Call Authorization and Quality of Service

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AT&T, CableLabs, 3Com, Cisco, Com21, General Instrument, Lucent Cable, NetSpeak, Telcordia

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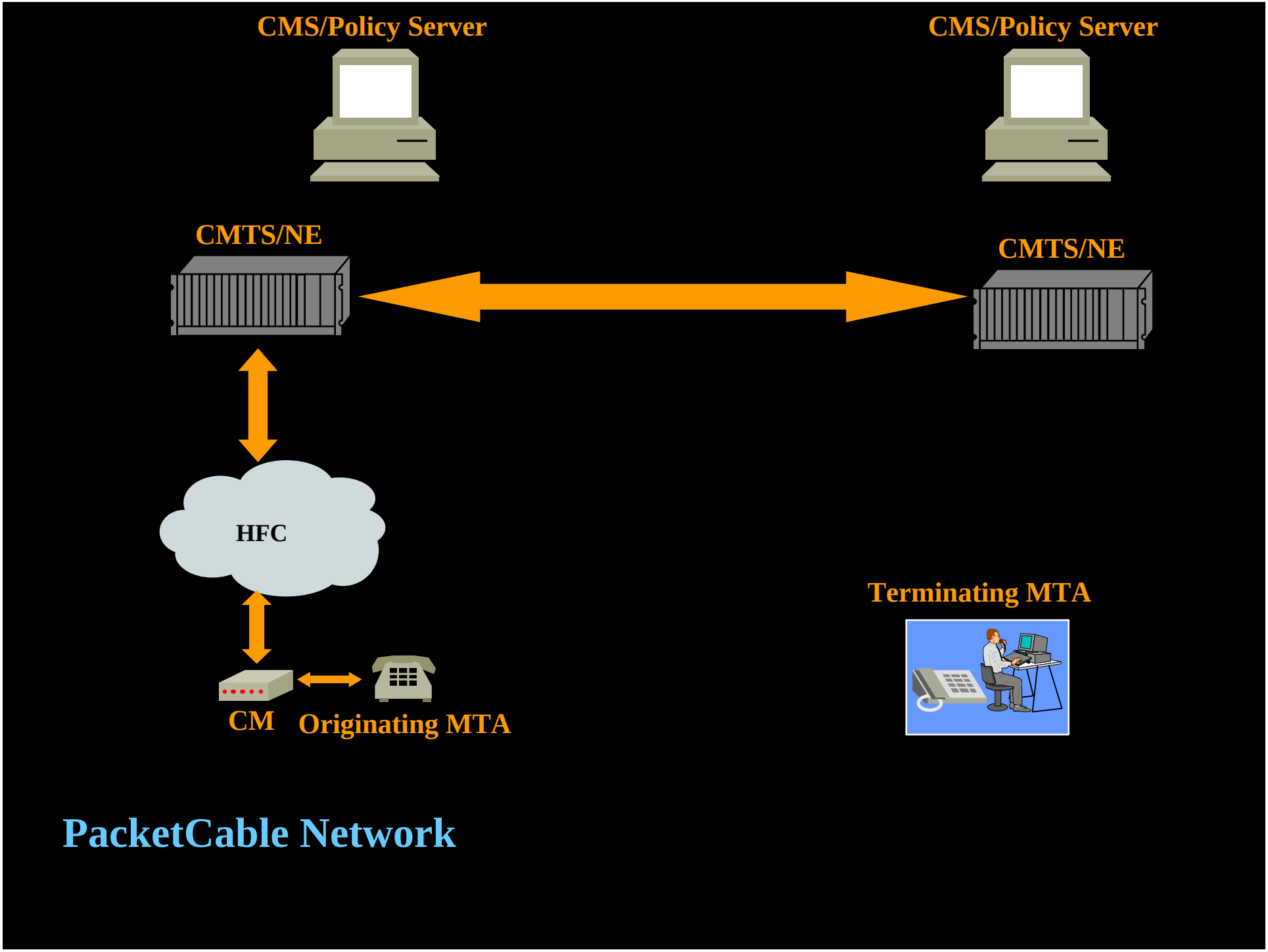
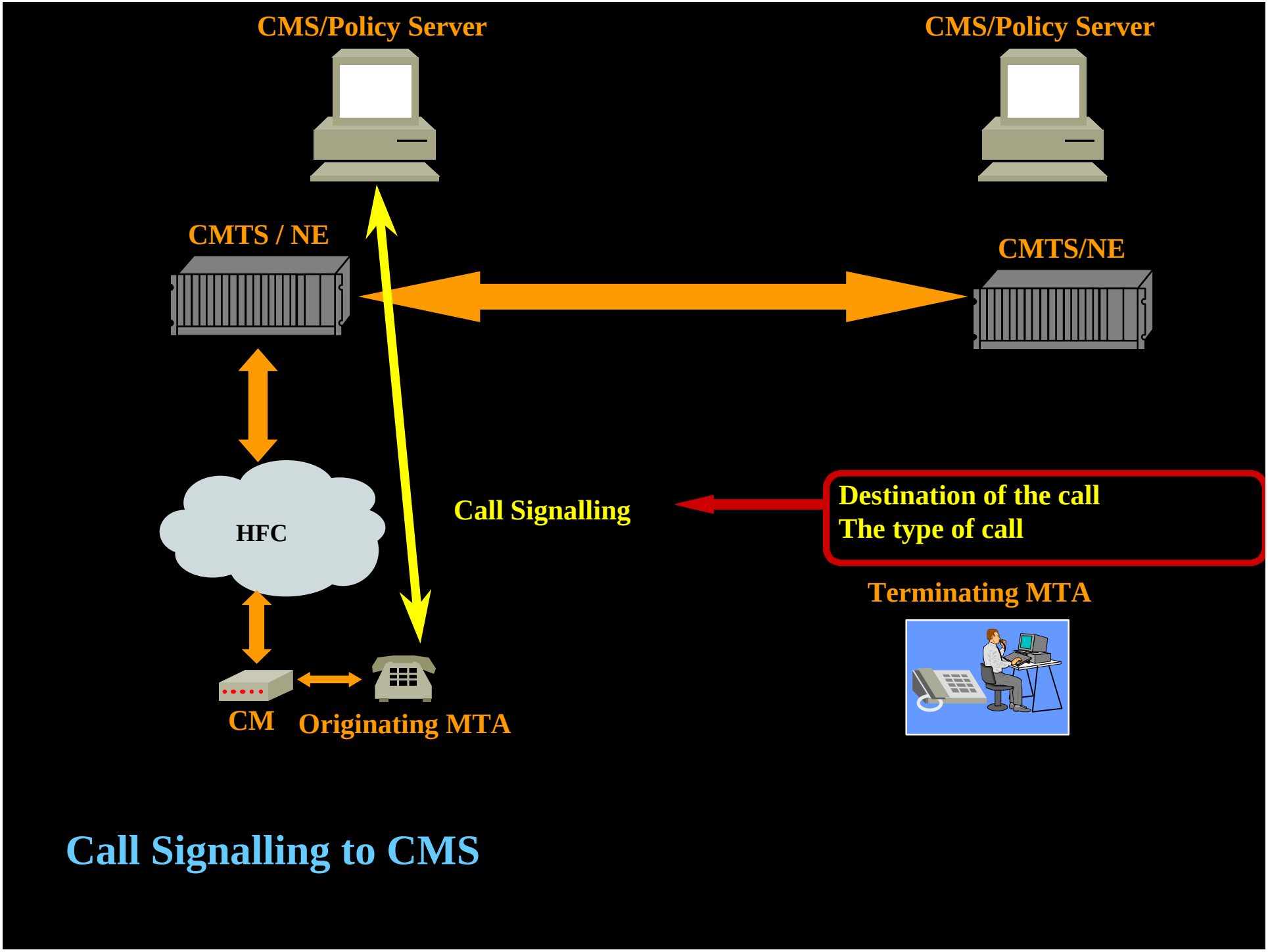
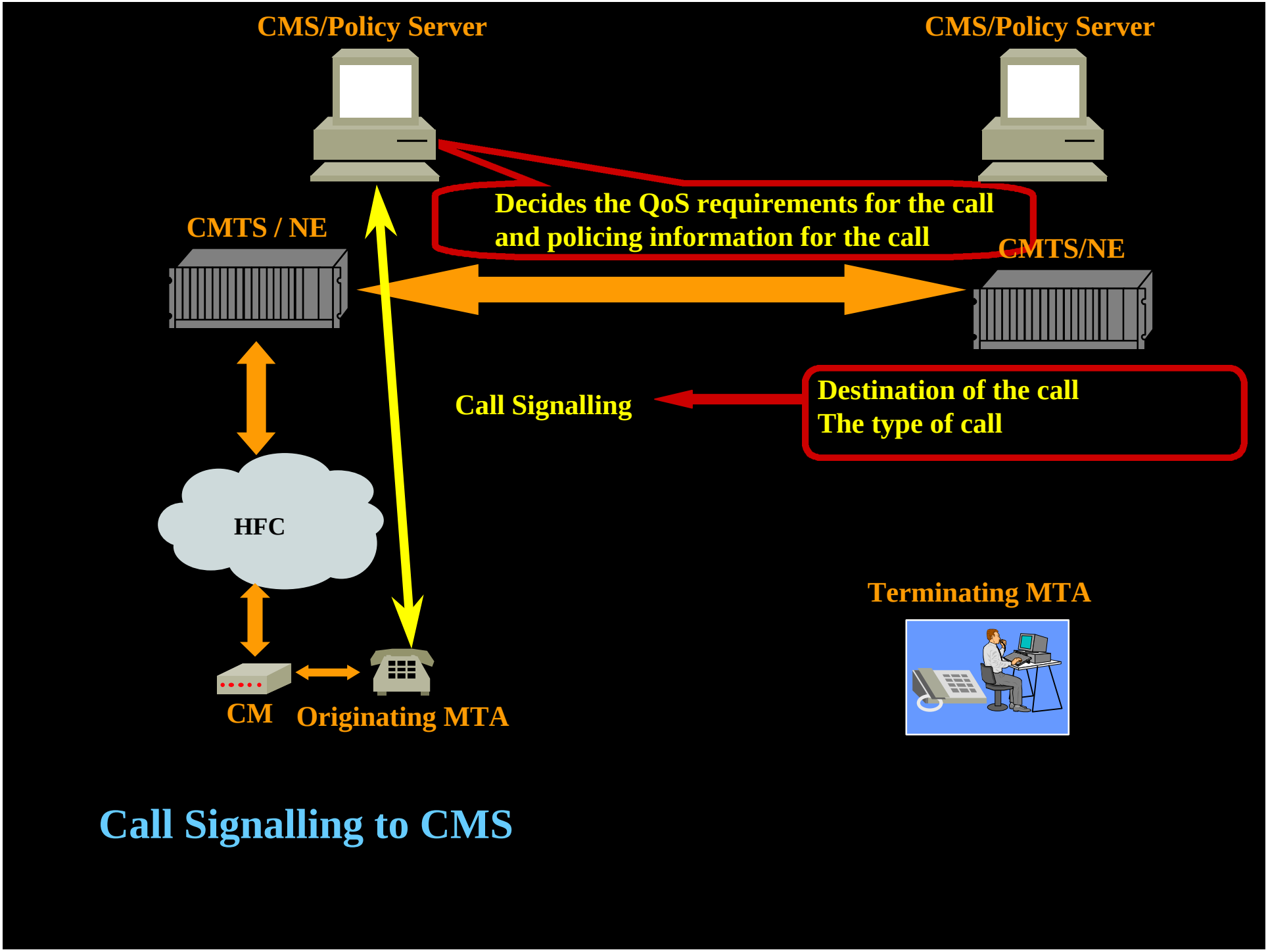

CMS/Policy Server
CMS/Policy Server
CMTS/NE
CMTS/NE
HFC
Terminating MTA
CM
Originating MTA
PacketCable Network

