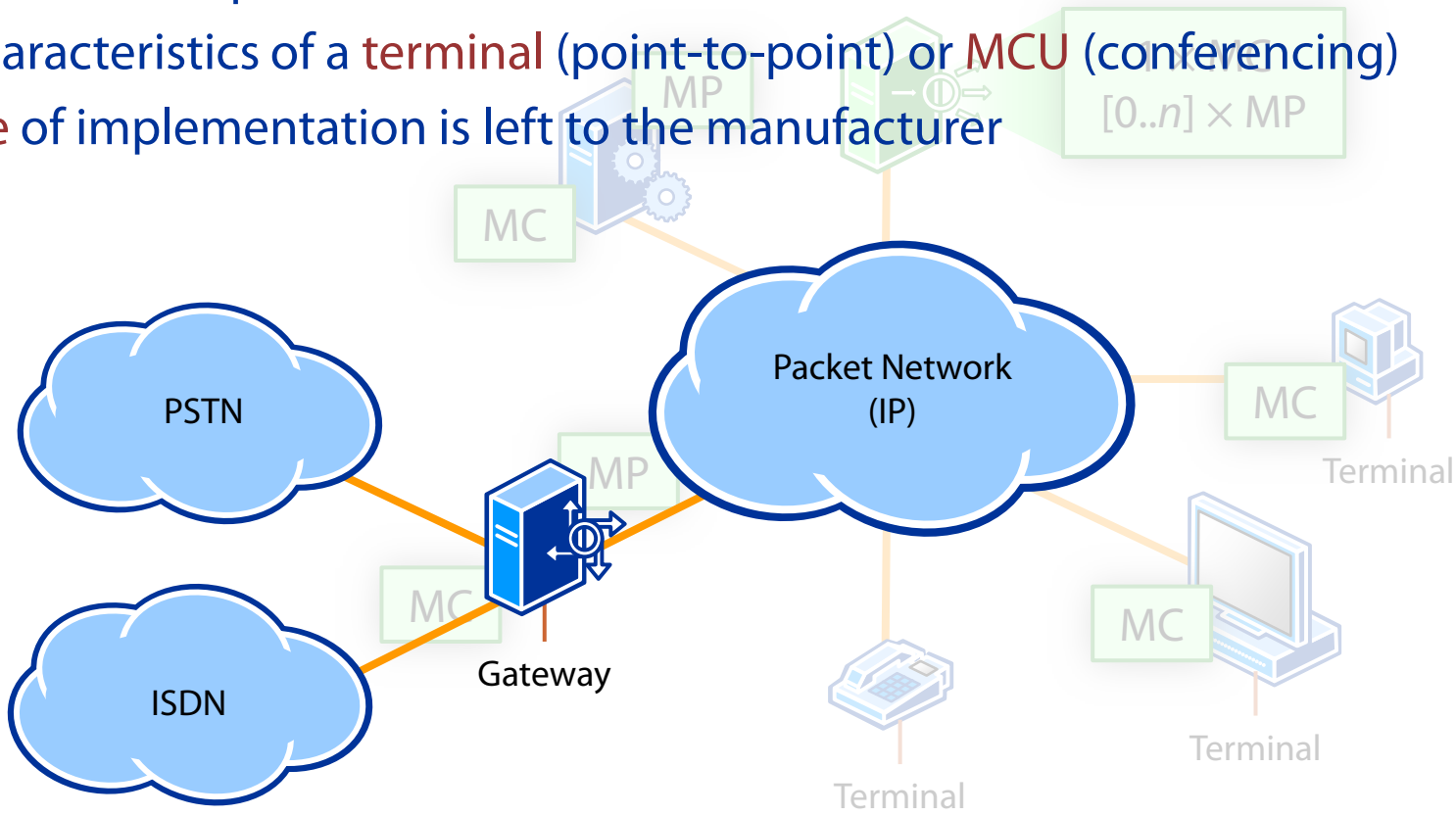


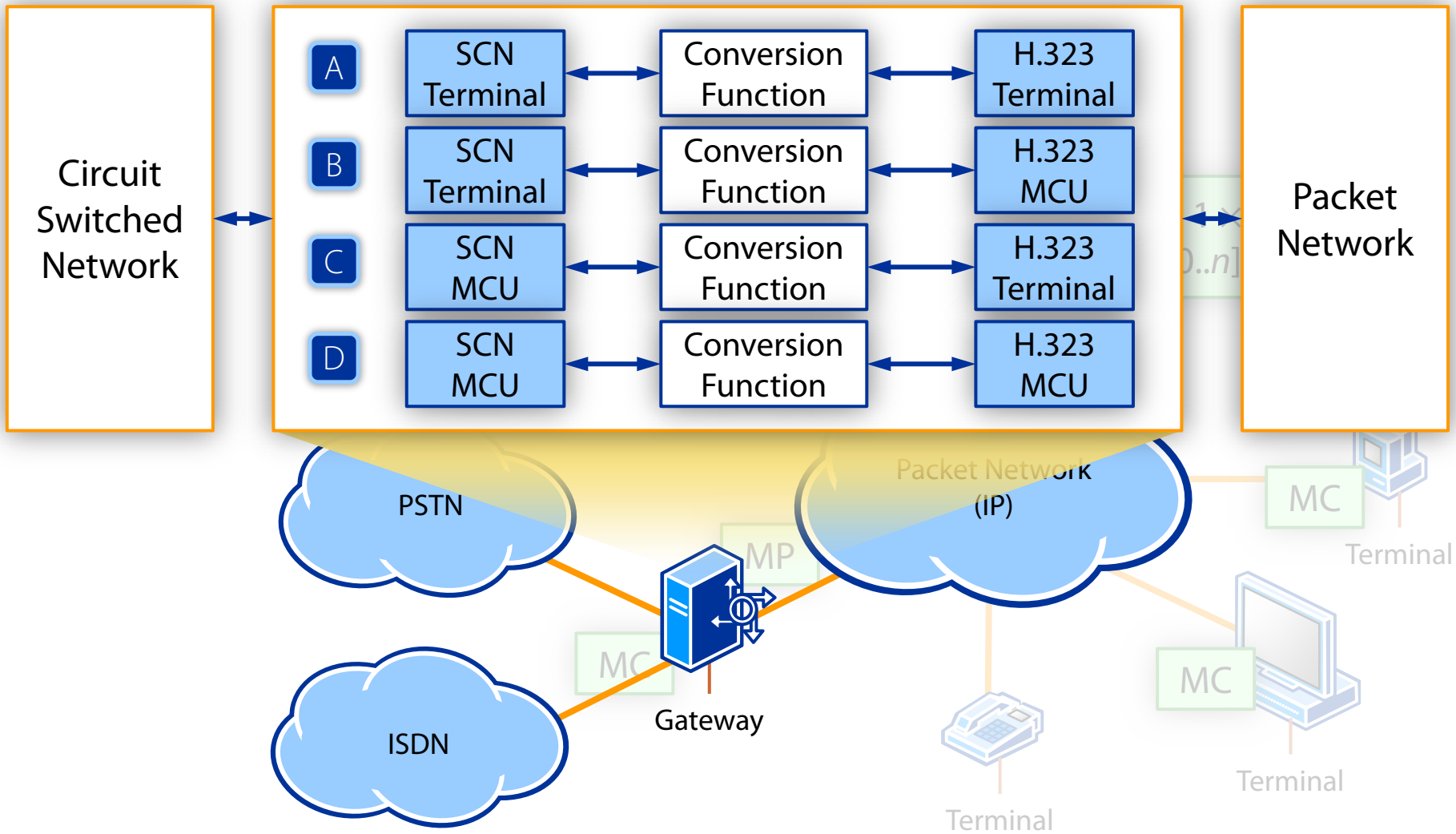
The Gateway

Translates audio, video, and data transmission formats between the Packet-Based Network and Circuit-Switched Networks

- Includes the call setup and teardown on both sides
- Has the characteristics of a terminal (point-to-point) or MCU (conferencing)
- The choice of implementation is left to the manufacturer



