
Distributing Call State to Endpoints

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**Nov. 1999
IETF Presentation**

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Managing State

- Retaining state in network entities
 - ◆ requires coordinated consistent, synchronized state management
 - recovery from failure can be complex
 - ◆ requires higher reliability components in the network: impact on scalability
- DCS distributes call state information to be stored in endpoints
 - ◆ state kept in those entities that care about that particular call
 - ◆ endpoint failure affects calls only to that endpoint
 - passing state to MTAs doesn't increase the reliability requirements

Managing State (continued)

- But, MTA is not trusted
 - ◆ network entities encrypt critical call info' before handing to MTA
 - ◆ network can then depend on information returned by MTA
- Accounting info stored at the edge router to generate usage events
 - ◆ opaque info' returned to record keeping servers for tracking usage and billing

Maintaining Call State in End-Points

● Mechanism:

- ◆ Call state stored at endpoints by their DCS-Proxies during the initial INVITE exchange. This allows Proxies to be stateless during the call.
- ◆ Endpoint passes state info' to Proxies when call characteristics require change.
- ◆ State information includes (but not limited to): participating endpoint information, billing information.
- ◆ State information cannot be altered undetectably by endpoints.

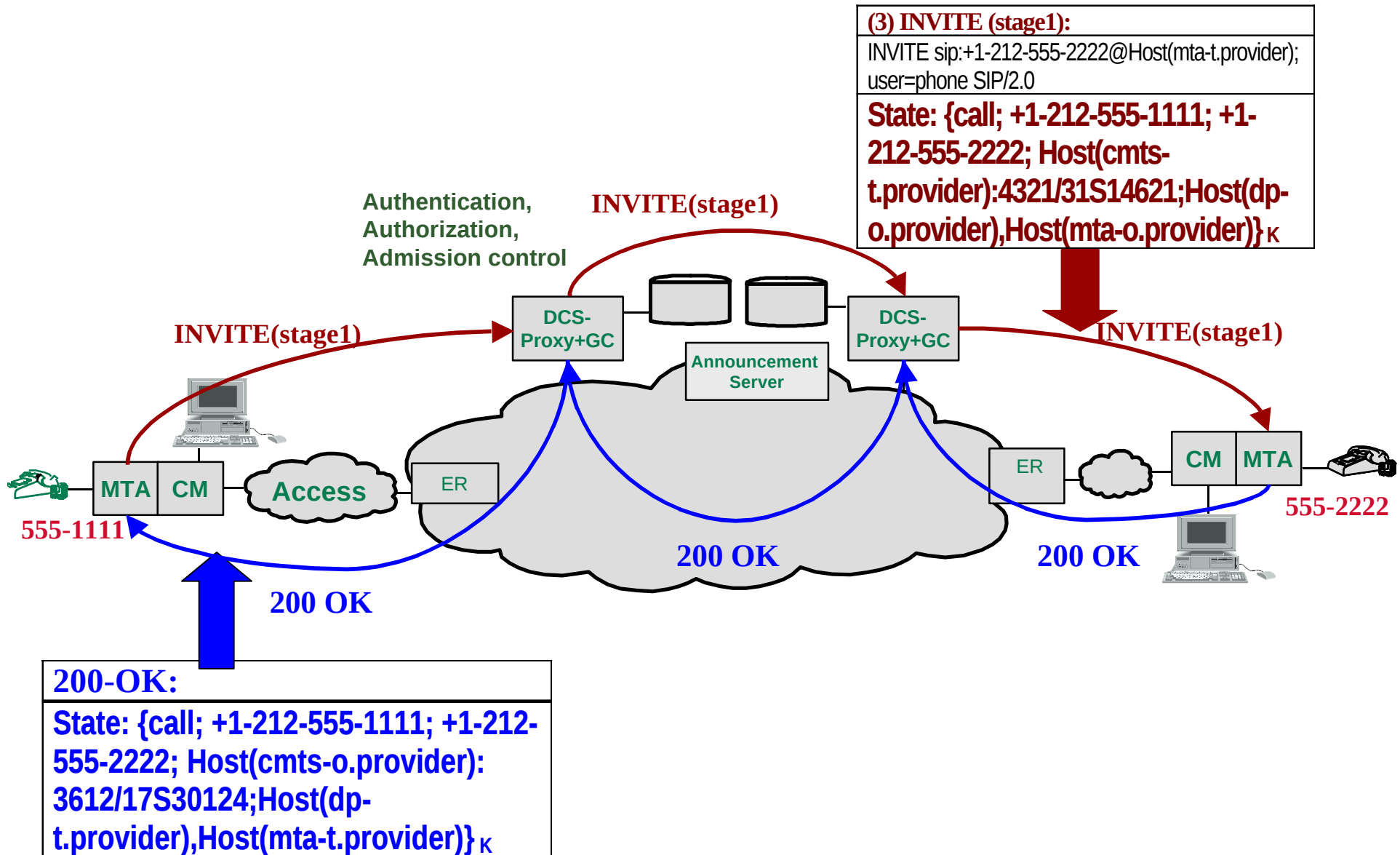
● Syntax of the State Header:

State = "State" ":" token

● Usage:

- ◆ “State” header encrypted and signed by Proxy and sent to called endpoint in an INVITE message.
- ◆ ‘State” header encrypted and signed by Proxy and sent to the calling endpoint in the response to the INVITE.