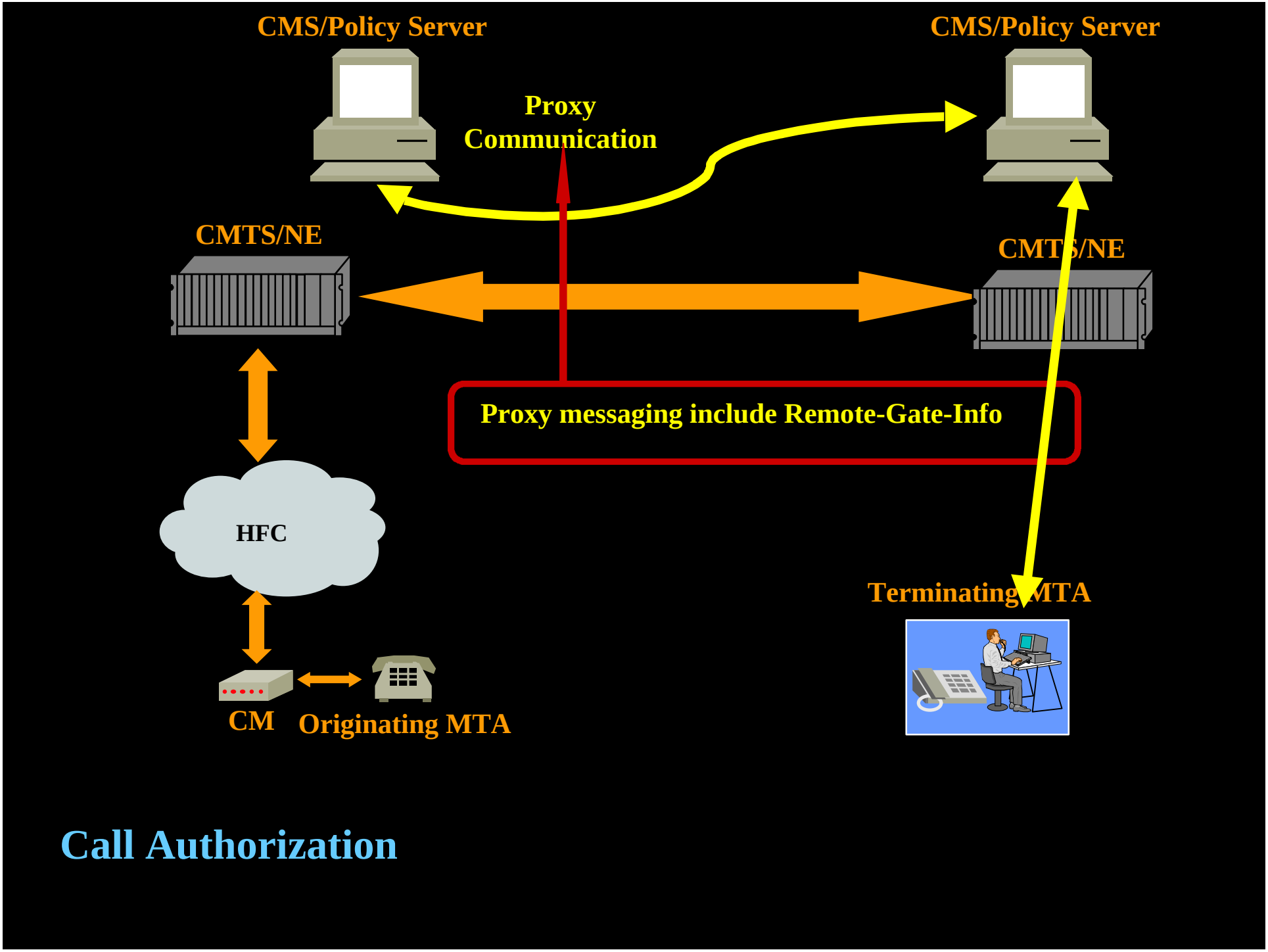


Call Signalling to CMS

INVITE	***Description***
INVITE sip:555-2222@Host(DP-o);user=phone SIP/2.0	*Request URI starts with the dialed number from the user*
aa	*IP Address or Domain name of originating MTA.*
Dcs-Caller: John Doe; 555-1111	*Calling name and number, as provided by MTA*
Dcs-Anonymity: Off	*Calling name and number privacy is not required for this call*
Require: DCS	
Proxy-Require: DCS	
From: “Alien Blaster” <sip:BASE64(SHA-1(555-1111; time=36123E5B; seq=72))>	*The triple (From, To, CallID) uniquely identifies the call-leg, excluding the display-name in the From: header.. To maintain privacy, the addr-spec is encrypted and calling-number and calling-name will be omitted from MTA-MTA signaling.*
To: sip:BASE64(SHA-1(555-2222; time=36123E5B; seq=73))	*To: is a cryptographical hash of a string that contains the dialed digits from the user, timestamp, and a sequence number, or other random string.*
Call-ID: BASE64(SHA-1(555-1111;time=36123E5B;seq=72))	*Call-ID is a cryptographically random identifier.*
CSeq: 127 INVITE	*Call sequence number*
Dcs-Stage1:	*Instructs far end not to ring phone on receipt of this INVITE*
Contact: sip:Host(mta-o.provider)	*Signaling address of originator*
Content-Type: application/sdp	*A SIP INVITE message must contain a SDP description of the media flow.*
Content-length: (…)	
v=0	*SDP description contains lines giving the following: Version number (v= line), Connection information at originator (c= line), and Media encoding parameters and port number (m= line)*
o=- 2987933615 2987933615 IN IP4 A3C47F2146789F0	
s=-	
c= IN IP4 Host(mta-o.provider)	
b=AS:64000	
t=907165275 0	
a=X-pc-csuite:312F	
a=rtpmap:0 PCMU/8000	
a=rtpmap:96 G726-32/8000	
m=audio 3456 RTP/AVP 0	
a=X-pc- codecs:96	

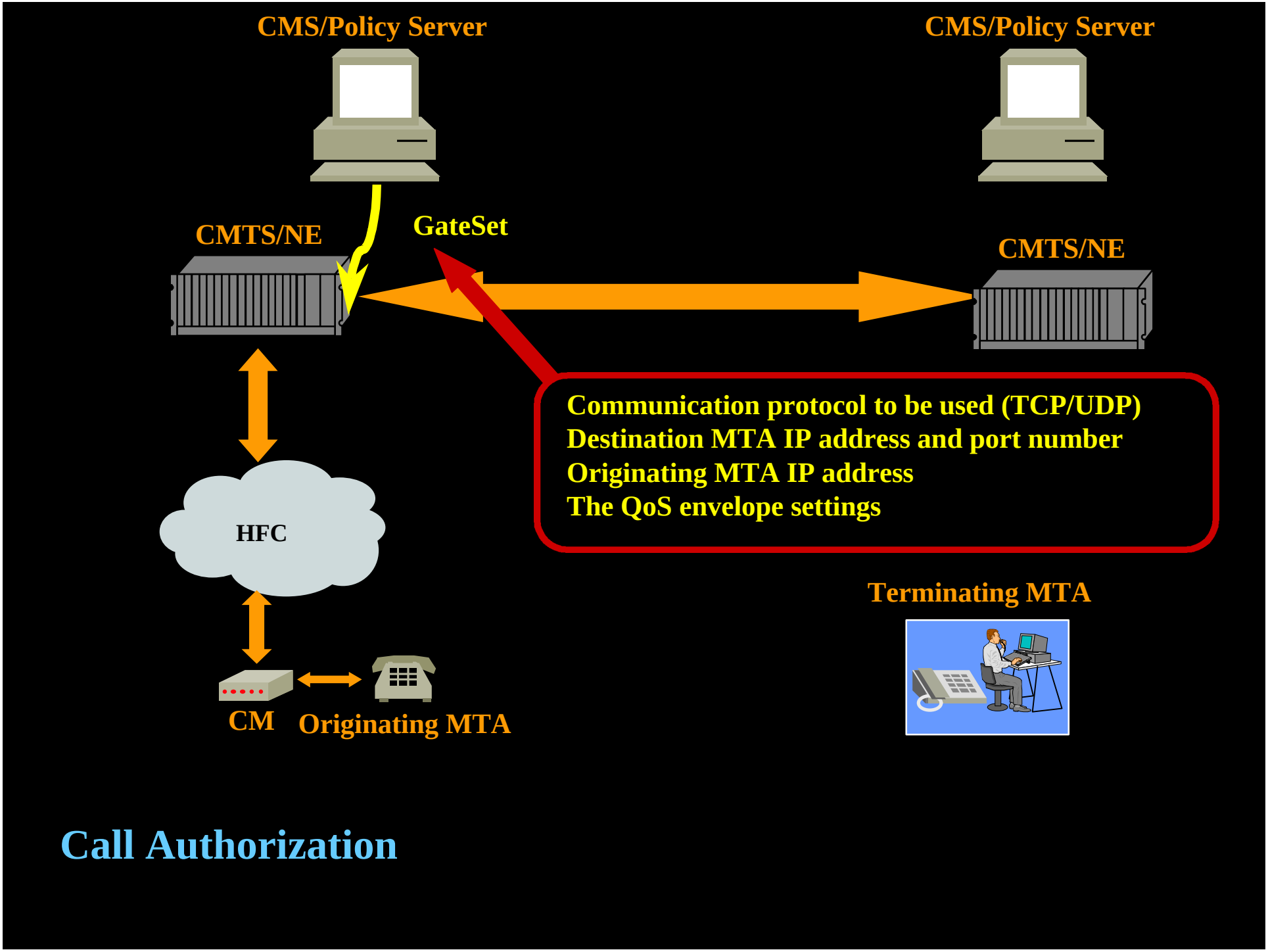


Call Signalling to CMS



Call Authorization

INVITE (stage1):	***Description***
INVITE sip: +1-212-555-2222,lnp=212-234@Host(DP-t) SIP/2.0	*"lnp" shows that LNP dip done and gives the result. Dialed number fully expanded into E.164 number*
Via: SIP/2.0/UDP Host(DP-o.provider);branch=1	*DP_O IP address; branch indicates this is the first destination attempt*
Via: SIP/2.0/UDP Host(mta-o.provider)	
Caller: John Doe; +1-212-555-1111	*Verified Calling Name, and full E.164 Calling Number*
Dcs-Remote-Gate: Host(cmts-o.provider):3612/17S30124/37FA1948	*IP addr of CMTS, ID of the originating gate, and key for gate coord.*
From: "Alien Blaster" <sip:BASE64(SHA-1(555-1111; time=36123E5B;seq=72))>	*The triple (From, To, CallID) is used by SIP to uniquely identify a call leg. The display-name is not part of the call leg identification*
To: sip:BASE64(SHA-1(555-2222; time=36123E5B; seq=73))	
Call-ID: BASE64(SHA-1(555-1111;time=36123E5B;seq=72))	
CSeq: 127 INVITE	
Contact: sip:Host(mta-o.provider)	
Dcs-Stage1:	
Content-Type: application/sdp	
Content-length: (…)	
v=0	
o=- 2987933615 2987933615 IN IP4 A3C47F2146789F0	
s=-	
c= IN IP4 Host(mta-o.provider)	
b=AS:64000	
t=907165275 0	
a=X-pc-csuites:312F	
a=X-pc-secret:clear:WhenInTheCourseOfHumanEvents	*Suggested encryption key inserted by DP-o*
a=rtpmap:0 PCMU/8000	
a=rtpmap:96 G726-32/8000	
m=audio 3456 RTP/AVP 0	
a=X-pc-codecs:96	



Call Authorization

COPS Usage

- The Gate messages use modified COPS messages.
- New headers are defined for Call Authorization.

GATE-SET

Transaction ID		3177	Unique Transaction ID for this message exchange
Subscriber		MTAo	Request for total resources in use by this client.
Gate-ID		37125	Identifier for allocated Gate
Remote-Gate-Info	CMTS Address	CMTSt	Information needed to perform gate coordination
	CMTS Port	2052	
	Remote Gate-ID	1273	
	Security Key	<key>	
Gate-Spec	Direction	up	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAo	
	Destination Address	MTAt	
	Source port	0	
	Destination port	7000	
	b	120	These are the maximum bandwidth parameters that MTAo is authorized to request for this conversation.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	R	12,000	
	S	0	
Gate-Spec	Direction	down	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAt	
	Destination Address	MTAo	
	Source port	0	
	Destination port	7120	
	b	120	These are the maximum bandwidth parameters that MTAo is authorized to request for this conversation.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	R	12,000	

Local Gate Info

GATE-SET

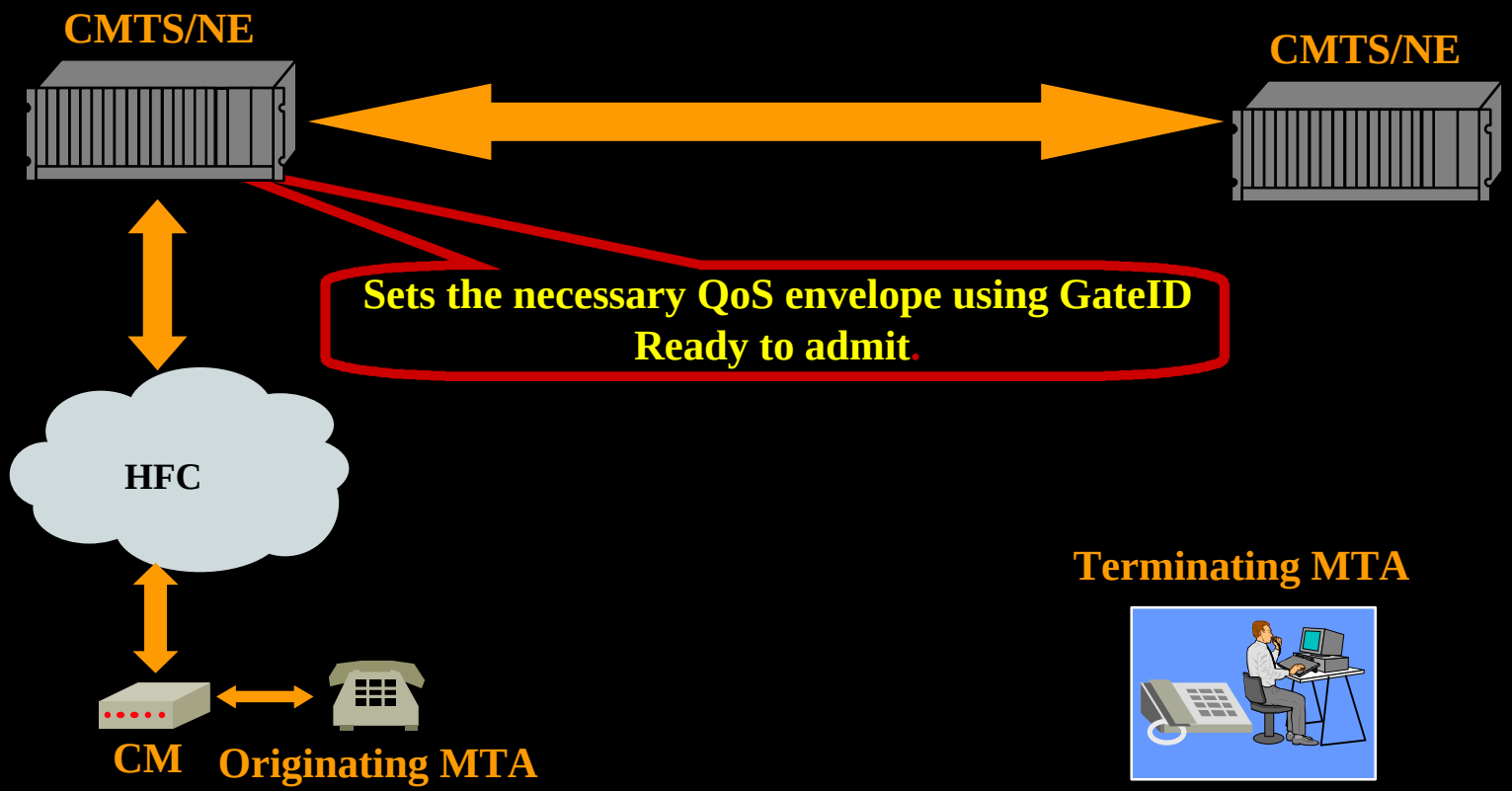
Transaction ID		3177	Unique Transaction ID for this message exchange
Subscriber		MTAo	Request for total resources in use by this client.
Gate-ID		37125	Identifier for allocated Gate
Remote-Gate-Info	CMTS Address	CMTSt	Information needed to perform gate coordination
	CMTS Port	2052	
	Remote Gate-ID	1273	
	Security Key	<key>	
Gate-Spec	Direction	up	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAo	
	Destination Address	MTAt	
	Source port	0	
	Destination port	7000	
	b	120	These are the maximum bandwidth parameters that MTAo is authorized to request for this conversation.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	R	12,000	
	S	0	
Gate-Spec	Direction	down	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAt	
	Destination Address	MTAo	
	Source port	0	