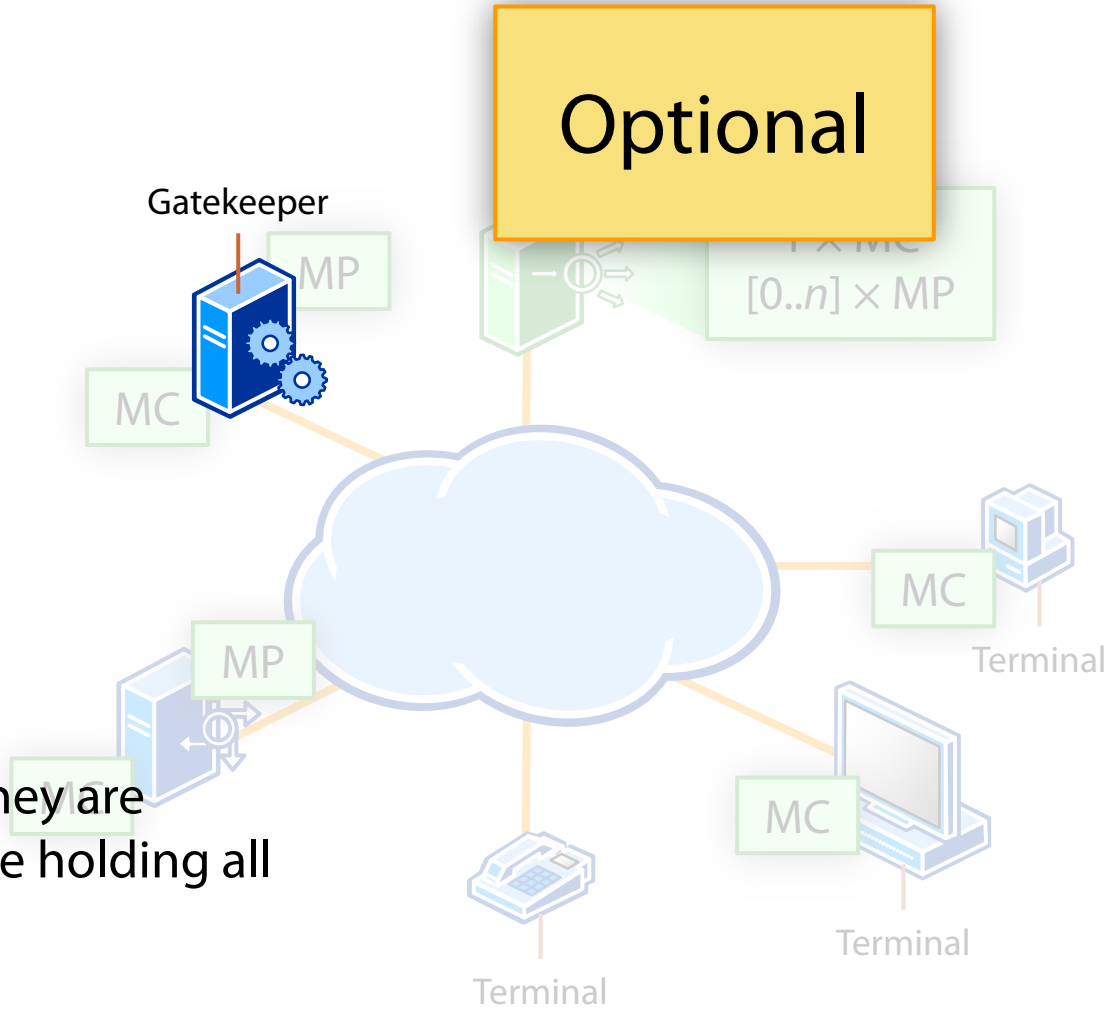
The Gateway



The Gatekeeper

Morpheus, describing an Agent to Neo

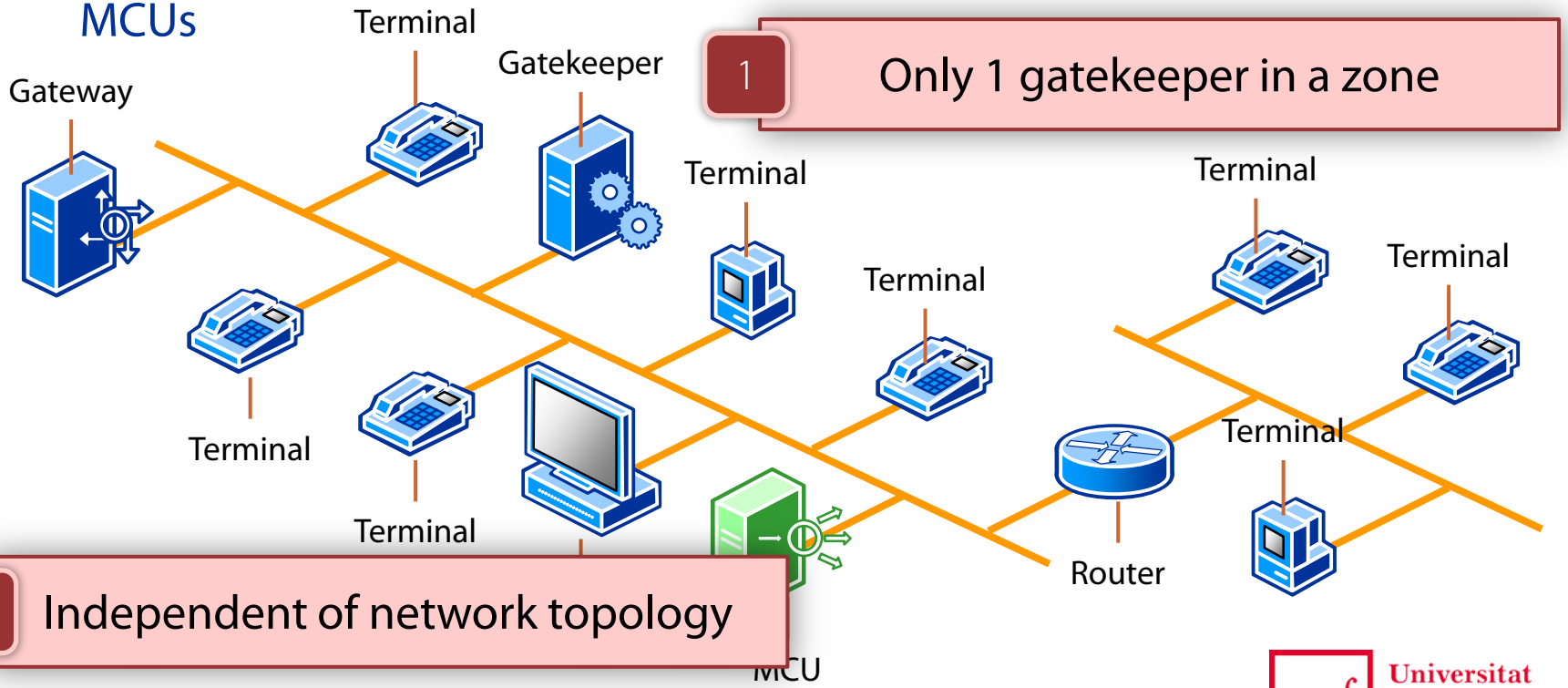
…they are the gatekeepers. They are guarding all the doors, they are holding all the keys…



The Gatekeeper

Provides pre-call and call-level control services to H.323 terminals

- The gatekeeper in a H.323 network:
  - There may be one or more gatekeepers
  - Each gatekeeper manages a zone: a collections of terminals, gateways, & MCUs



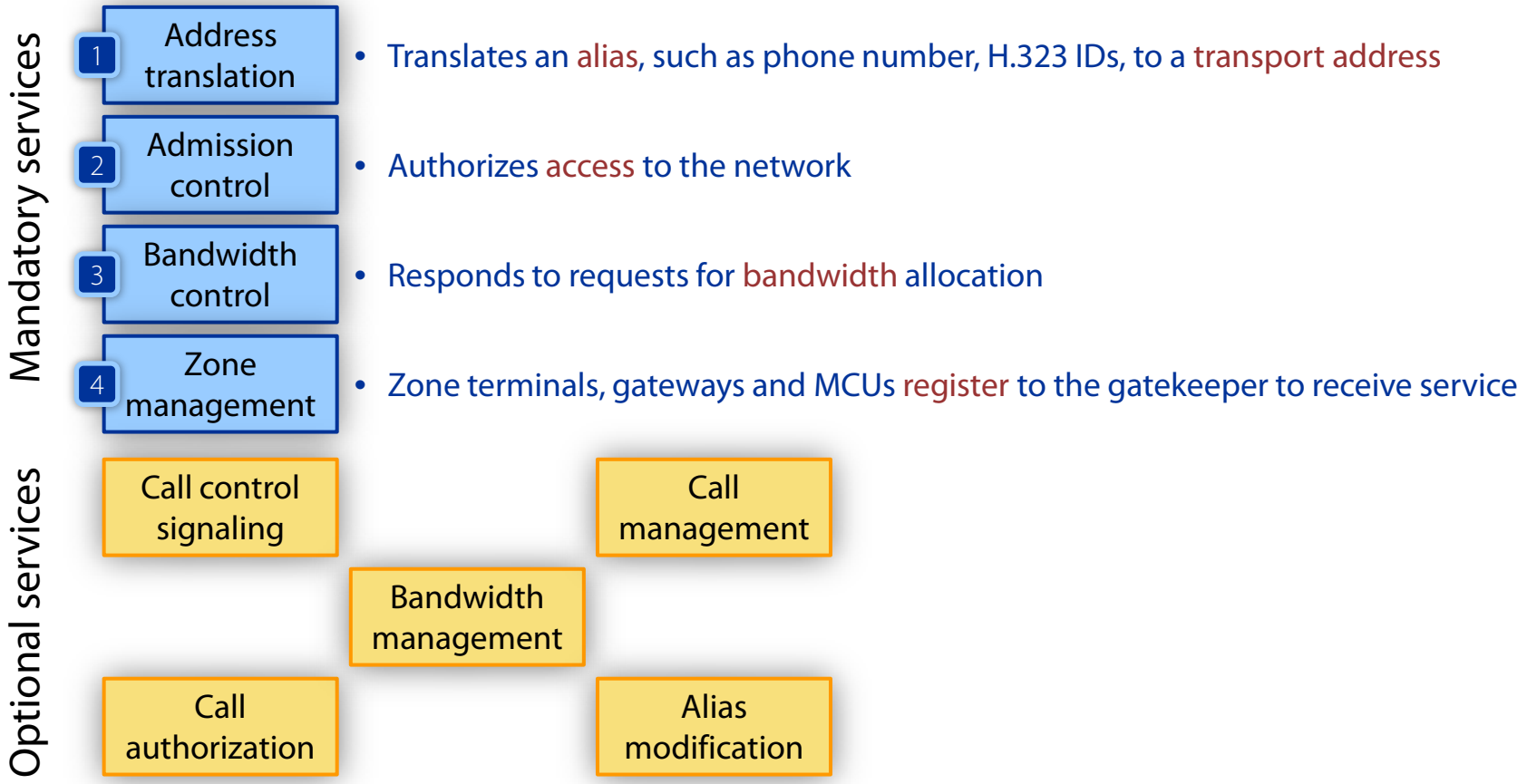
1 Only 1 gatekeeper in a zone

2 Independent of network topology

The Gatekeeper

Provides pre-call and call-level control services to H.323 terminals

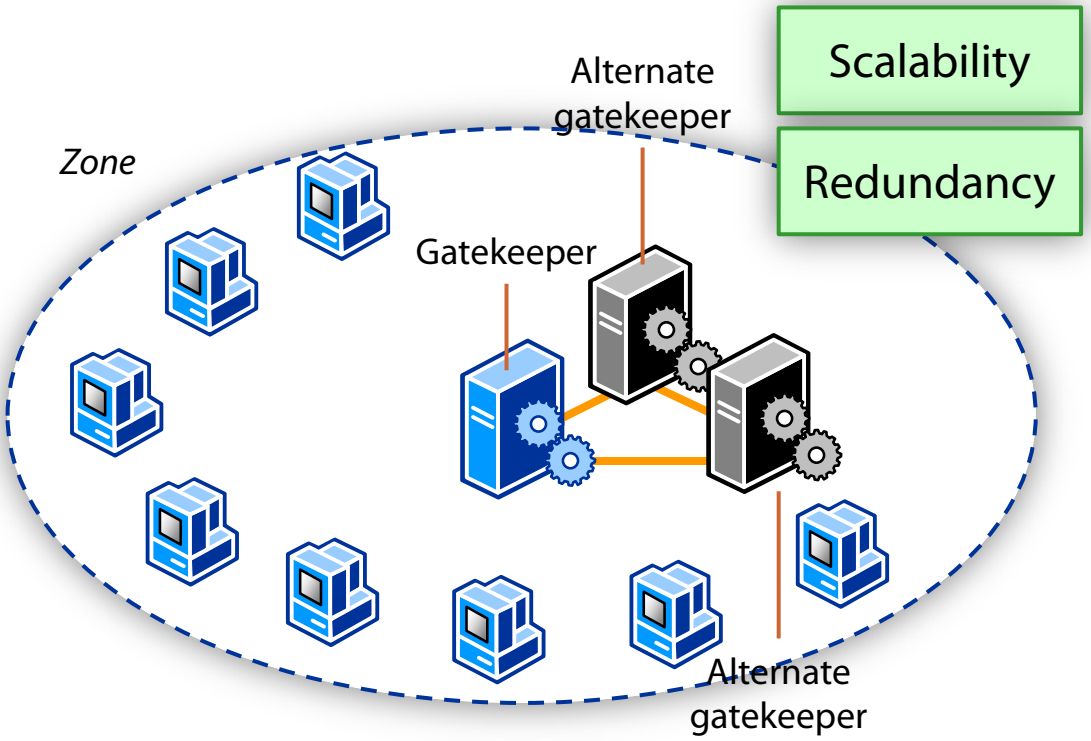
- What type of services?



The Gatekeeper

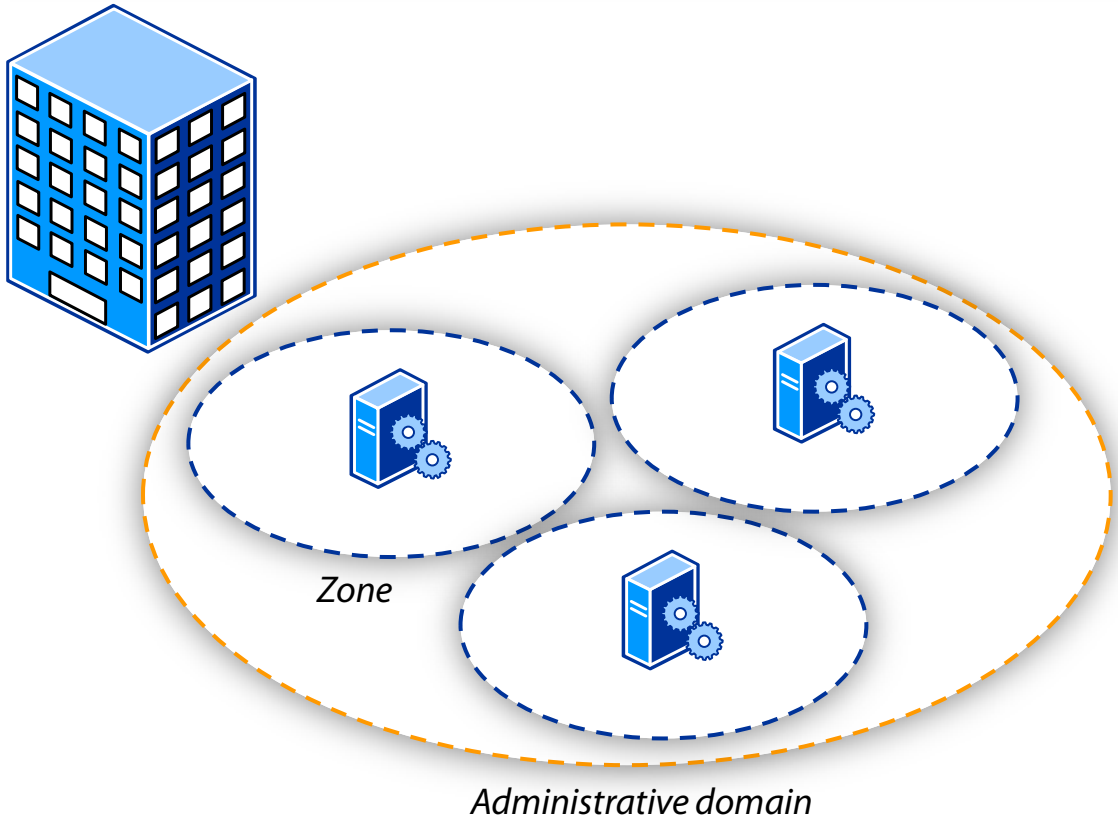
Provides pre-call and call-level control services to H.323 terminals