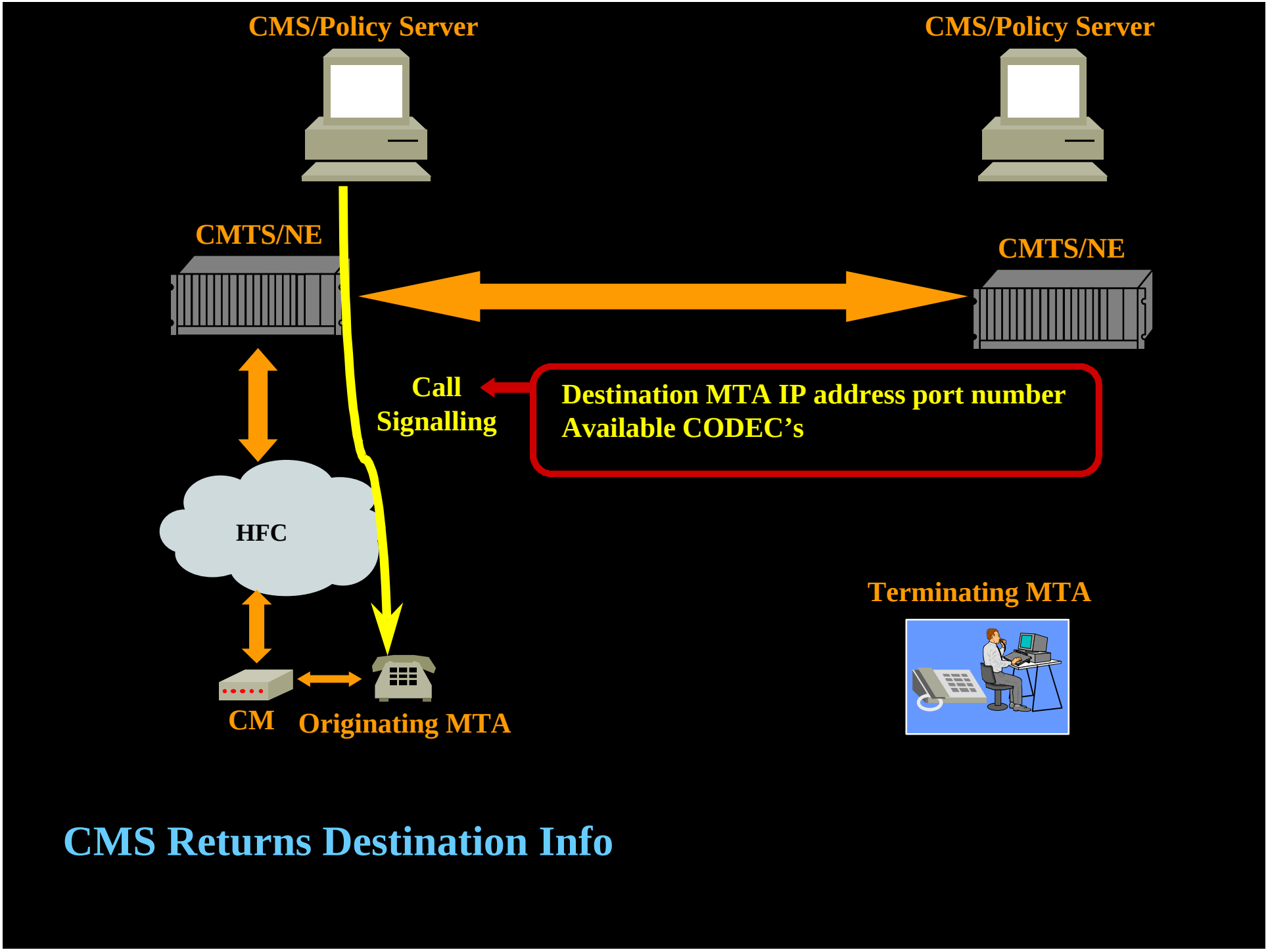
Remote Gate Info

GATE-SET

Transaction ID		3177	Unique Transaction ID for this message exchange
Subscriber		MTAo	Request for total resources in use by this client.
Gate-ID		37125	Identifier for allocated Gate
Remote-Gate-Info	CMTS Address	CMTSt	Information needed to perform gate coordination
	CMTS Port	2052	
	Remote Gate-ID	1273	
	Security Key	<key>	
Gate-Spec	Direction	up	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAo	
	Destination Address	MTAt	
	Source port	0	
	Destination port	7000	
	b	120	These are the maximum bandwidth parameters that MTAo is authorized to request for this conversation.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	R	12,000	
	S	0	
Gate-Spec	Direction	down	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAt	
	Destination Address	MTAo	
	Source port	0	

CMTS is Ready to Process a Reservation

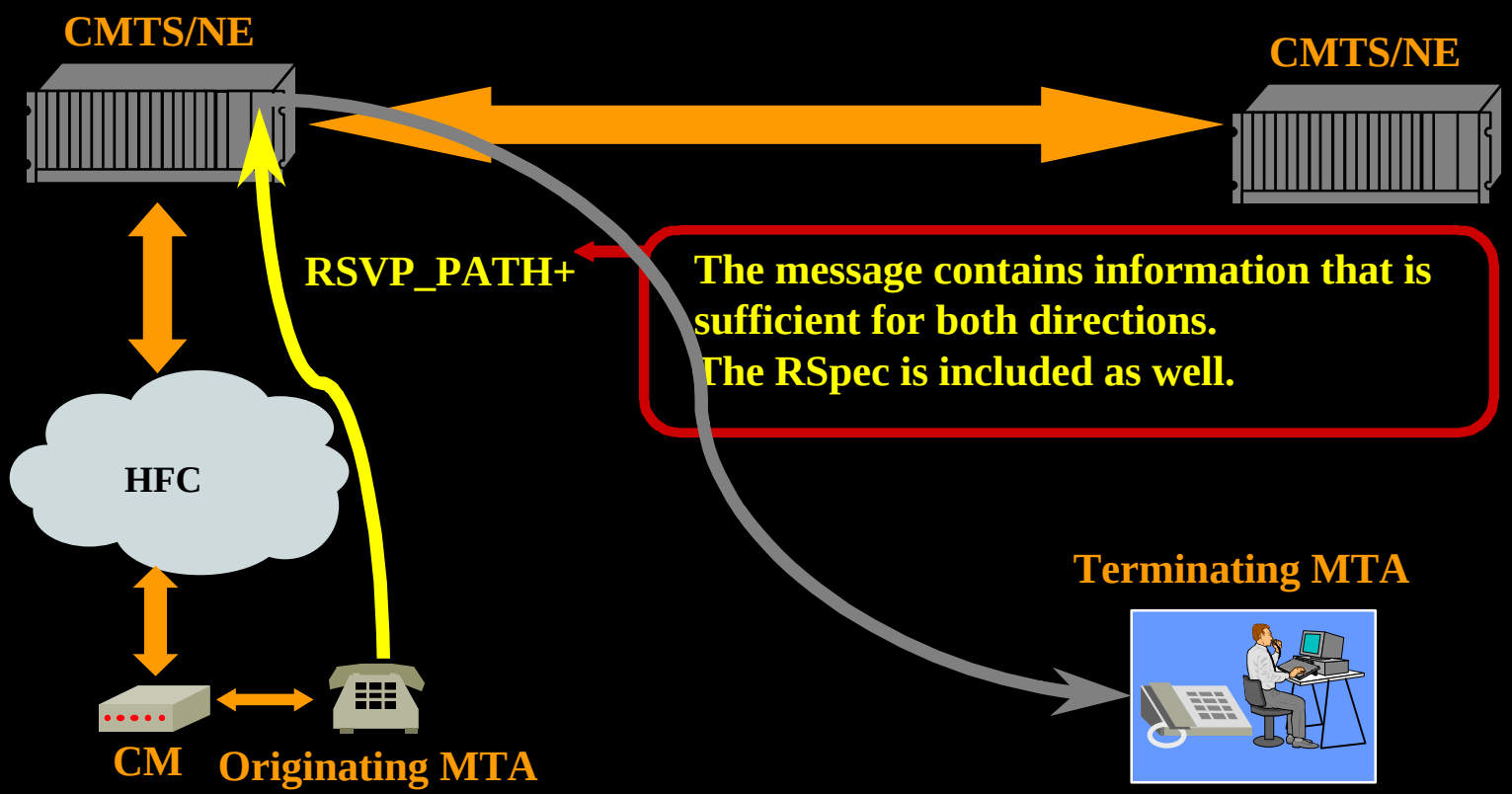




CMS Returns Destination Info

200-OK:	***Description***
SIP/2.0 200 OK	
Via: Sip/2.0/UDP Host(mta-o.provider)	
DCS-Local-Gate: 17S30124	*ID of gate at originator end of connection*
State: {call; +1-212-555-1111; +1-212-555-2222; Host(cmts-o.provider): 3612/17S30124;Host(dp-t.provider),Host(mta-t.provider)}$_K$	*State blob encrypted with a DP$_O$ private key containing: E.164$_O$; E.164$_T$; CMTS$_O$ IP address:port and Gate-ID, and routing to destination MTA*
From: "Alien Blaster" <sip:BASE64(SHA-1(555-1111; time=36123E5B;seq=72)) >	*Call leg identification*
To: sip:BASE64(SHA-1(555-2222; time=36123E5B; seq=73))	
Call-ID: BASE64(SHA-1(555-1111;time=36123E5B;seq=72))	
CSeq: 127 INVITE	
Contact: sip:Host(mta-t.provider)	
Content-Type: application/sdp	
Content-length: (…)	
v=0	
o=- 2987933615 2987933615 IN IP4 A3C47F2146789F0	
s=-	
c= IN IP4 Host(mta-o.provider)	
b=AS:64000	
t=907165275 0	
a=X-pc-csuites:312F	
a=X-pc-secret:clear:WhenInTheCourseOfHumanEvents	
a=rtpmap:0 PCMU/8000	
m=audio 6544 RTP/AVP 0	

RSVP_PATH+ to Destination MTA



RSVP Enhancements

- All enhancements use opaque objects that does work with traditional RSVP routers.
- RSpec has to be carried with RSVP_PATH message.
- The reverse direction RSVP information (including RSpec) has to be carried with the RSVP_PATH message.

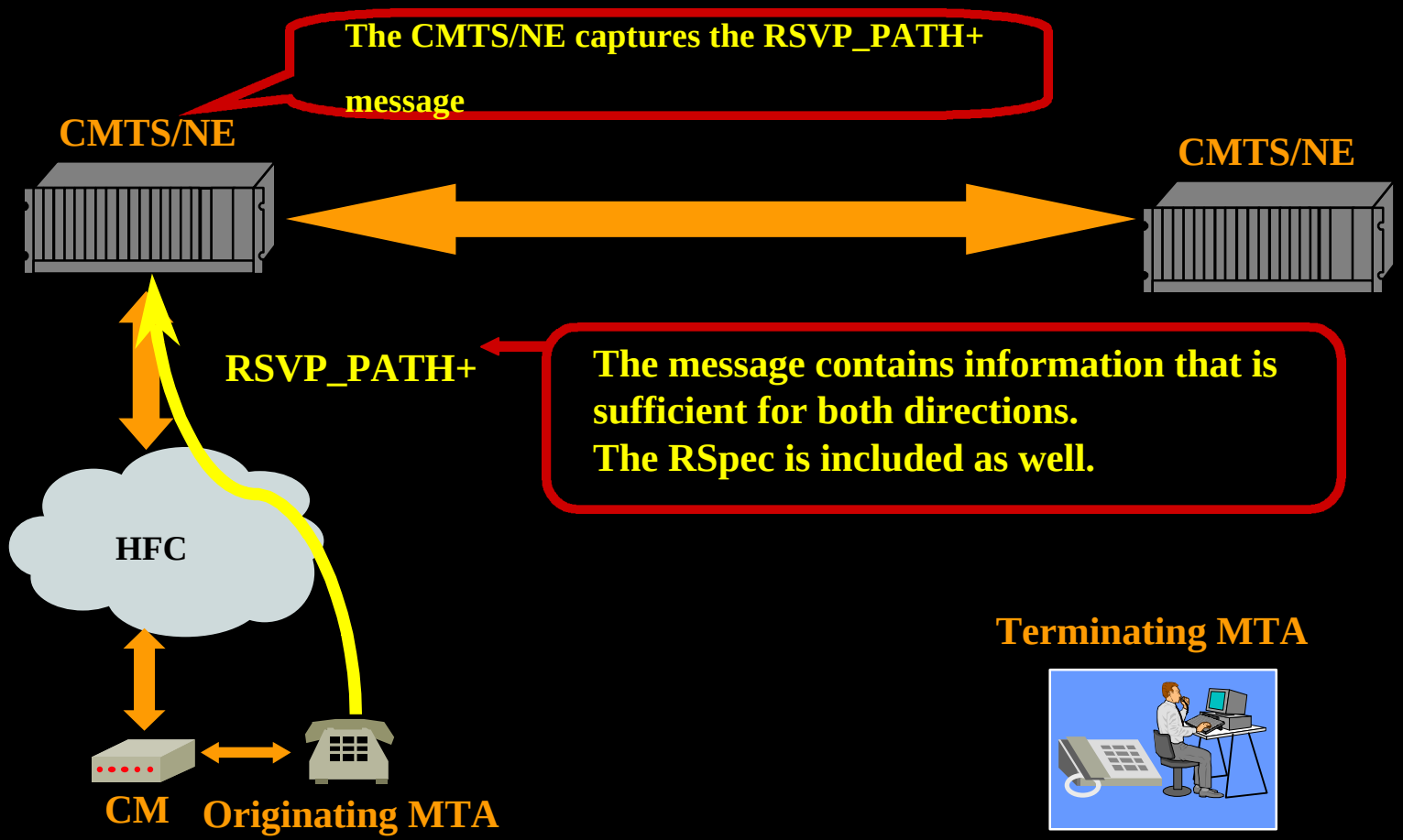
RSVP_PATH+

Session Object	Protocol	UDP	The parameters act as the Gate ID, matching the authorization previously sent by the CMS, and are also used for QoS classifiers.
	Destination Address	BTIt	
	Destination port	7000	
Sender Templ	Source Address	BTIo	
	Source port	7120	Since the source port is not known during gate
Sender Tspec	b	120	These are the negotiated traffic parameters actually being requested for this call. The CMTS calculates the actual upstream QoS parameters using these TSpec and RSpec parameters. This is a standard RSVP object, which will be interpreted by all intermediate routers in the path between the BTI and CMTS.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	Hdr Suppression	40	
	VAD	off	
Forward Rspec	**R**	12,000	
	S	0	
Reverse Session.	**Protocol**	UDP	New RSVP objects that provides the CMTS with sufficient information to calculate downstream traffic parameters and to generate an RSVP-PATH message for the downstream flow.
	Destination Addr	BTIo	
	Destination port	7120	
Reverse Sender Templ	**Source Address**	BTIt	
	Source port	7000	
Reverse Sender Tspec	**b**	120	Negotiated traffic parameters actually being requested for this call. The CMTS calculates the actual downstream QoS parameters using these TSpec and RSpec parameters. This is a new RSVP object, which will be ignored by intermediate routers.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	Hdr Suppression	0	
	VAD	off	
Reverse Rspec	**R**	12,000	
	S	0	
Gate-ID		37125	Gate-ID is the same as used in the Gate-Set

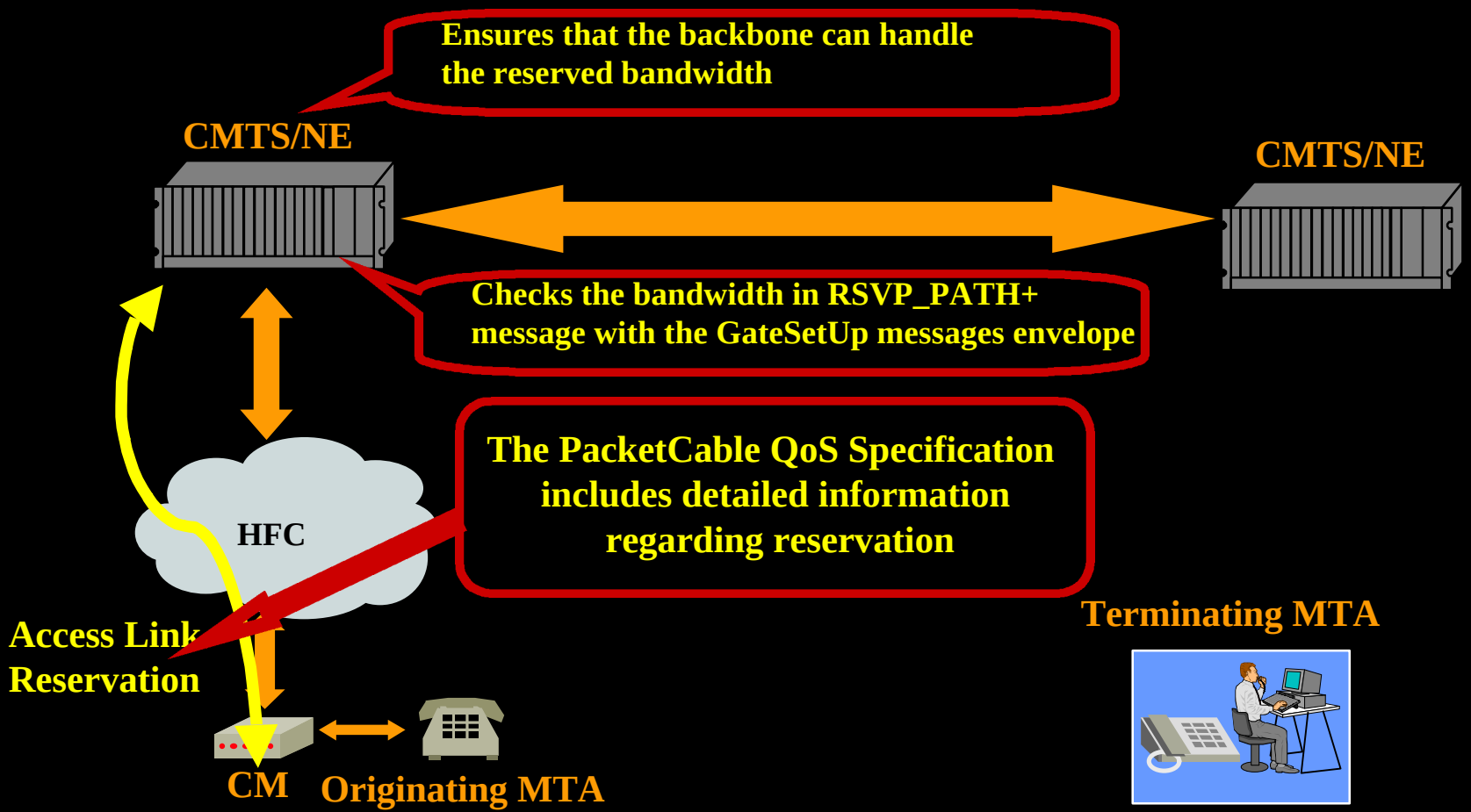
RSVP Optimizations

- RSVP_PATH+ message has all the information regarding bi-directional reservation.
- RSVP_RESV+ would indicate the bi-directional reservation.

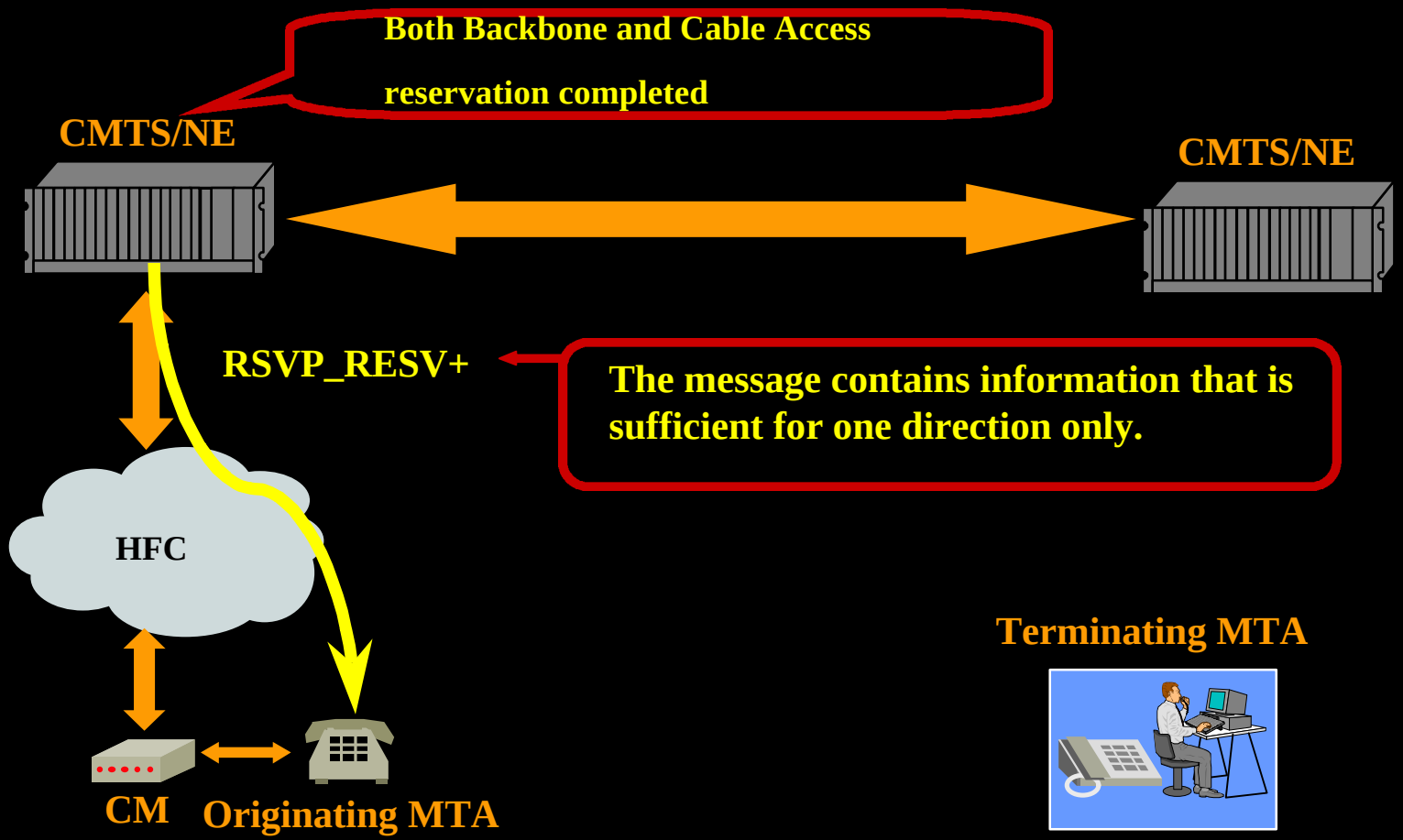
CMTS/NE Captures RSVP_PATH+



CMTS/NE makes the reservation for RFI link



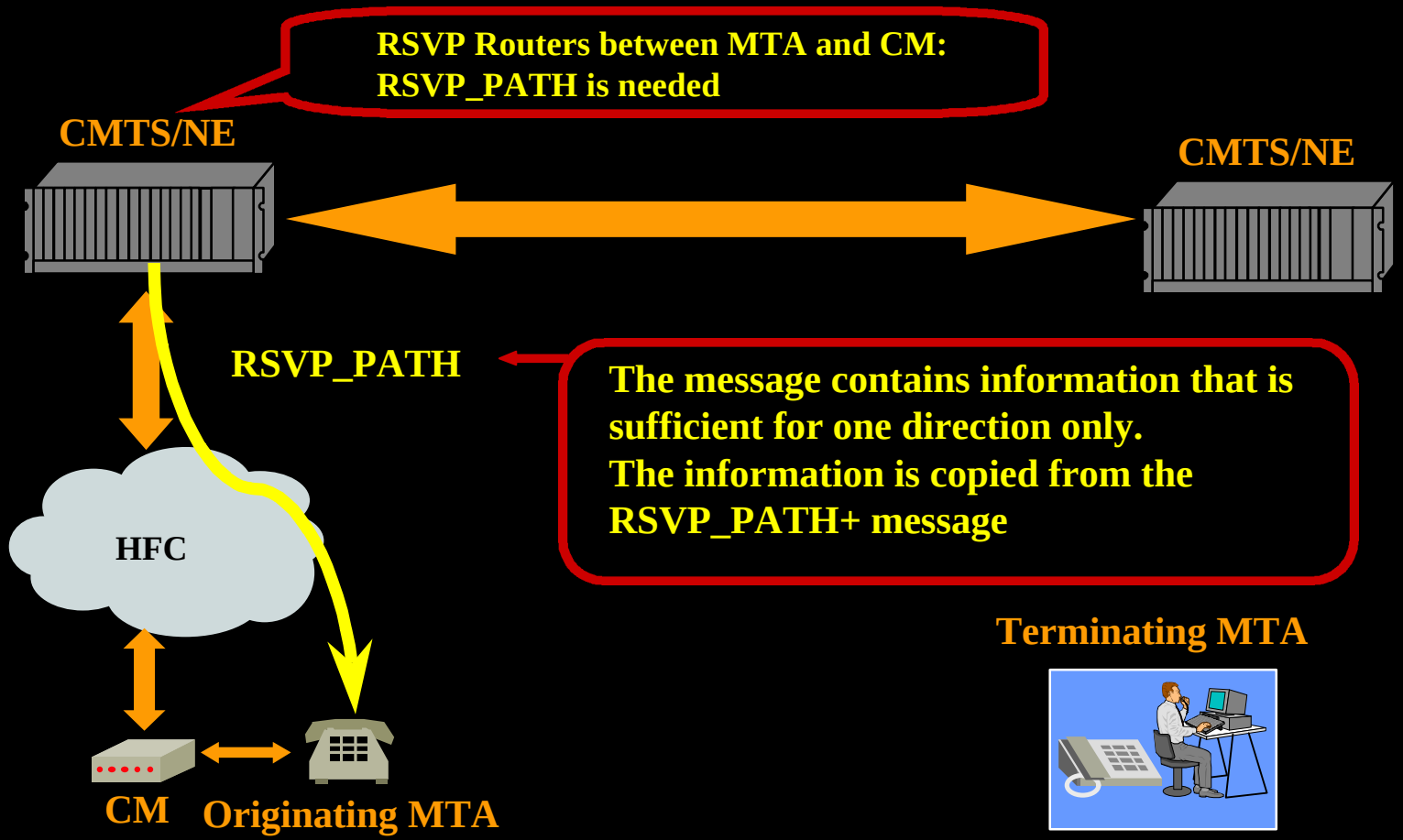
CMTS/NE Signals the Success



RSVP_RESV+

Session Object	Protocol	UDP	These fields identify the IP flow for which the reservation is being established
	Destination Address	BTIt	
	Destination port	7000	
Sender Templ	Source Address	BTIo	
	Source port	7120	
Sender Tspec	b	120	These fields identify the resources being reserved for this flow.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
Forward Rspec	R	12,000	
	S	0	
ResourceID		1	New Resource ID created for this reservation