- There exists one gatekeeper in a zone
  - Multiple devices can provide the gatekeeper function



The Border Element

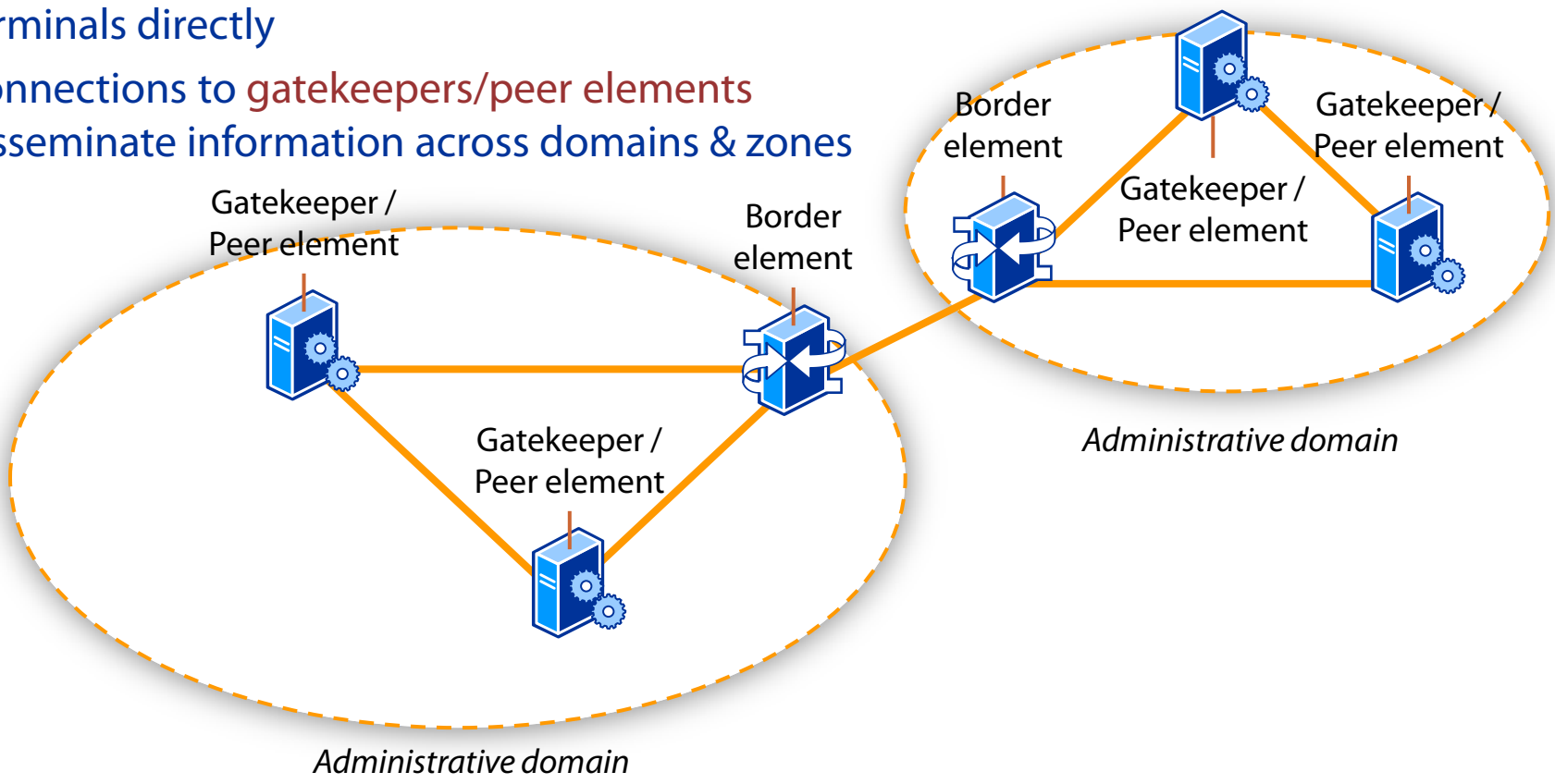
Administrative domain **collection of zones under the control of a person/organization**



The Border Element

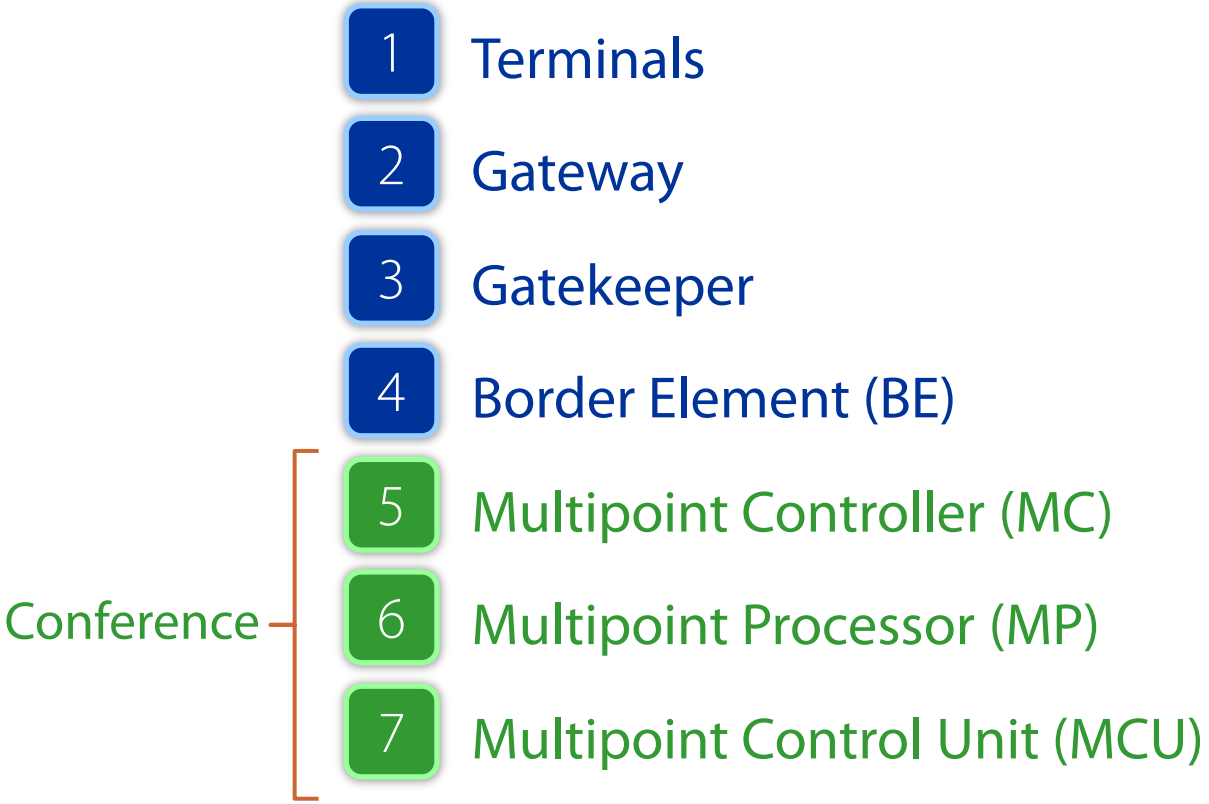
Interconnect multiple administrative domains within a H.323 packet network

- Similar to a gatekeeper, but does not manage terminals directly
- Connections to gatekeepers/peer elements disseminate information across domains & zones



H.323 Elements

- Let's recap:



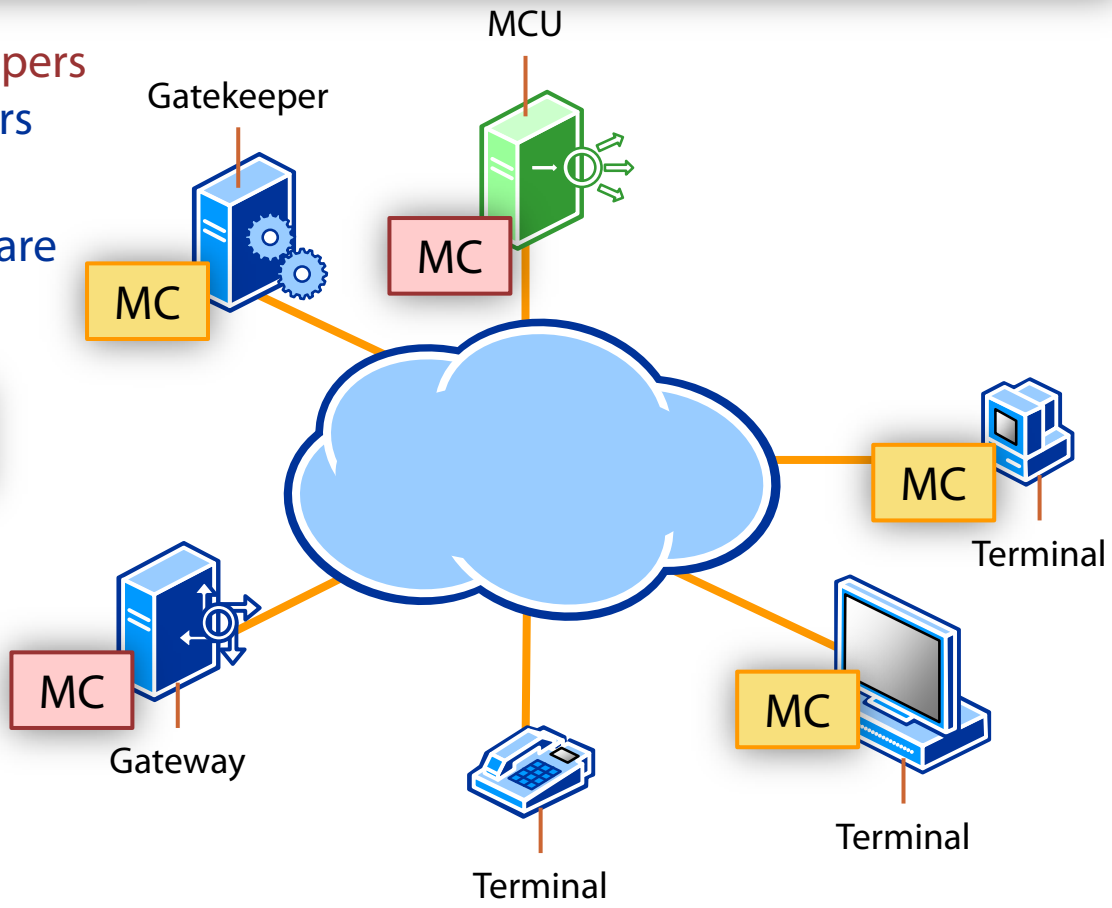
The Multipoint Controller

A set of signaling functions to support conferences between three or more endpoints in a multipoint conference

- Terminals, gateways & gatekeepers may have Multipoint Controllers (MC)
- Terminal and gatekeeper MCs are not callable