If Two-Way reservation is necessary at CPE Routers



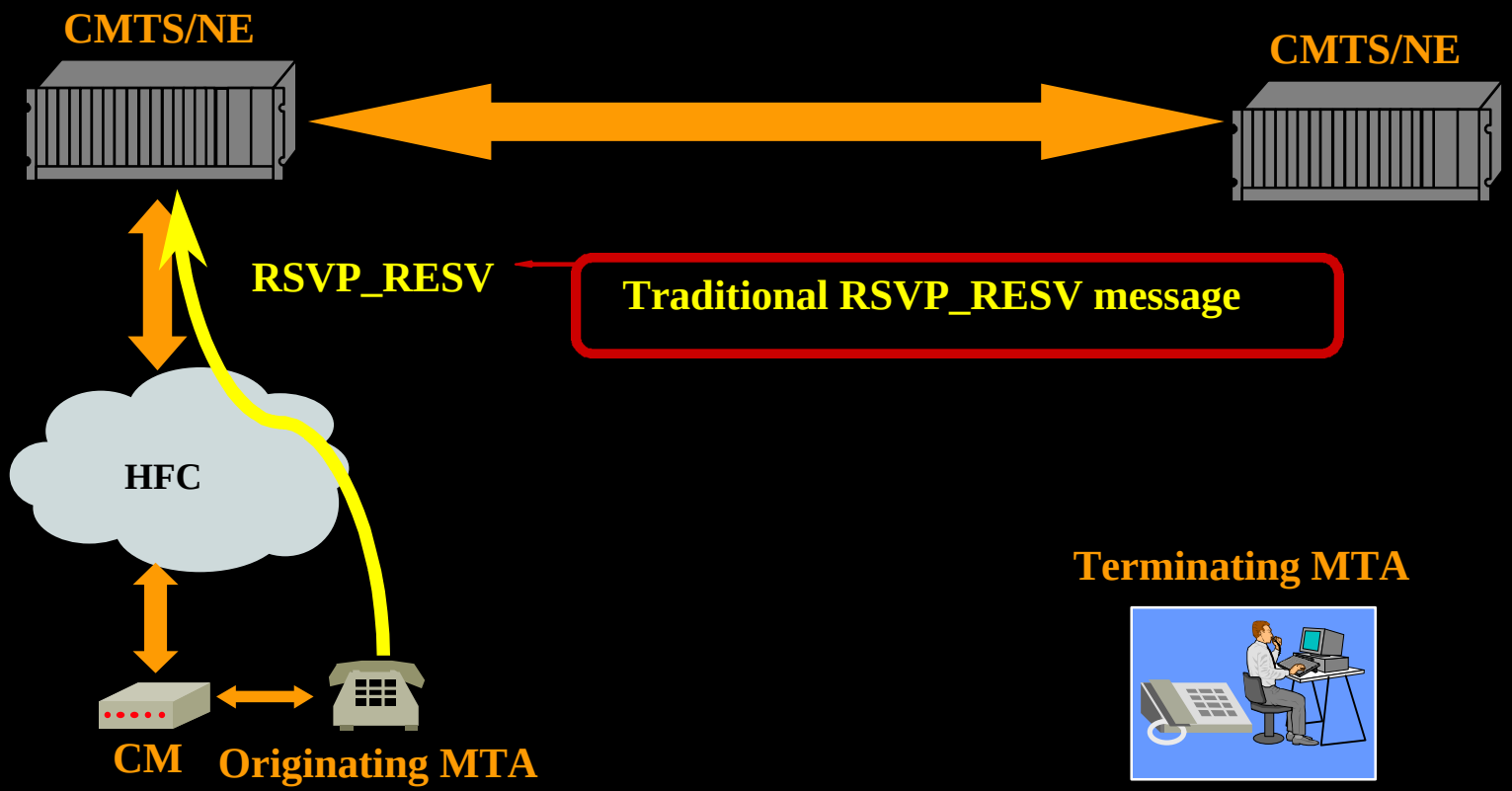
RSVP_PATH

RSVP PATH+

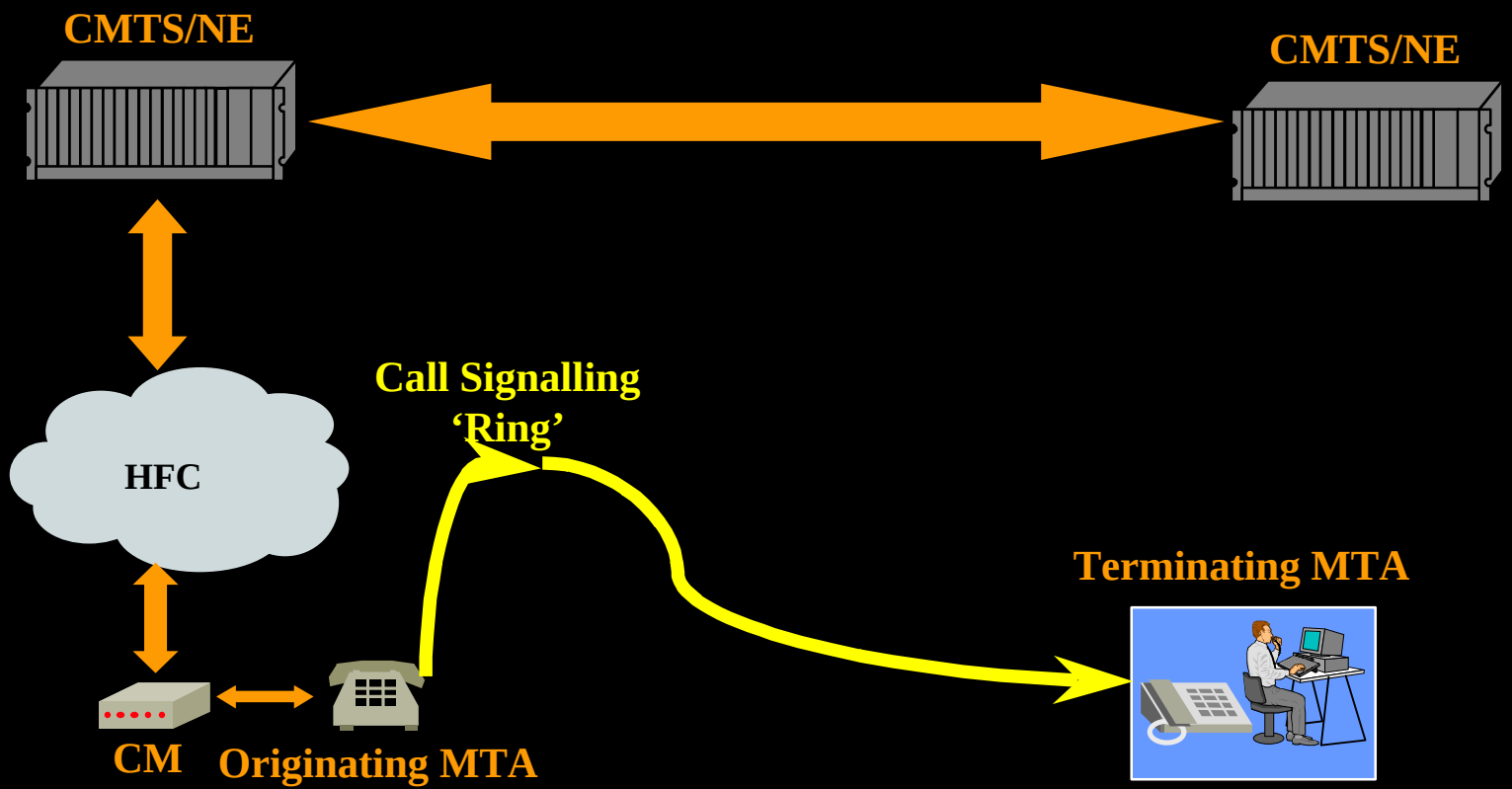
Session Object	Protocol	UDP	The parameters act as the Gate ID, matching the authorization previously sent by the CMS, and are also used for QoS classifiers.
	Destination Address	BTIt	
	Destination port	7000	
Sender Templ	Source Address	BTIo	
	Source port	7120	Since the source port is not known during gate
Sender Tspec	b	120	These are the negotiated traffic parameters actually being requested for this call. The CMTS calculates the actual upstream QoS parameters using these TSpec and RSpec parameters. This is a standard RSVP object, which will be interpreted by all intermediate routers in the path between the BTI and CMTS.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	Hdr Suppression	40	
	VAD	off	
Forward Rspec	R	12,000	
	S	0	
Reverse Session.	**Protocol**	UDP	New RSVP objects that provides the CMTS with sufficient information to calculate downstream traffic parameters and to generate an RSVP-PATH message for the downstream flow.
	Destination Addr	BTIo	
	Destination port	7120	
Reverse Sender Templ	**Source Address**	BTIt	
	Source port	7000	
Reverse Sender Tspec	**b**	120	Negotiated traffic parameters actually being requested for this call. The CMTS calculates the actual downstream QoS parameters using these TSpec and RSpec parameters. This is a new RSVP object, which will be ignored by intermediate routers.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
	Hdr Suppression	0	
	VAD	off	
Reverse Rspec	R	12,000	
	S	0	

Information used to construct the RSVP_PATH message downstream

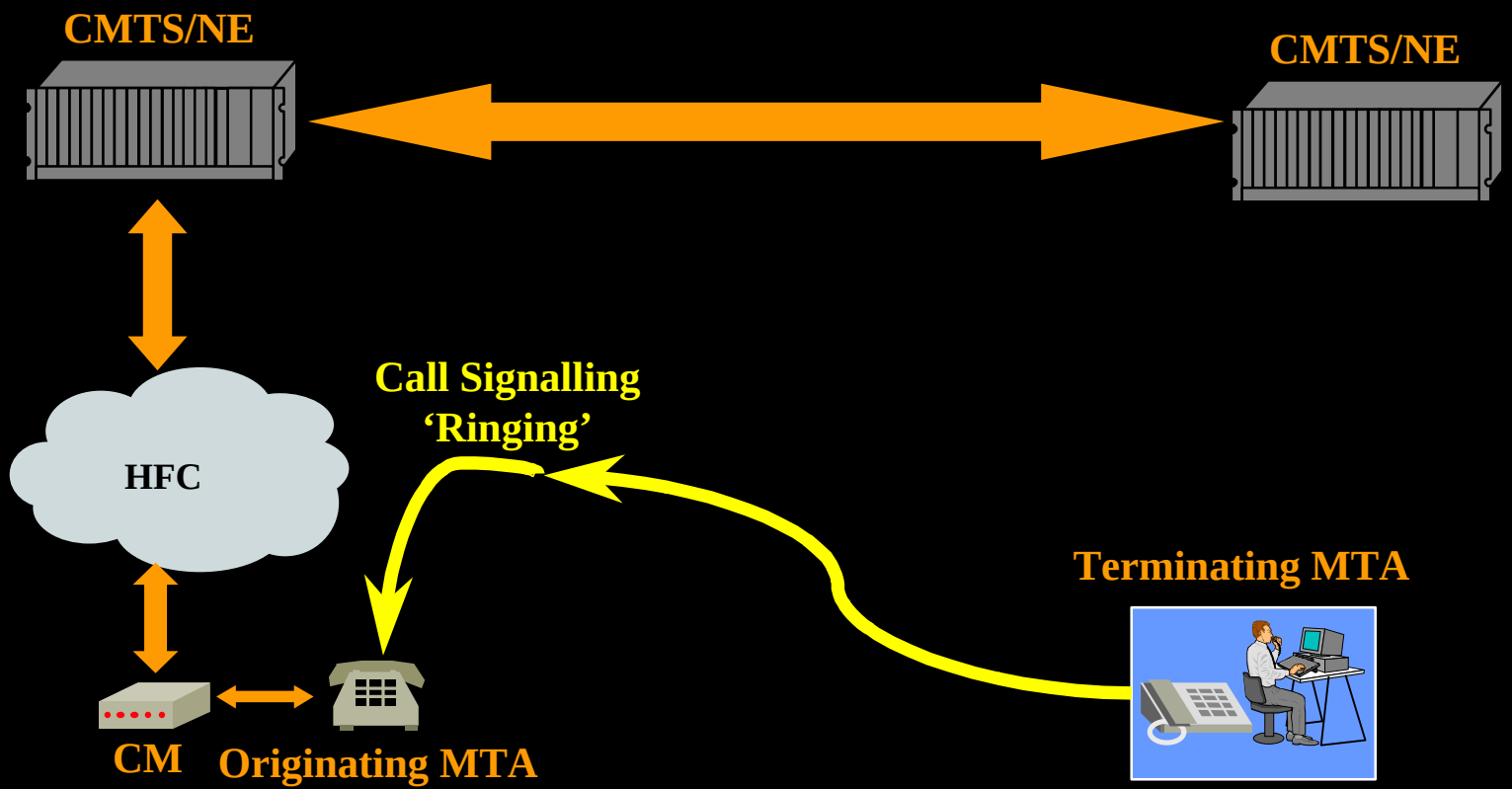
Access Segment Reservation is Completed



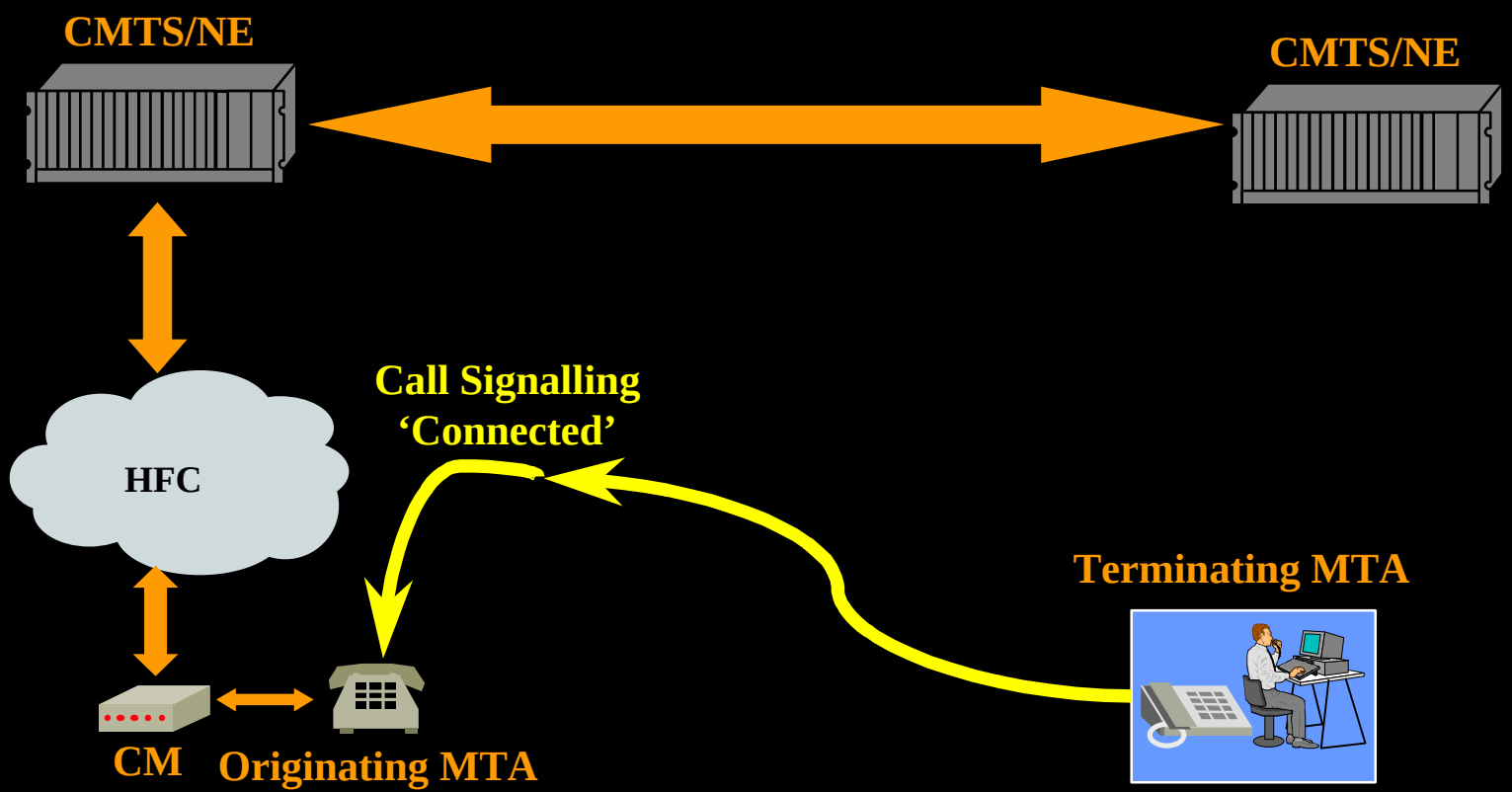
It is time to ring the other end



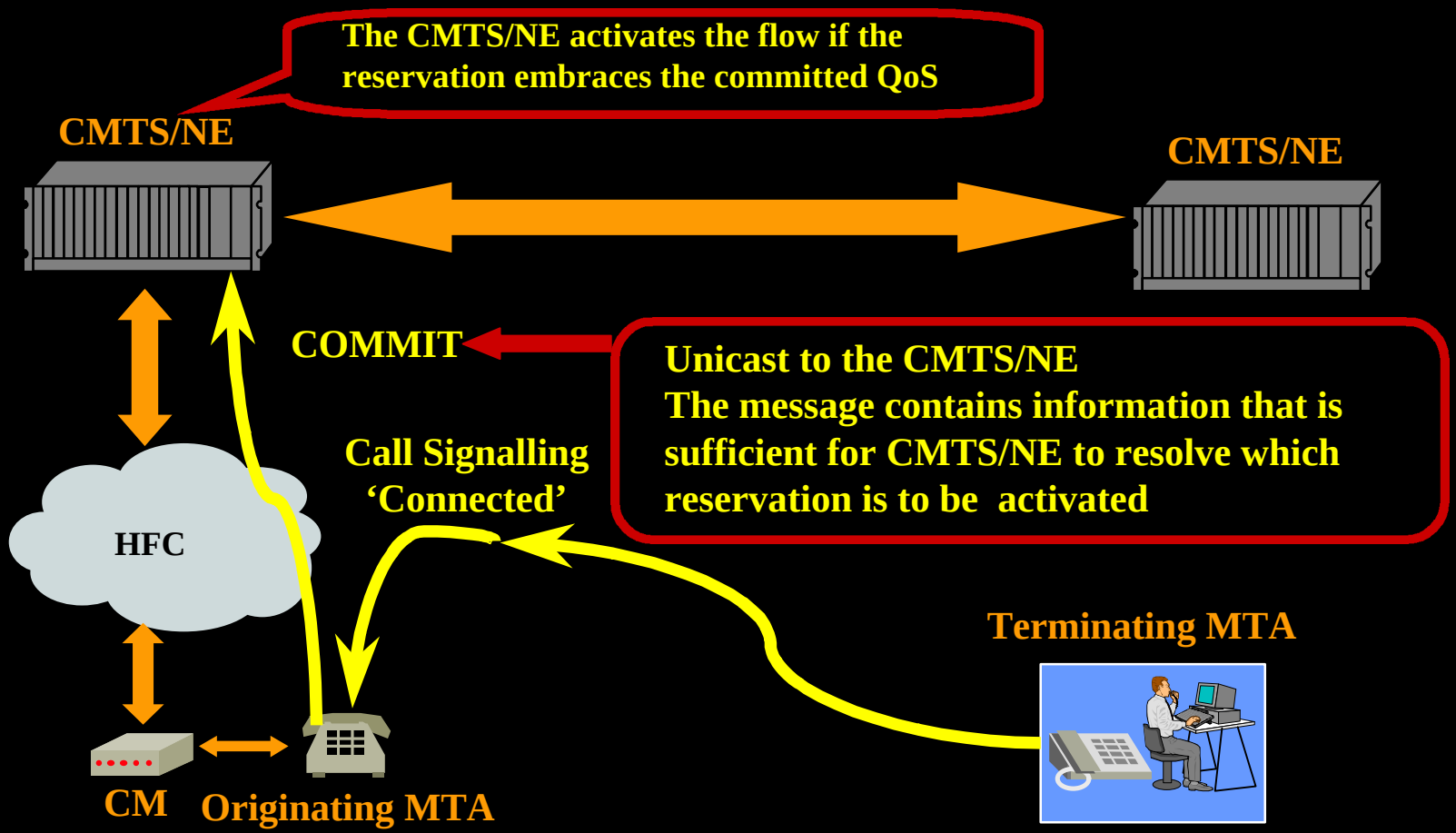
Ringing


CMTS/NE
CMTS/NE
HFC
Call Signalling
'Ringing'
Terminating MTA
CM
Originating MTA

Connected


CMTS/NE
CMTS/NE
HFC
Call Signalling
'Connected'
Terminating MTA
CM
Originating MTA

Before sending media stream the MTA commits the bandwidth

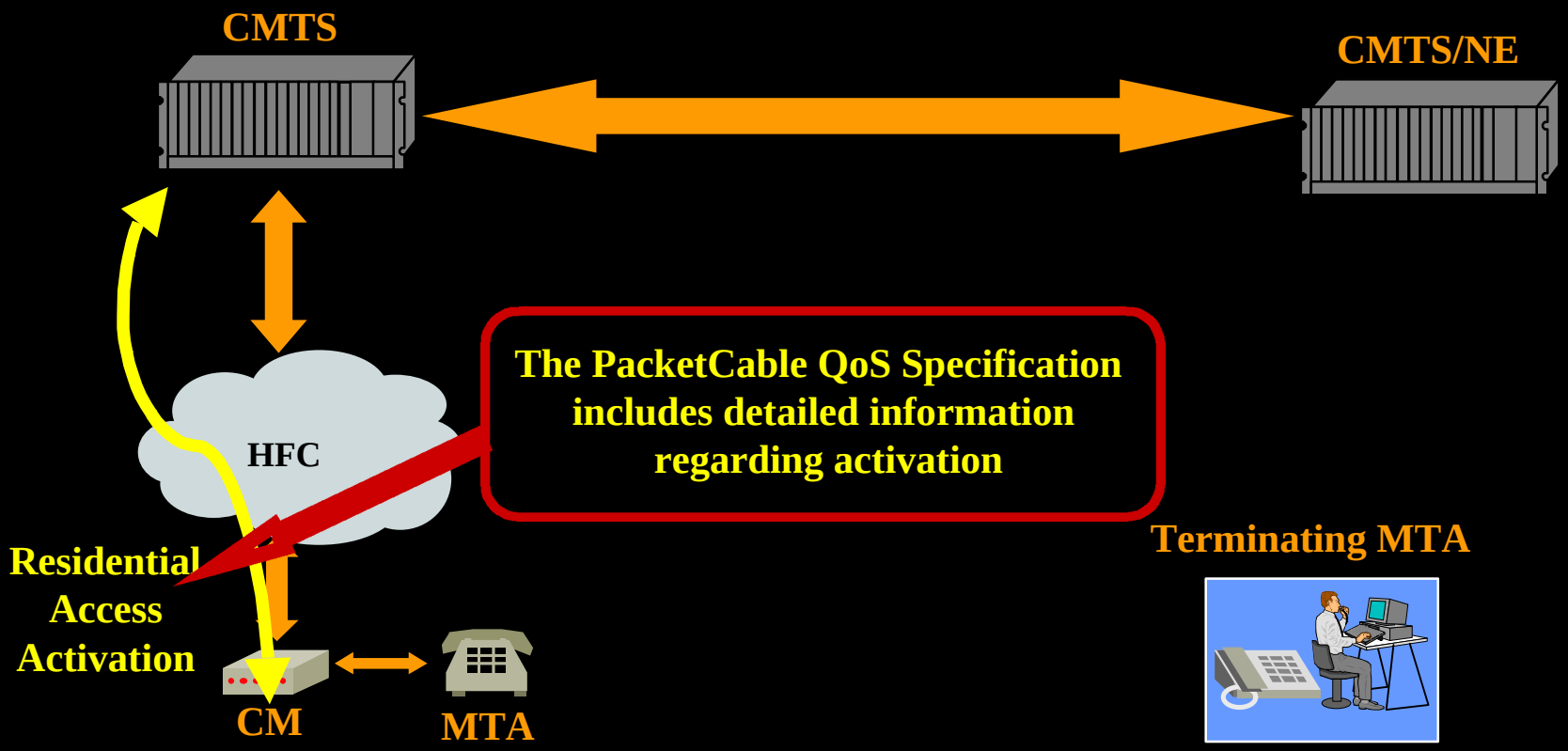


COMMIT

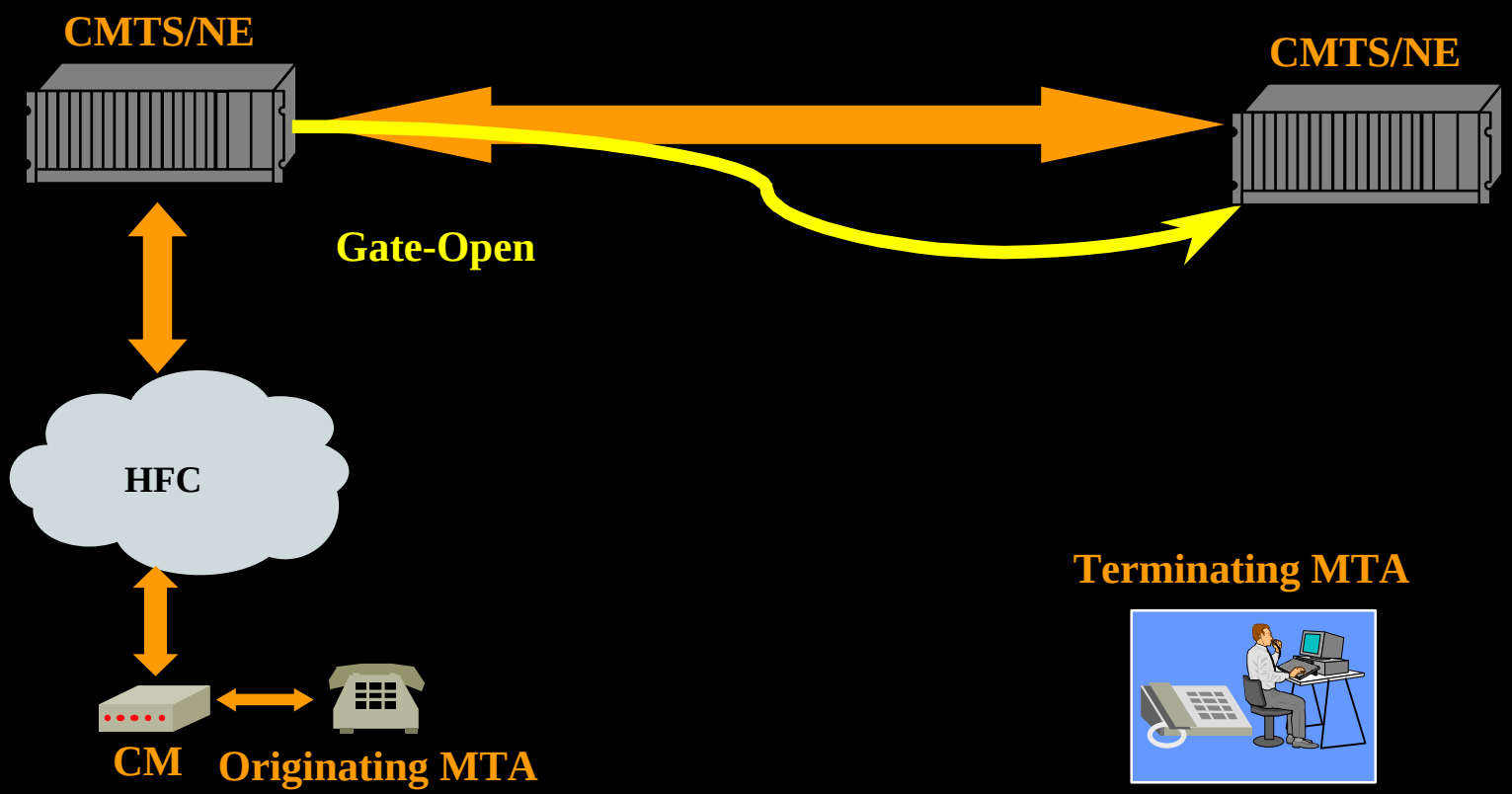
Session Object	**Protocol**	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple acts Gate ID.
	Destination Address	BTIt	
	Destination port	7000	
Sender Templ	**Source Address**	BTIo	
	Source port	7120	
Gate-ID		37125	

May contain a flow spec if you want to commit less than what has been reserved

CMTS Activates the RFI link flow



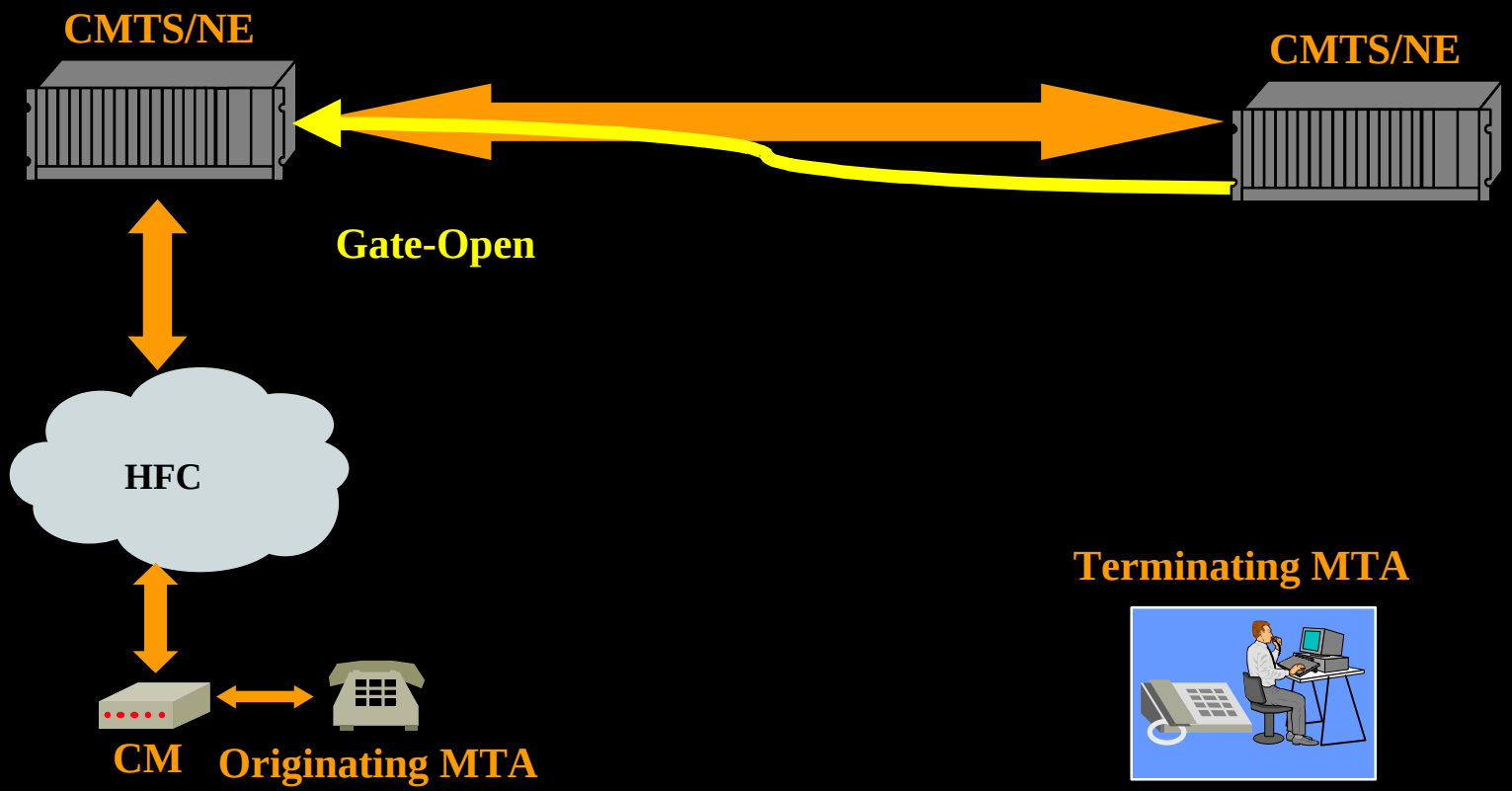
CMTS Signals the Gate Commit to Remote End