Multiple Controller Unit

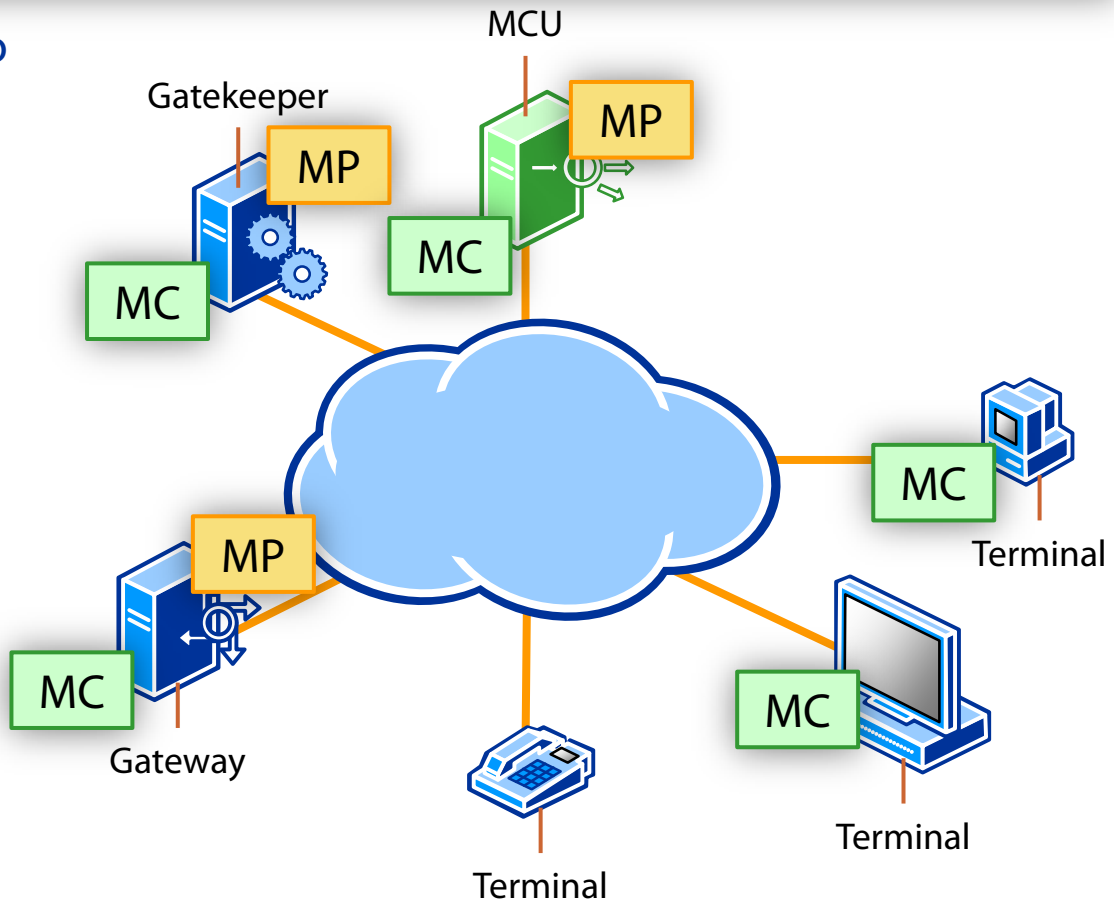
- Has an MC that is callable
- Gateways may function as a terminal or an MCU



The Multipoint Processor

Receive the audio, video and data streams from terminals engaged in a multipoint conference

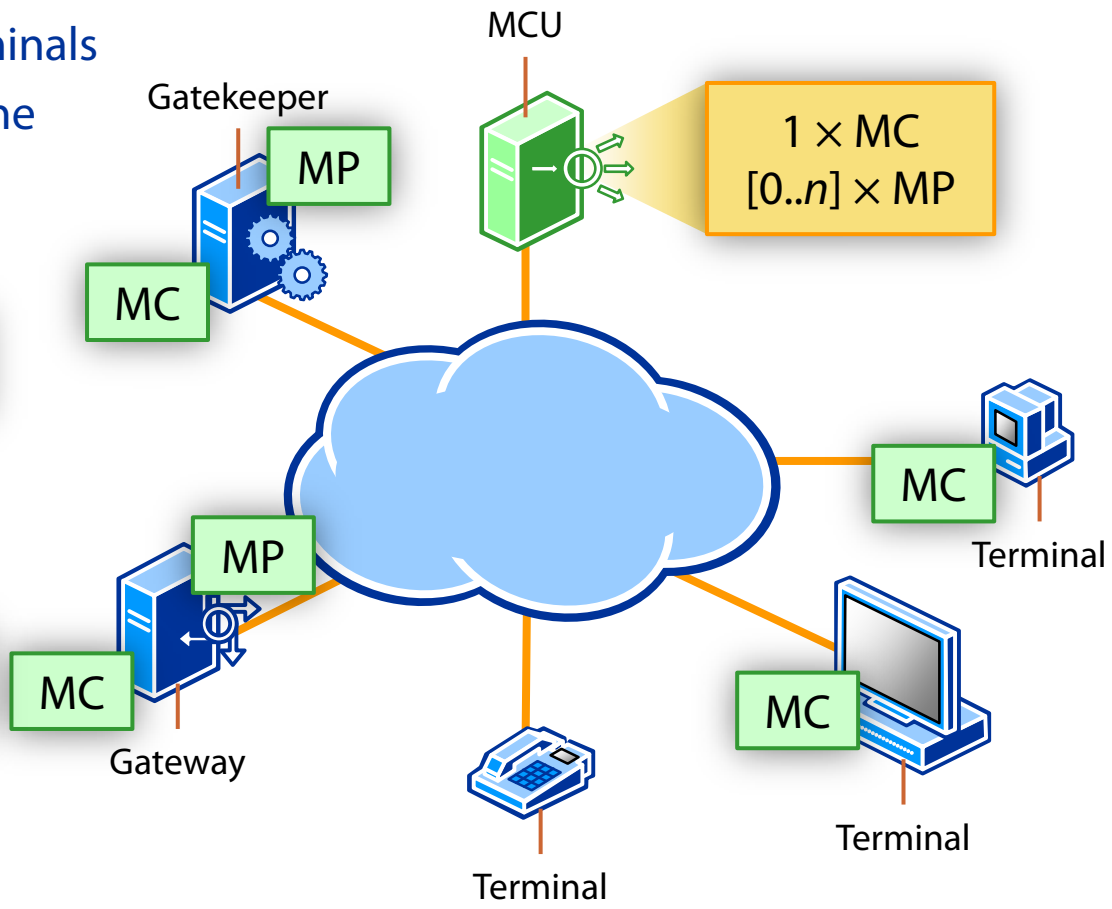
- Distributes received streams to the conference participants



The Multipoint Control Unit

An endpoint specialized for multipoint conferences

- One callable MC to receive conference requests from terminals
- Zero or more MPs to process the conference audio/video/data



1 Centralized conference

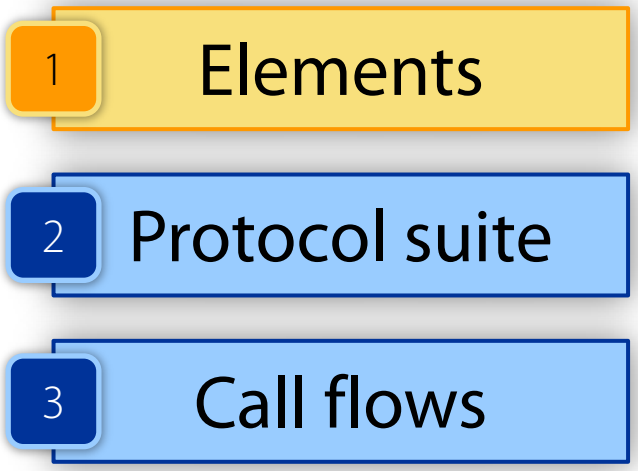
- Audio and video MP
- Centralized audio and video processing at the MCU

2 Decentralized conference

- Data MP
- Decentralized audio and video processing at the terminals

Let's Recap

H.323



H.323 Protocols

Supports call admission, setup, status, teardown, media streams, and messages in H.323 systems.

- Divided into three main areas of control:

1. **Registration, Admission and Status (RAS) signaling**

   Signaling before a call (pre-call)

2. **Call Control signaling**

   Signaling during a call (in-call)

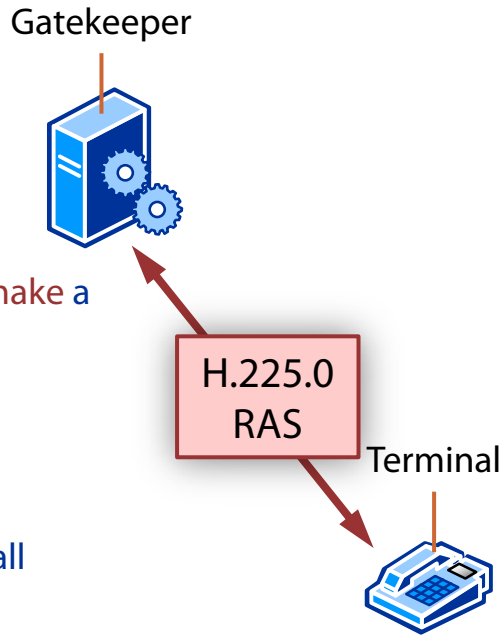
3. **Media Control and Transport**

   Handles the media: voice, video, data

Registration, Admission and Status

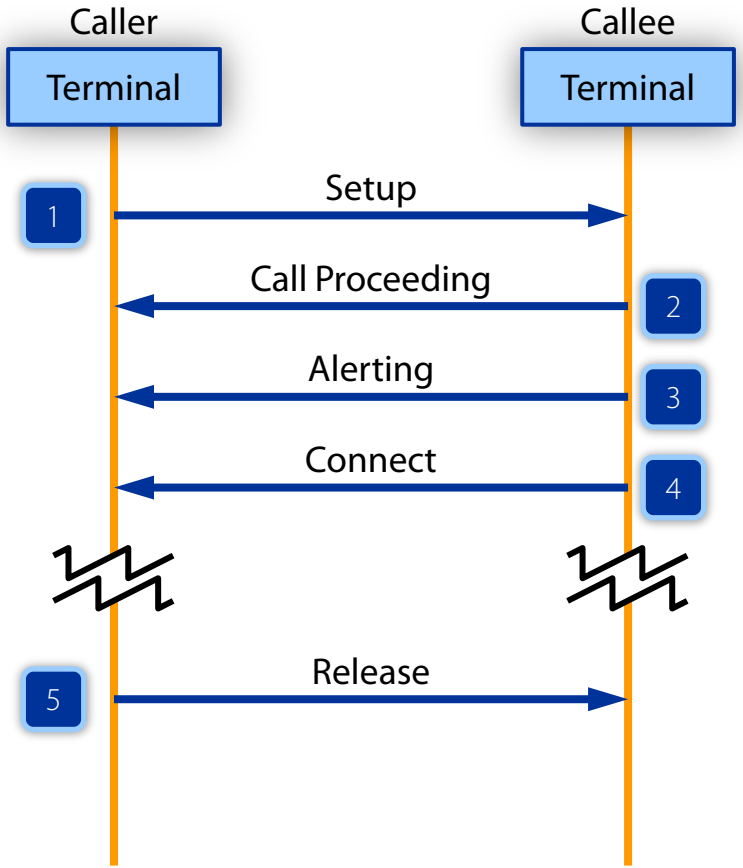
H.225.0 Applies to zones with a gatekeeper
Pre-call communication with the gatekeeper

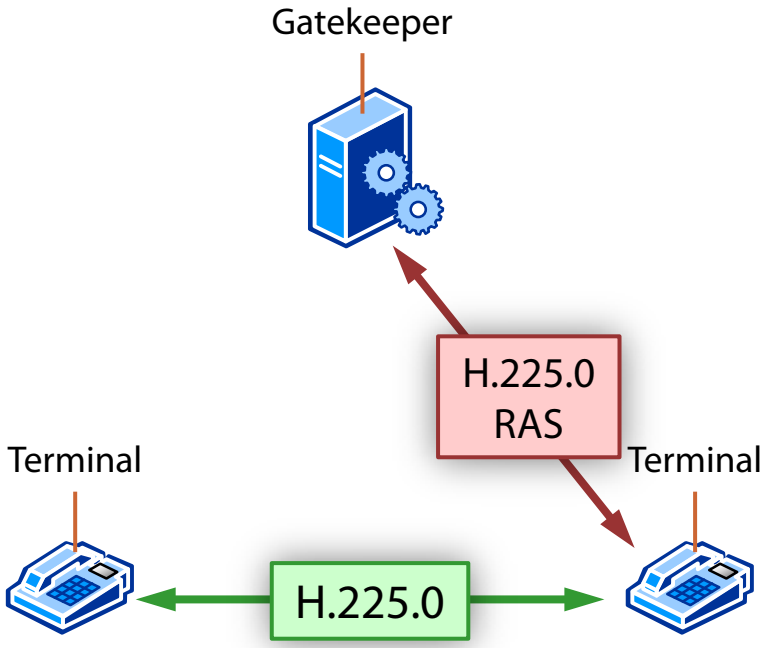
1	Gatekeeper discovery	• Manual: endpoint configured with the gatekeeper address • Automatic: uses a multicast message
2	Endpoint registration	• Joins a zone • Informs the gatekeeper of their address and alias names
3	Endpoint location	• Translates an alias, such as phone number, H.323 IDs, to a transport address
4	Call admission	• Authorizes an H.323 terminal to reserve bandwidth and make a call
5	Status information	• Gatekeeper checks the status of the endpoint
6	Bandwidth control	• Authorizes an H.323 to change the bandwidth during a call



Call Control

H.225.0 Uses Q.931 messages to setup and release a call between two endpoints





Media Control

H.245 Logical channels for the transmission of audio, video and data
Uses TCP/IP with a dynamic port for each call

1 Exchange capabilities

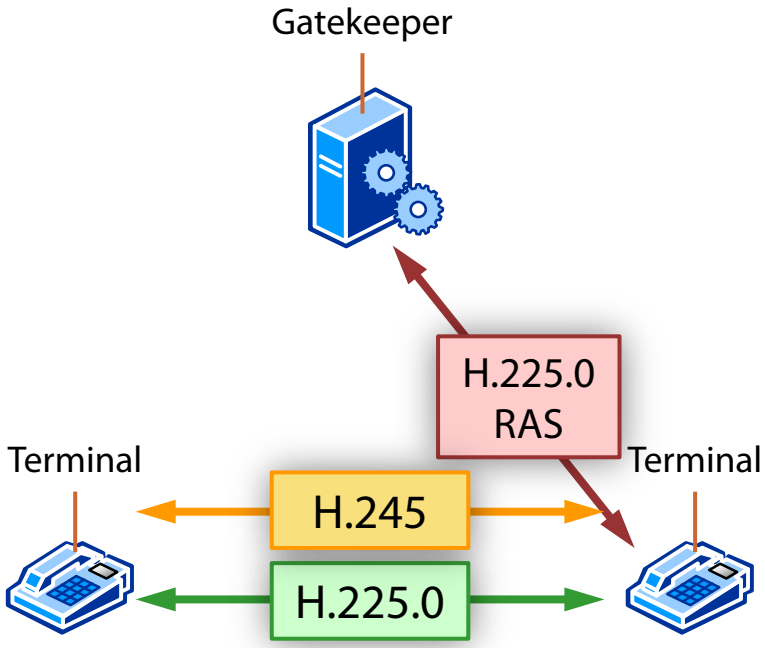
- Negotiates the audio/video codecs supported by the endpoints

2 Determine master/slave

- In a call, one endpoint is master, one slave
- Used to resolve conflicts

3 Logical channels

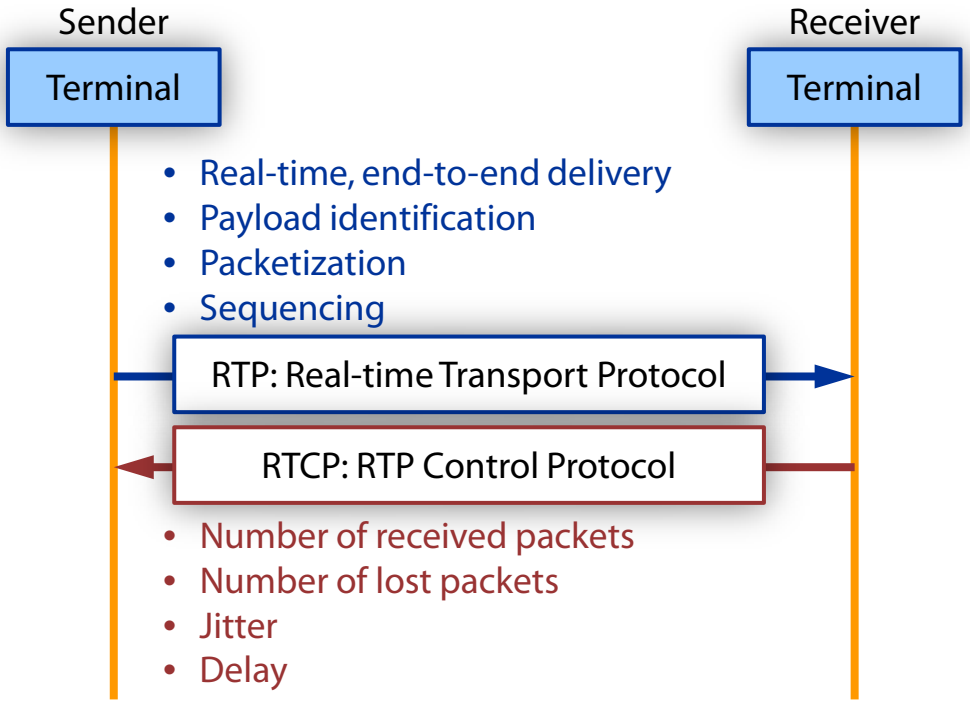
- Opens and closes the channels for audio, video and data

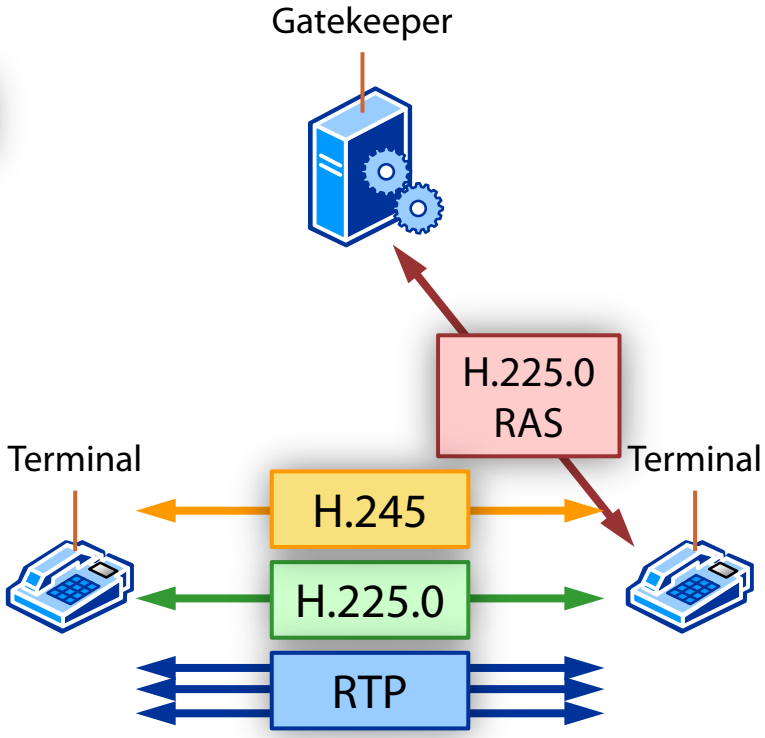


Media Transport

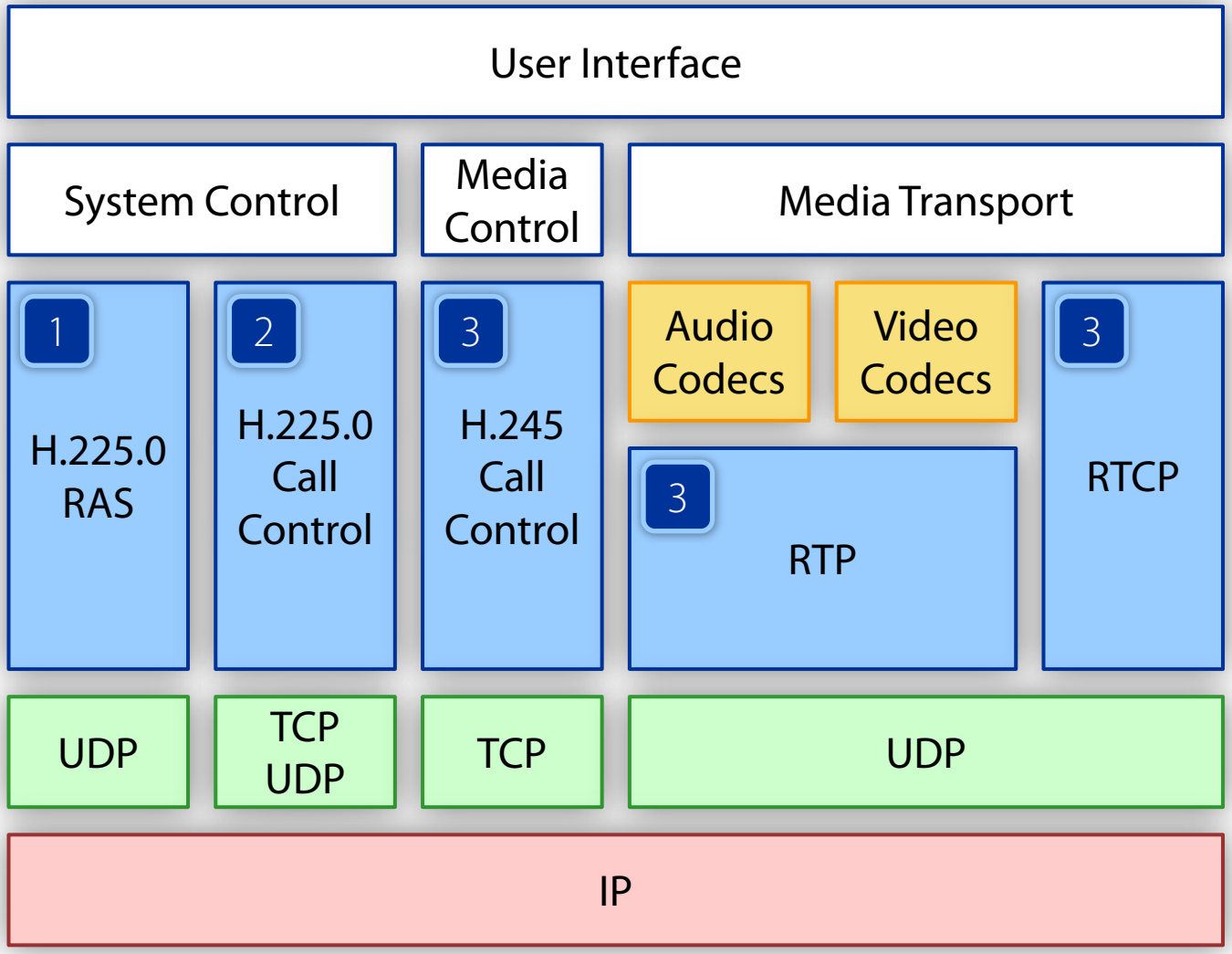
RTP/RTCP Media channels over UDP
Established using the media control H.245 channel

- The media channels are unidirectional
- We need one for each direction and voice, video, data





How Does This Stack Up?