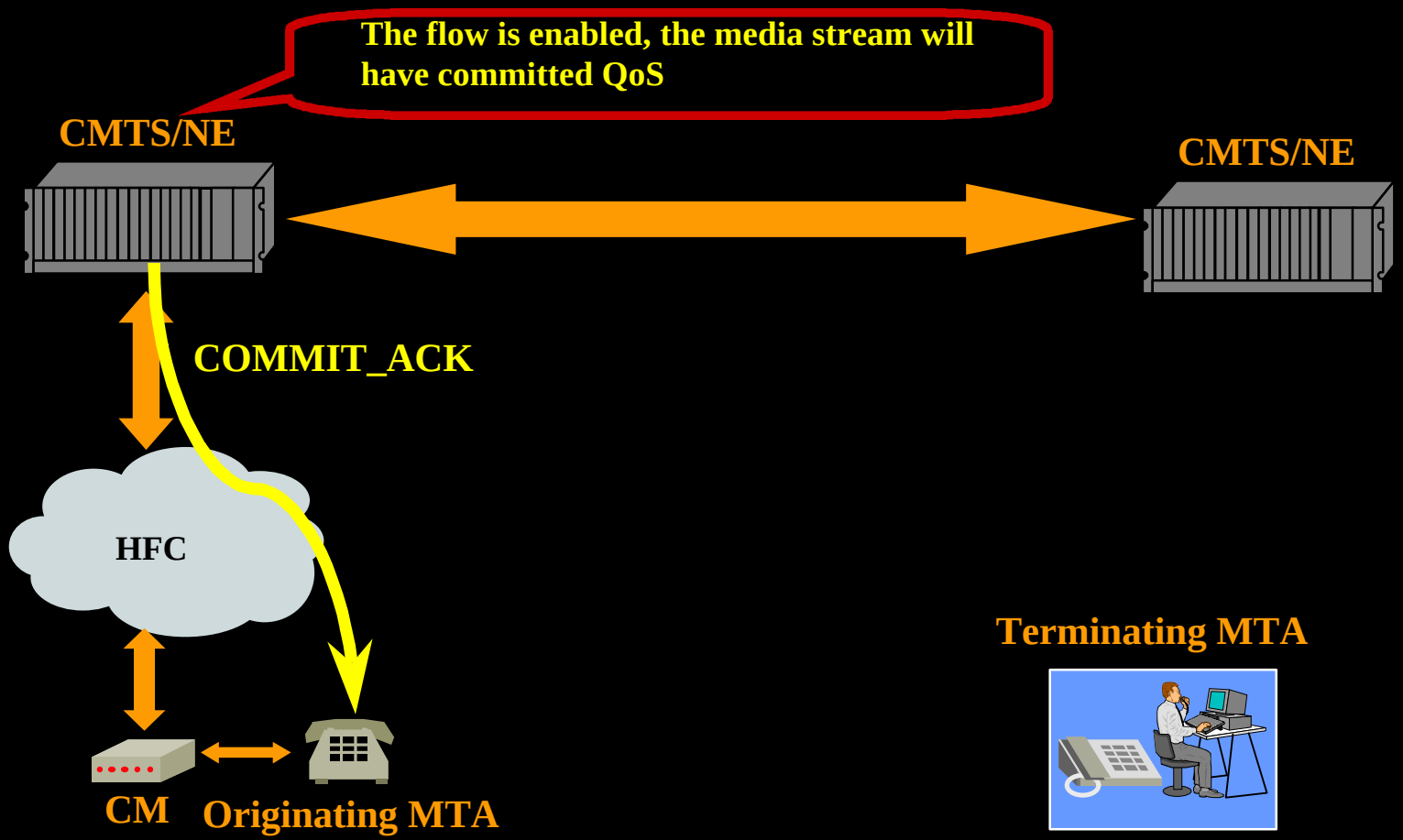
GATE-OPEN

Transaction ID		72	Identifier to match this message with its response
Gate ID		1273	Gate-ID at remote CMTS
Tspec	b	120	These are the committed traffic parameters actually being utilized in the MTAo to MTAt direction.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
Reverse-Tspec	b	120	These are the expected traffic parameters being utilized in the MTAt to MTAo direction.
	r	12,000	
	p	12,000	
	m	120	
	M	120	
HMAC			Security checksum for this message

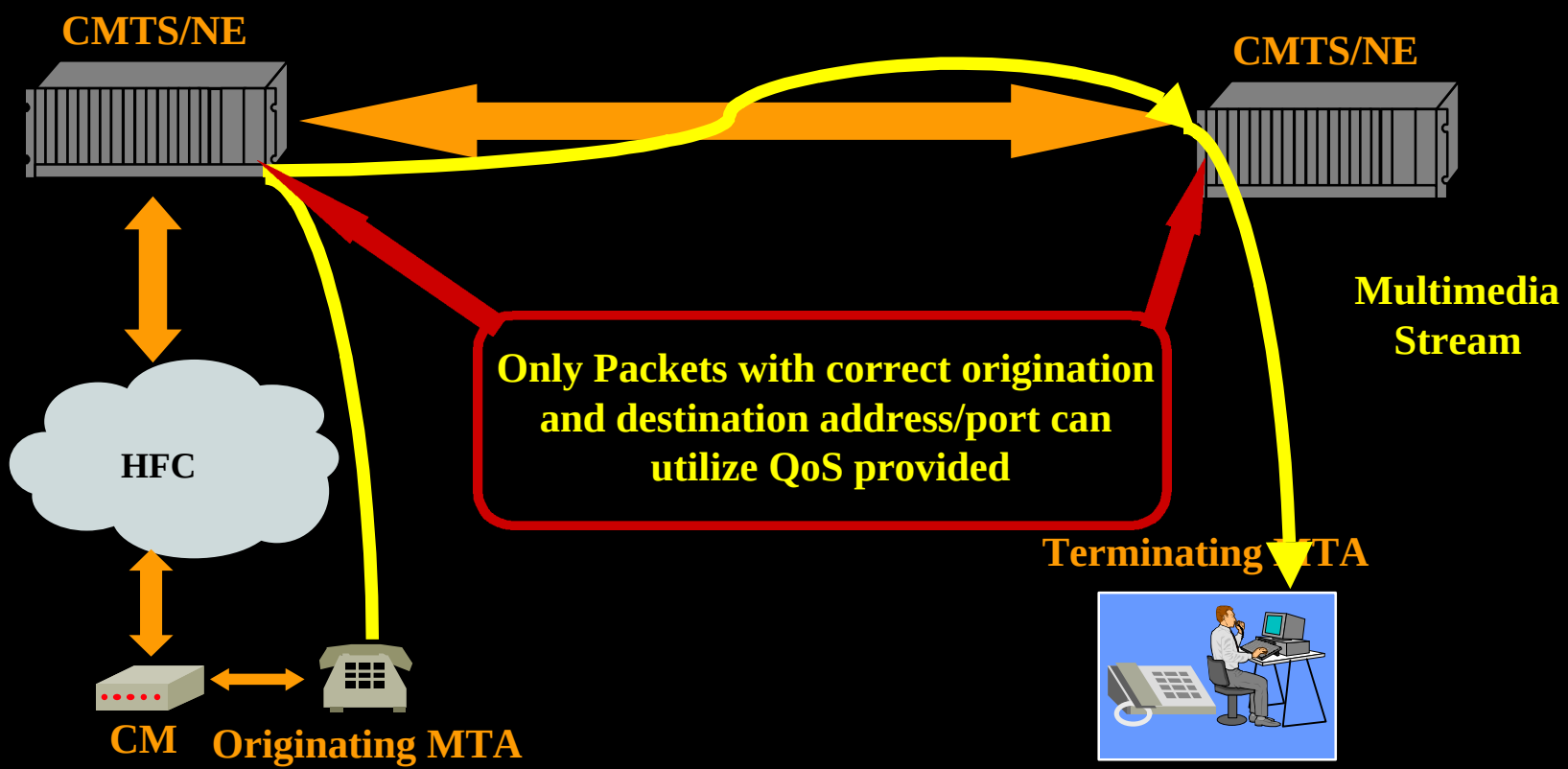
The gate at the remote end must be committed as well



CMTS Signals the Success



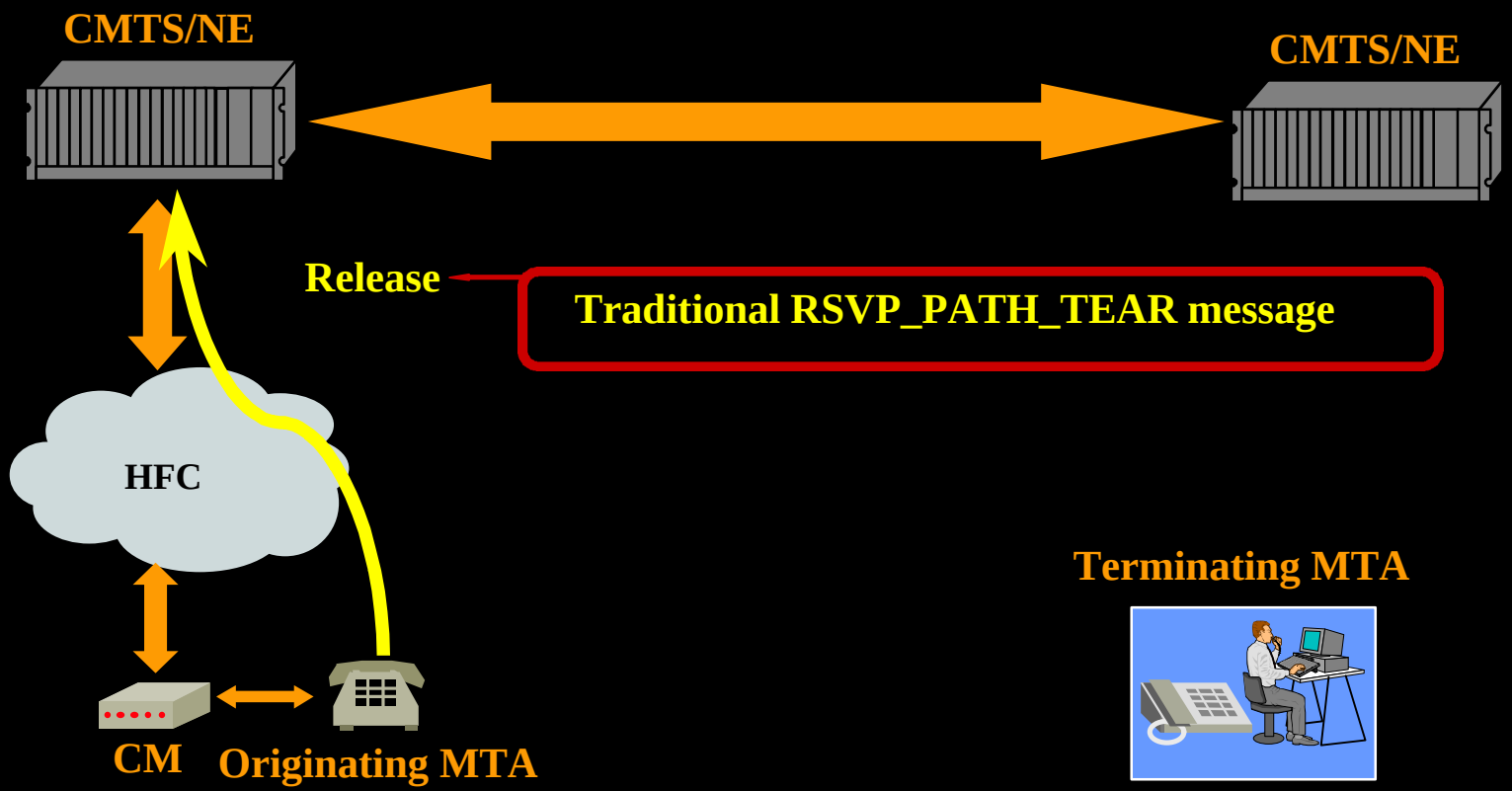
From now on the media flow will have proper QoS



Only the packets which fit the Gate Specification can pass-through CMTS

Gate-Spec	Direction	up	
	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port quadruple are used for QoS classifiers.
	Source Address	MTAo	
	Destination Address	MTAt	
	Source port	0	
	Destination port	7000	