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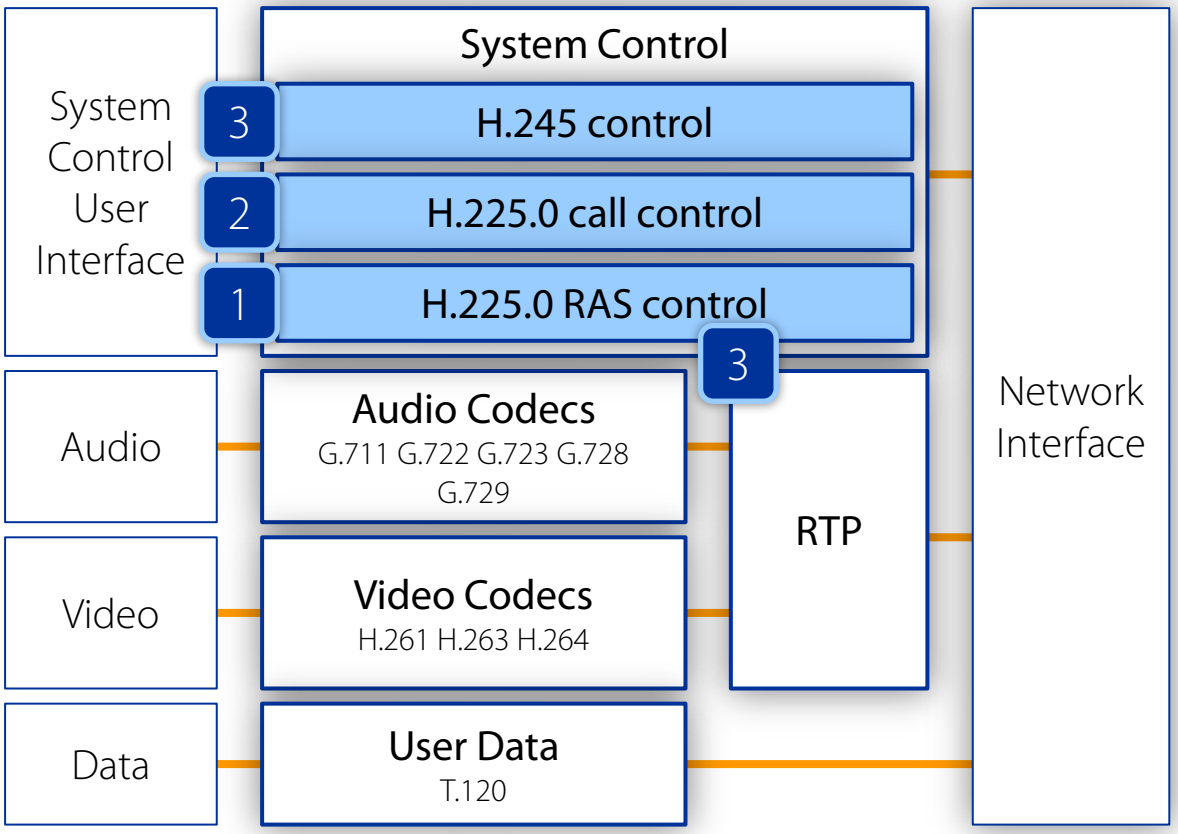
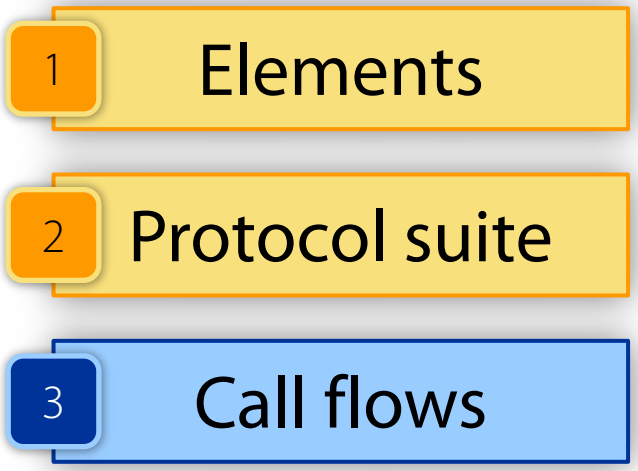


Back to H.323

H.323



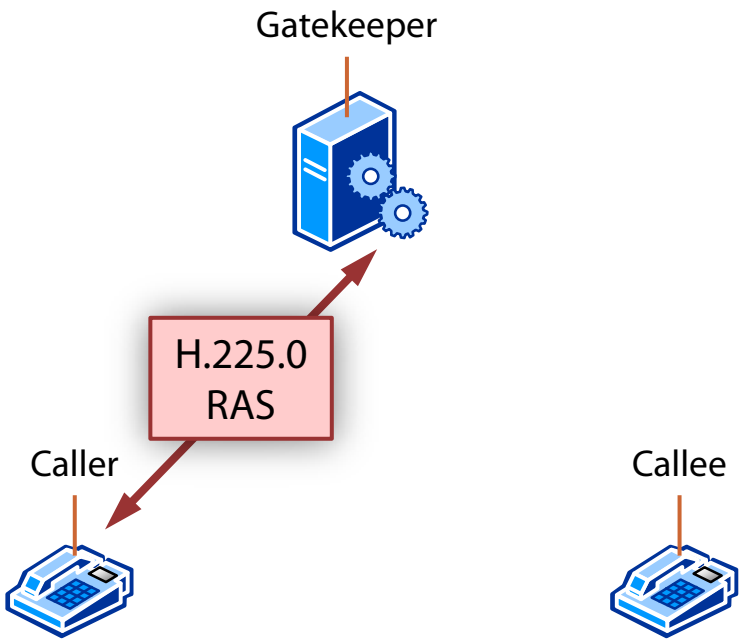
Call Flows

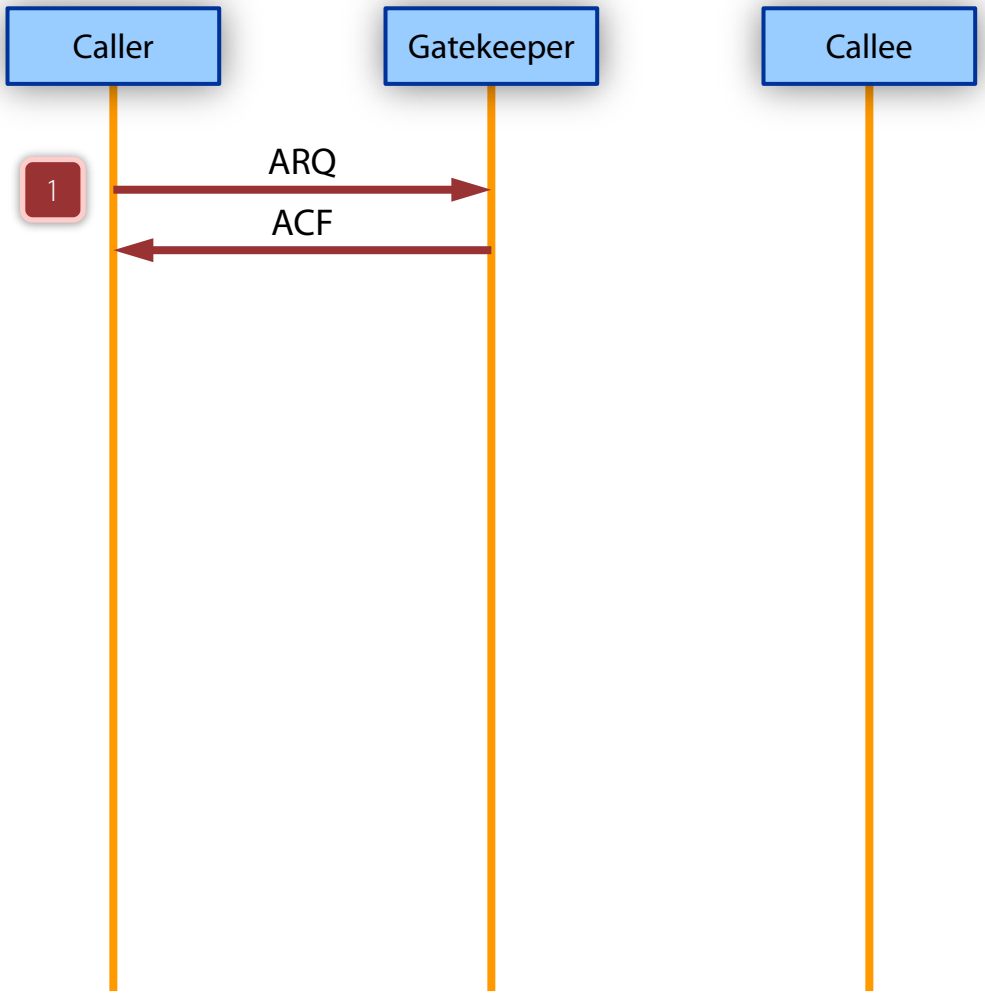
A detailed look of the messages exchanged by the H.323 protocols

Let's make a call

1. A terminal calls another terminal
2. They are in a zone with a gatekeeper

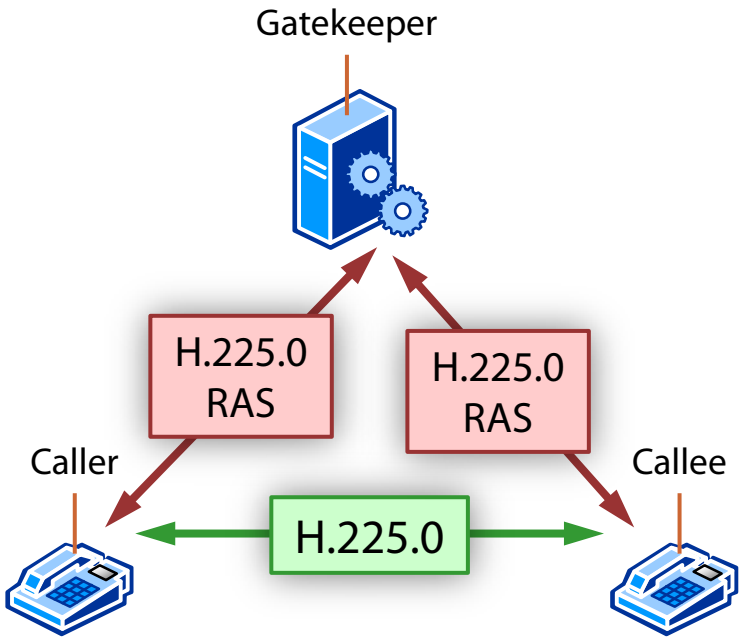
Call Setup

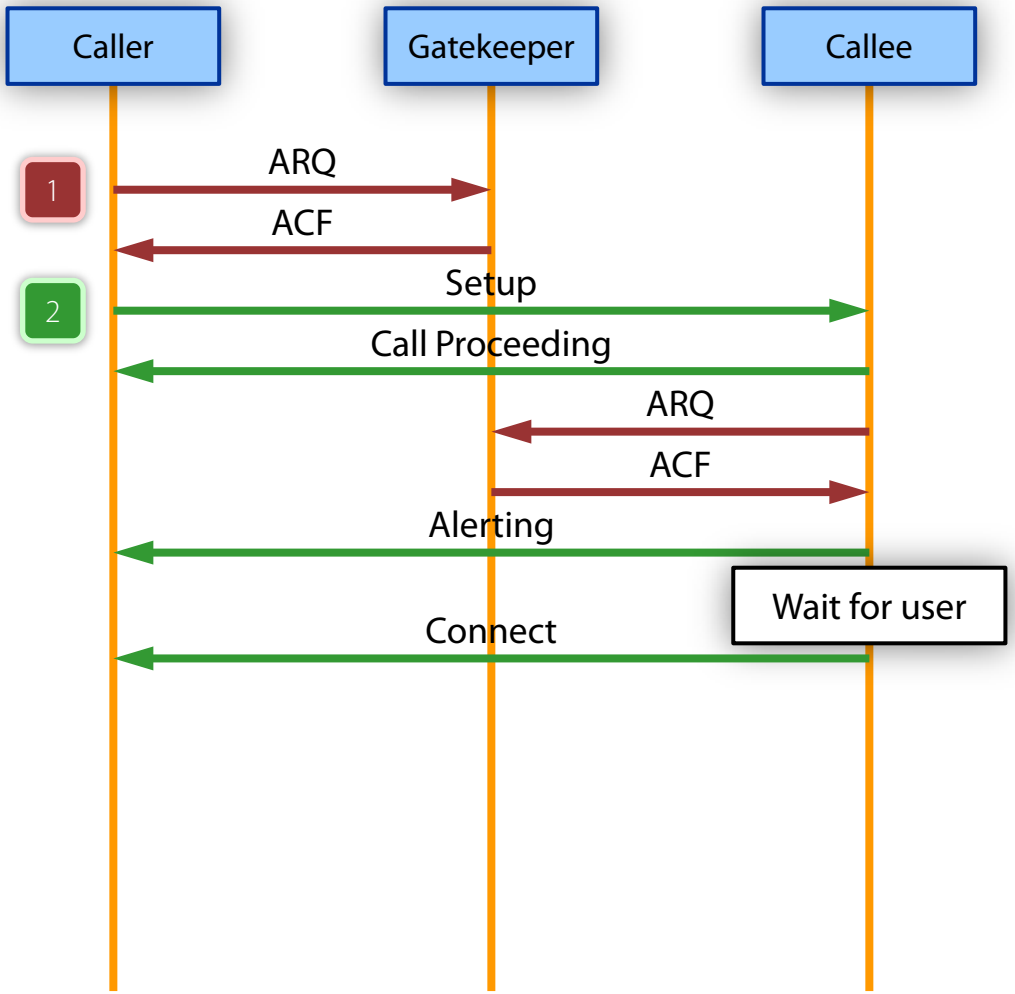




1 Request permission to make the call

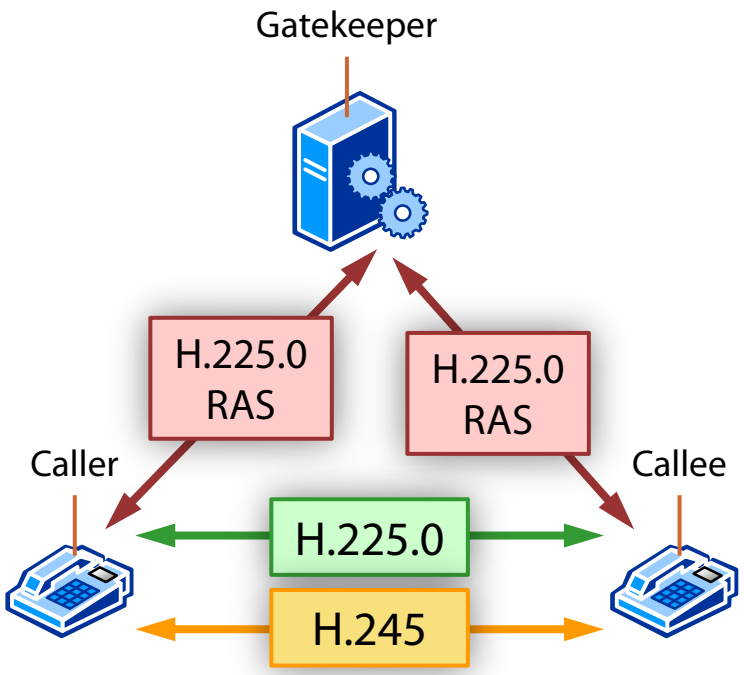
Call Setup

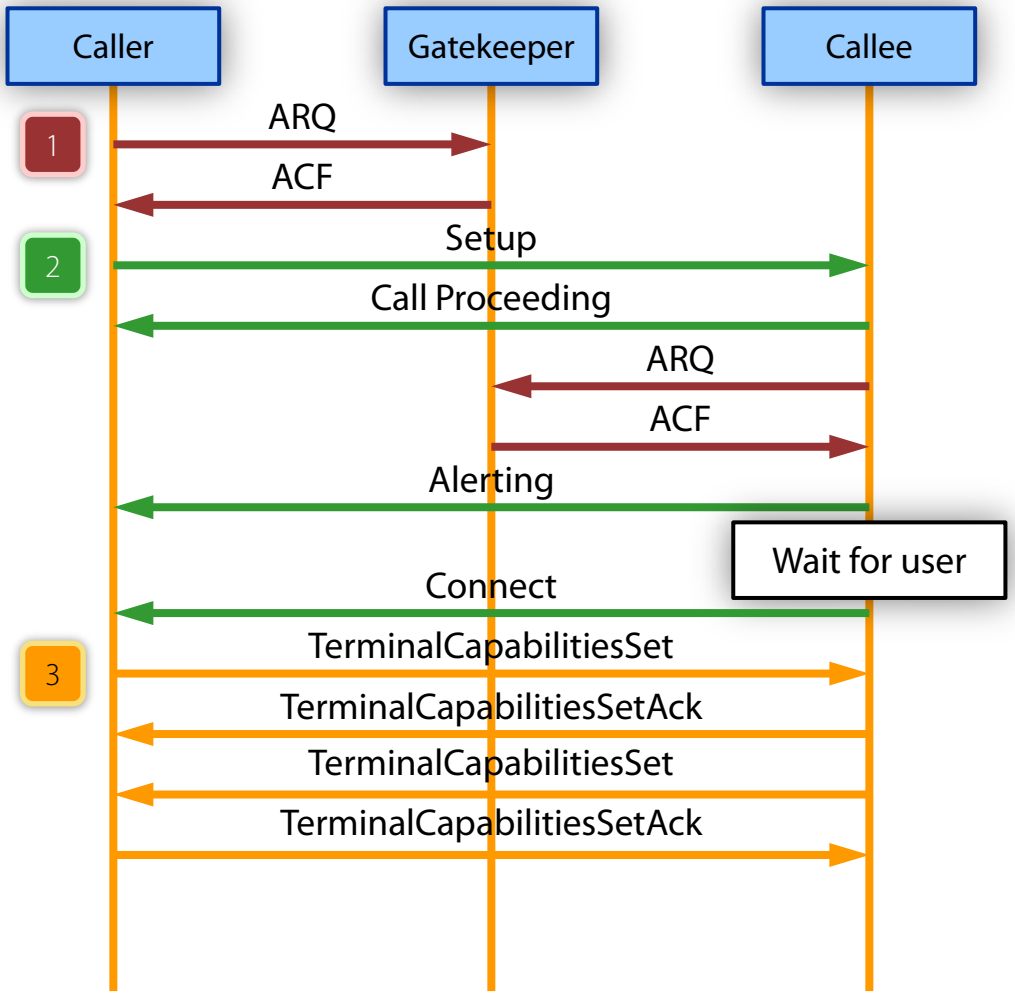




2 Setup the call

Call Setup



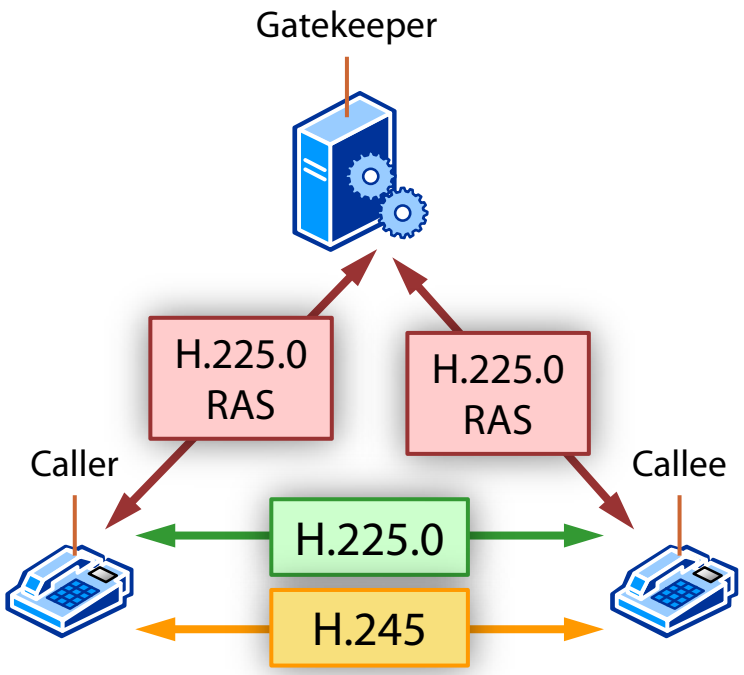


Media control

3

- Exchange capabilities
- Determine master slave
- Open media channels

Call Setup



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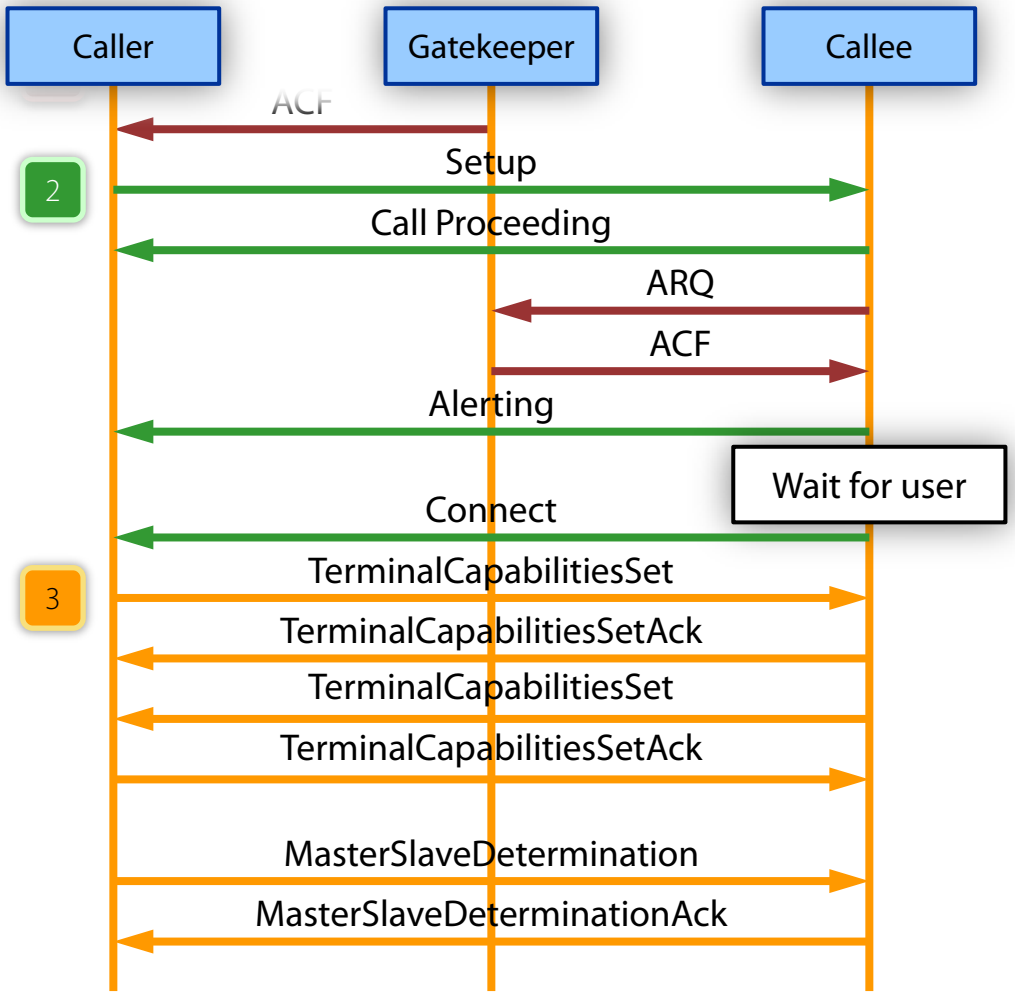

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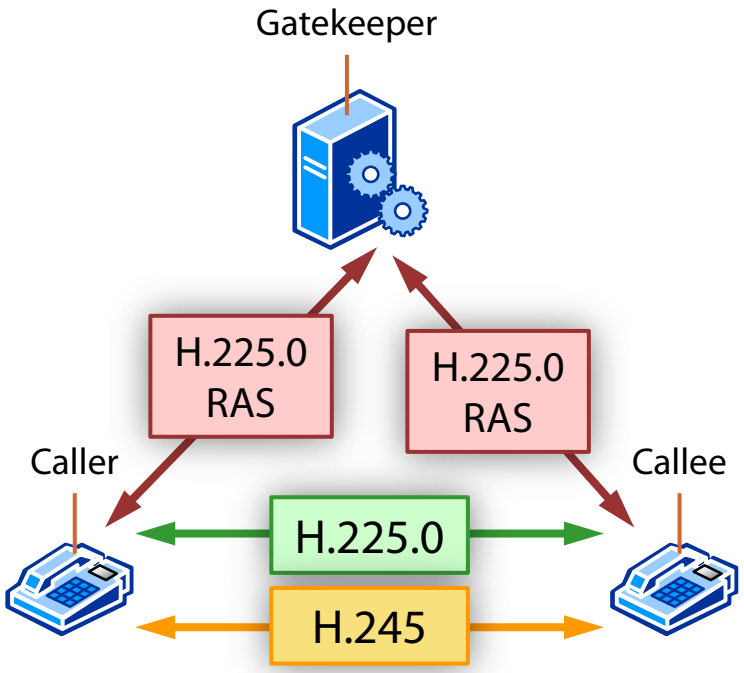