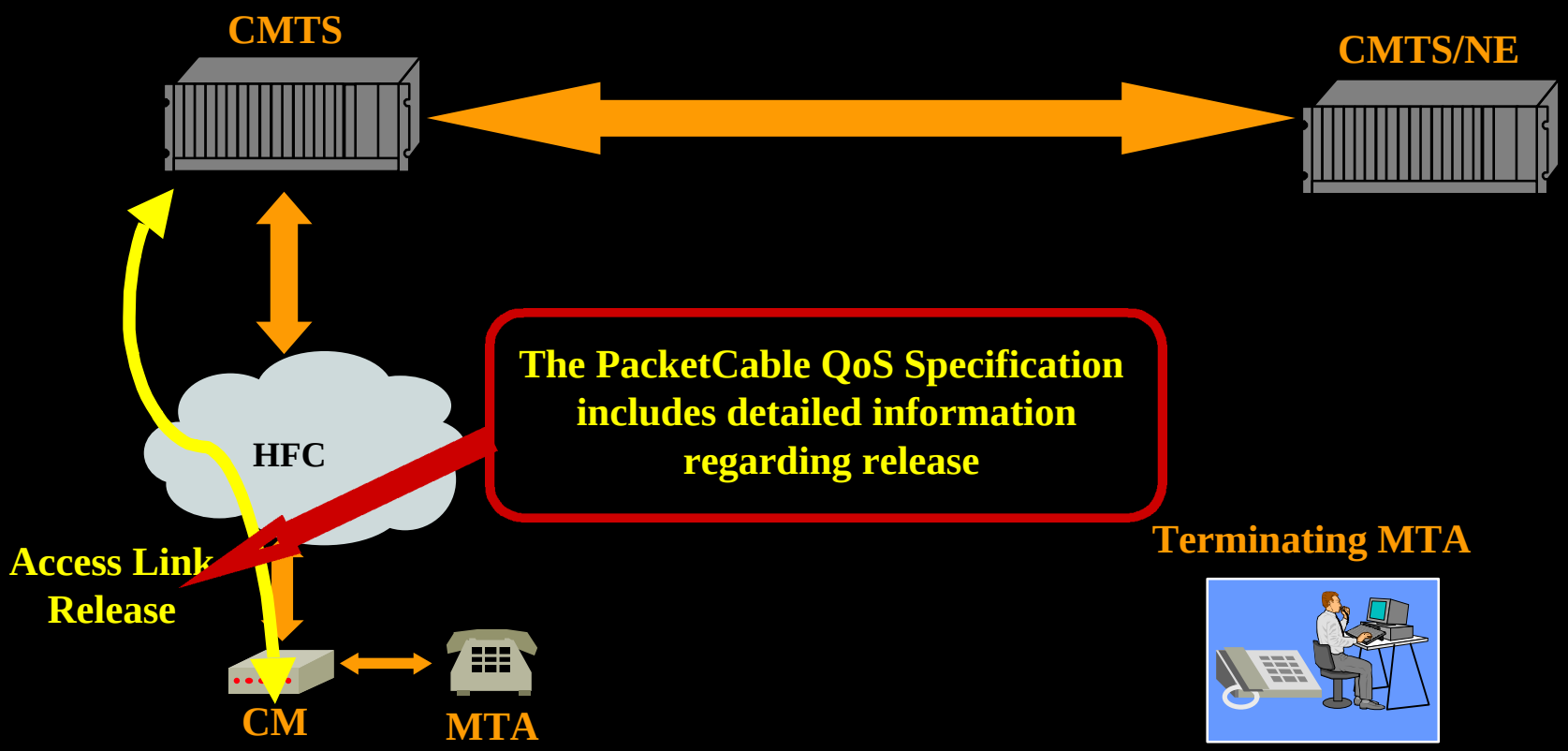
Call is Terminated
The Resources are Released



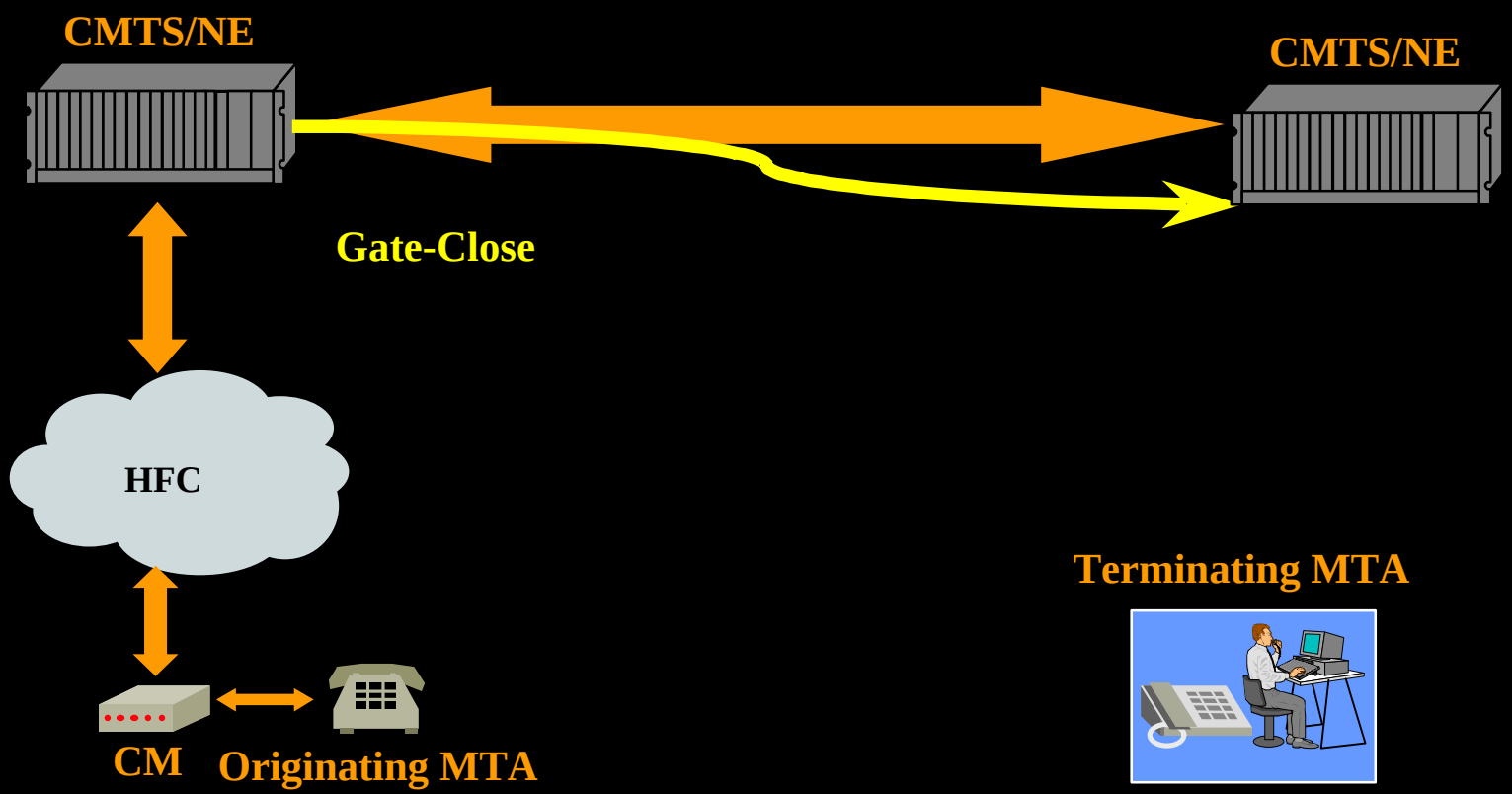
RSVP-PATH-TEAR

Session-Object	Protocol	UDP	The protocol, Destination Address, Source Address, and Destination Port identify the RSVP flow.
	Destination Address	MTAt	
	Destination port	7000	
Sender Templ	Source Address	MTAo	
	Source port	7120	

CMTS Releases the RFI link for the flow



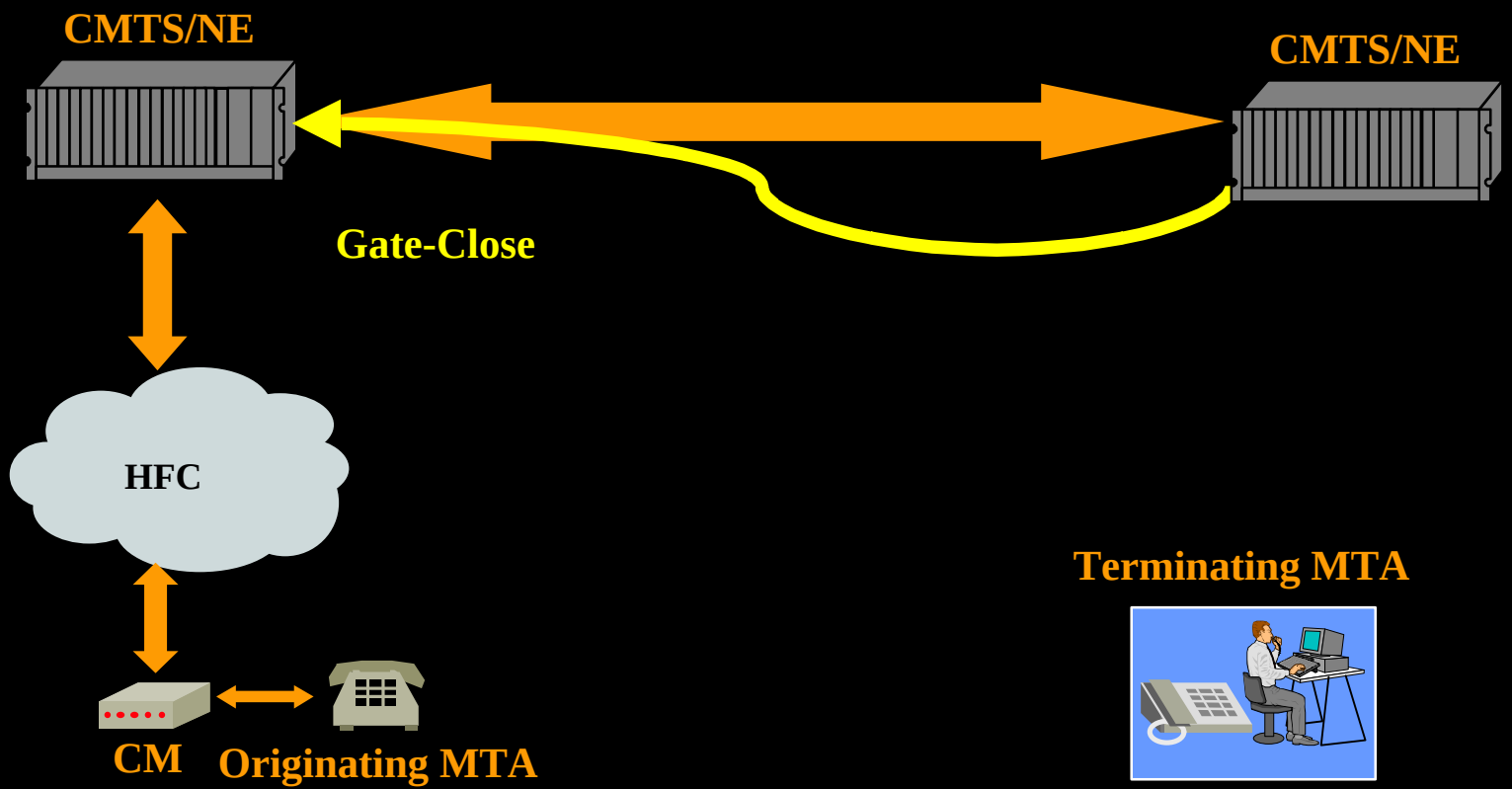
CMTS Signals the Gate Release to Remote End



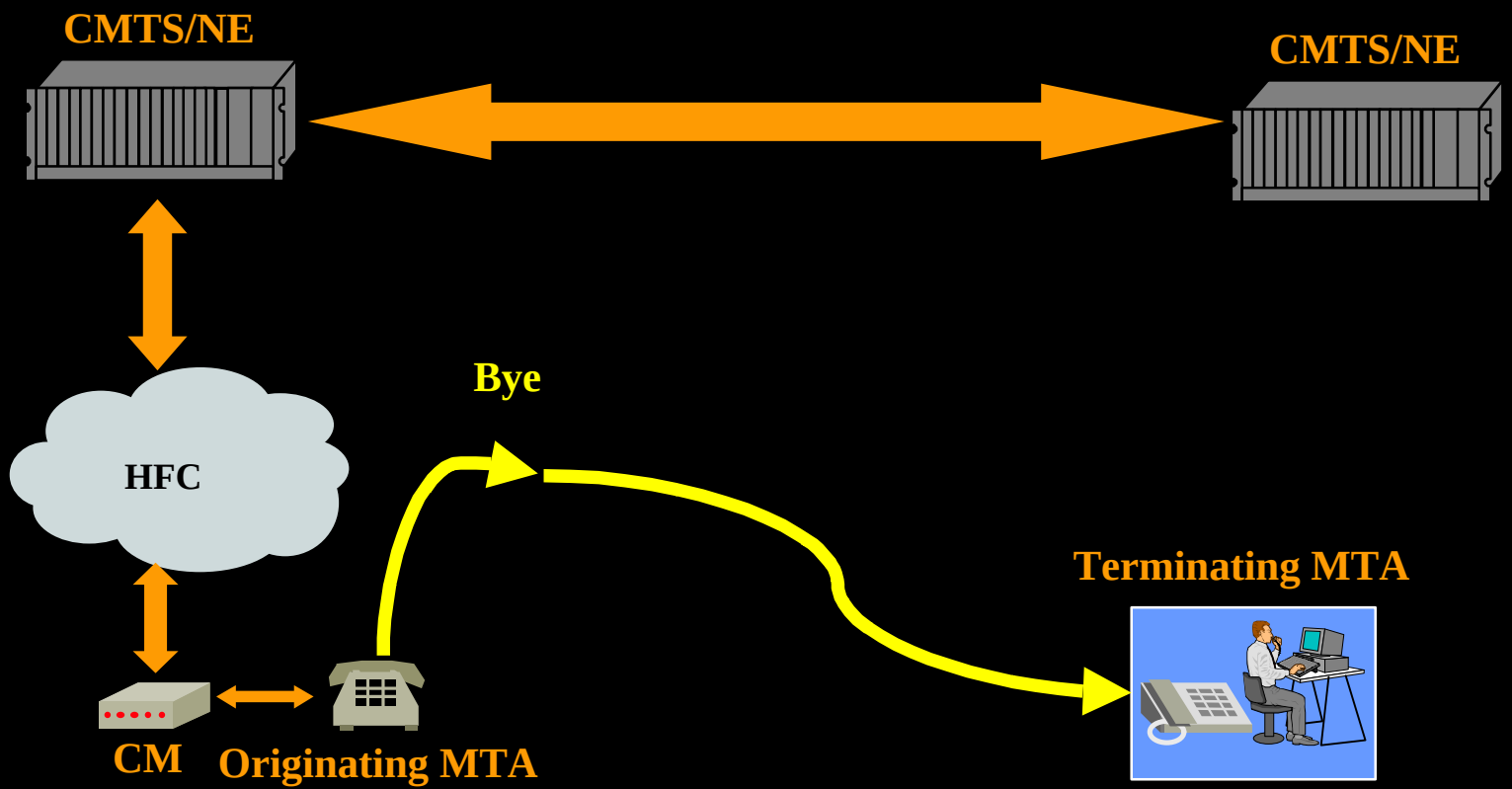
GATE-CLOSE

Transaction ID		73	Identifier to match this message with its response
Gate-ID		1273	This identifies the GateID at the remote CMTS.
HMAC			Security checksum for this message

The gate at the remote end must be released as well



Call Terminated



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