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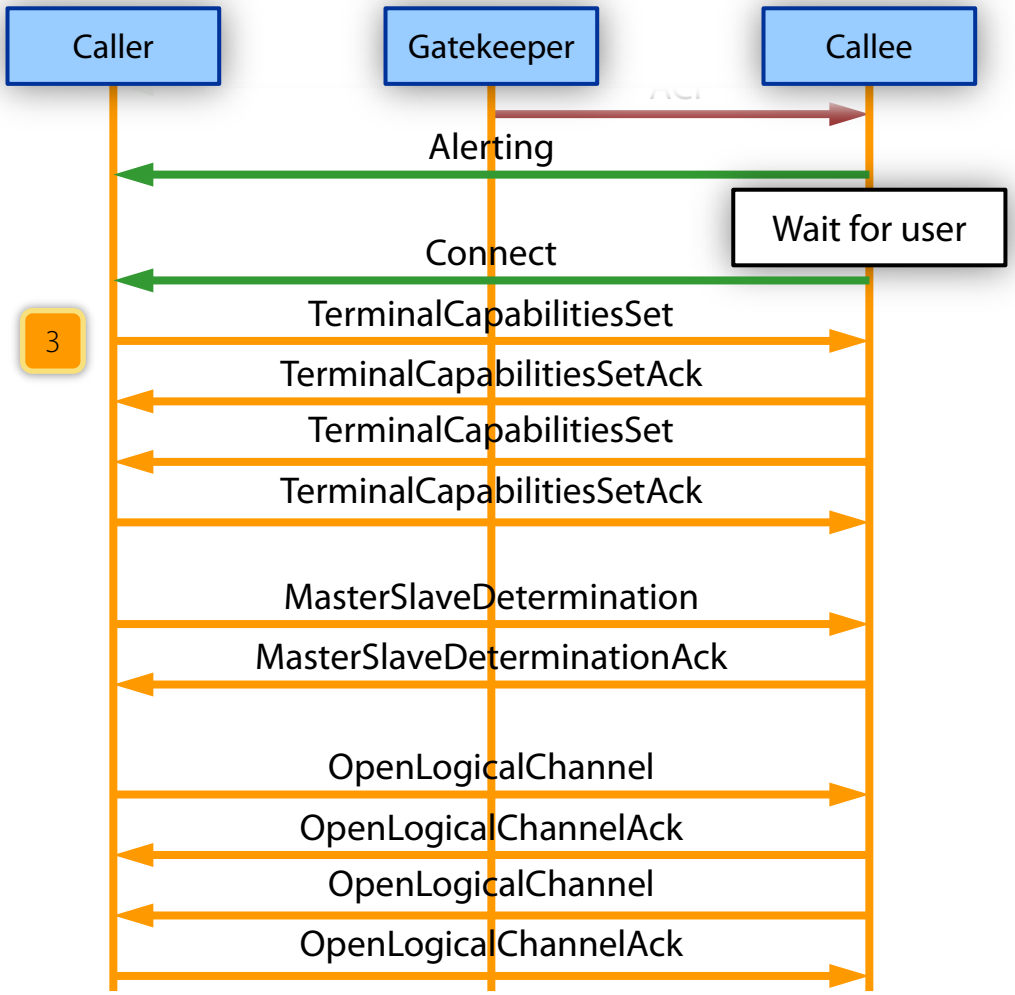

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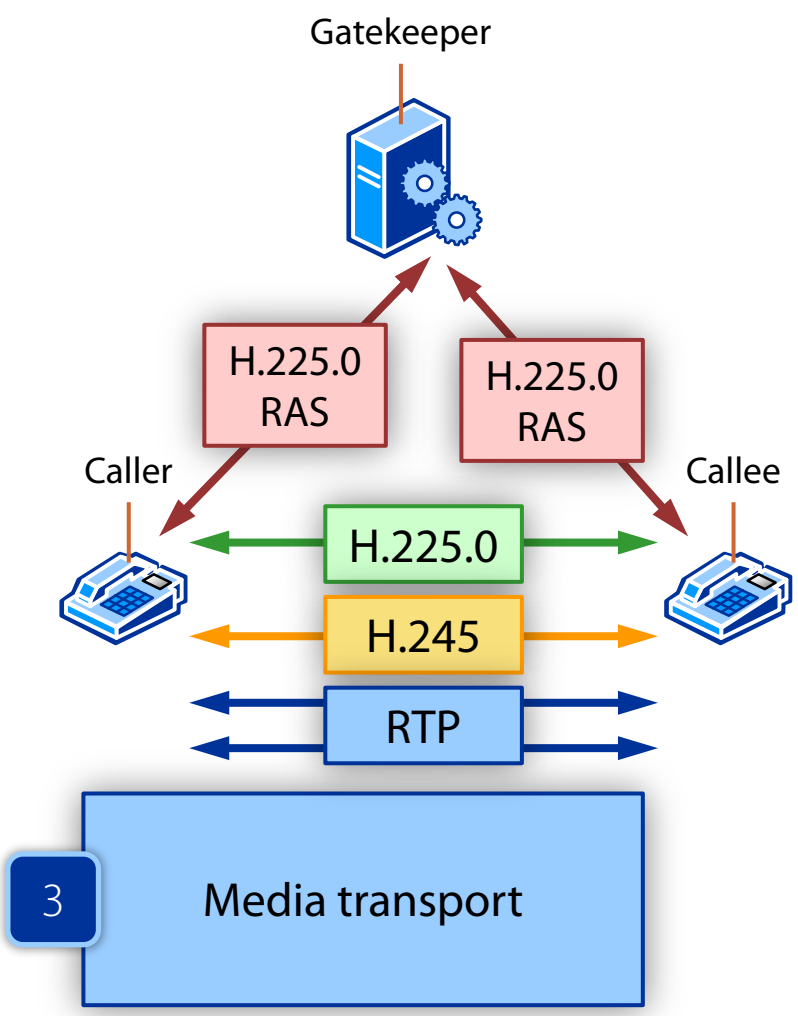
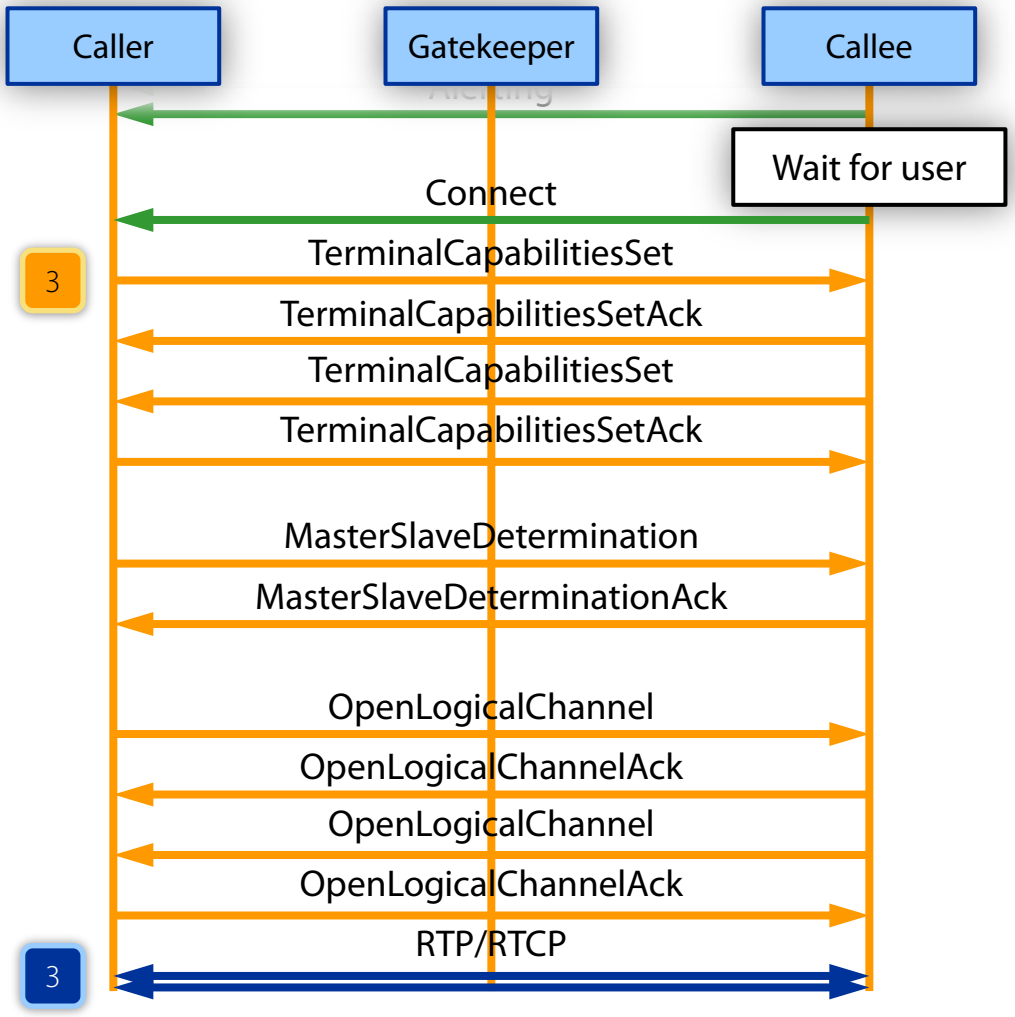
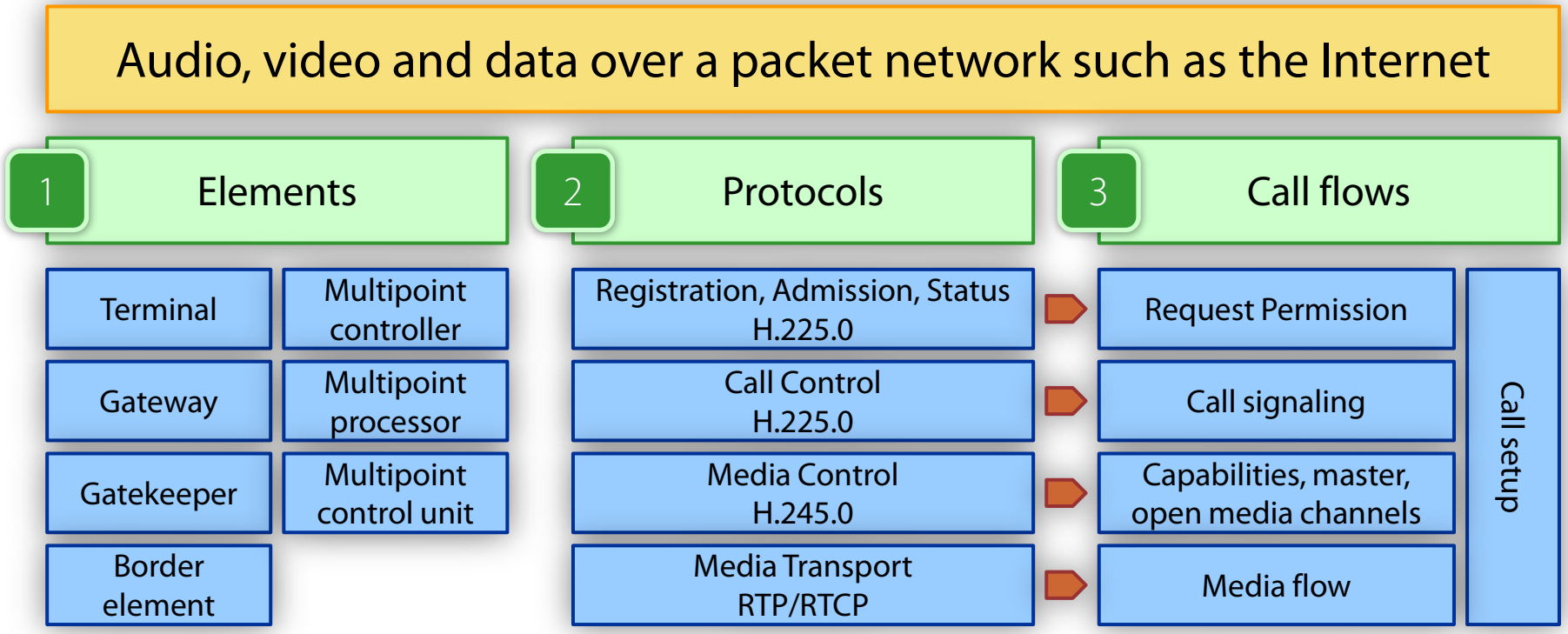




Let's Summarize

- What did we learn?

H.323



Multimedia in Packet Networks

H.323

SIP

P2PSIP

See you next time

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H.323 Audio Codecs

	Algorithm	Bit-rate	Sampling
G.711	PCM Pulse Coded Modulation	64 kbps	8 kHz / 8 bits
G.722	ADPCM Adaptive Differential PCM	48, 56, 64 kbps	16 kHz / 14 bits
G.723	ADPCM	16, 24, 32, 40 kbps	8 kHz
G.722	LD-CELP Low Delay Code Excited Linear Prediction	16 kbps	8 kHz
G.722	ACELP Algebraic Code Excited Linear Prediction	8 kbps	8 kHz / 16 bits