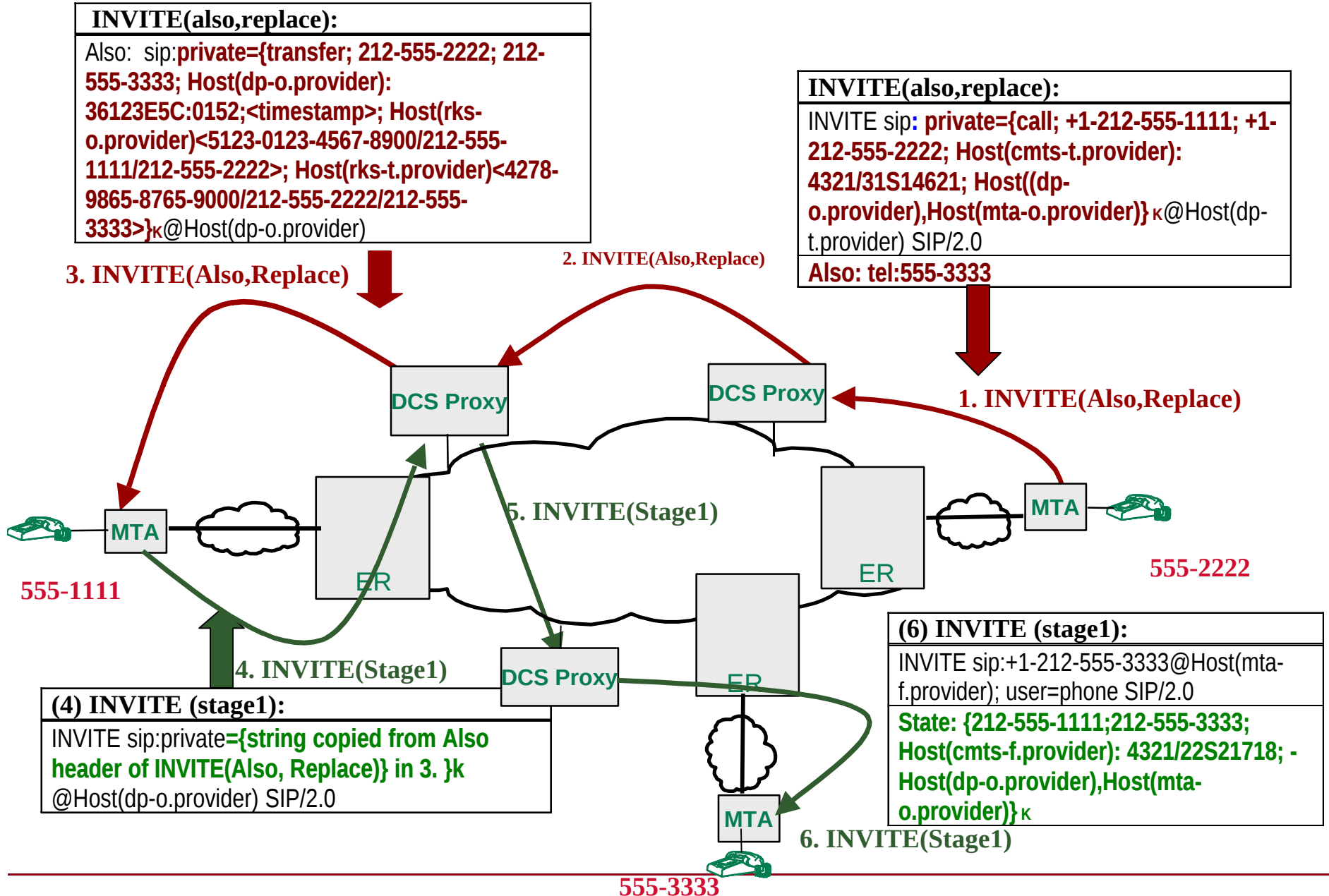
Storing state at endpoints during INVITE(stage1)



Achieving Call Features with Stateless Proxy using “State” header information

- Call Transfer, Call Return, Call Trace : Endpoints detect and initiate call transfer
- MTA/endpoint presents encrypted call information (to DCS Proxy
- Proxy can use it to initiate a call to new endpoint
 - ◆ state available to Proxy for call leg manipulation without keeping track of state of entire call
 - ◆ Proxy can pass encrypted info on new call to be initiated by the endpoint in the “Also” and “Replaces” headers.

Call Transfer - Illustration of the use of State Information



Dcs-State and HTTP Cookies

- Similarity -- both are opaque identifiers
 - ◆ HTTP uses Cookie for “state” management/as a handle to pass session context change from server to client.
 - Server is the other endpoint of the session.
 - ◆ DCS State header sent by proxy to client so that call state can be stored at the endpoint making the associated proxy “stateless” during the call.
 - Can be considered to be a handle to request session change by client from its proxy.

Dcs-State and HTTP Cookies - Differences

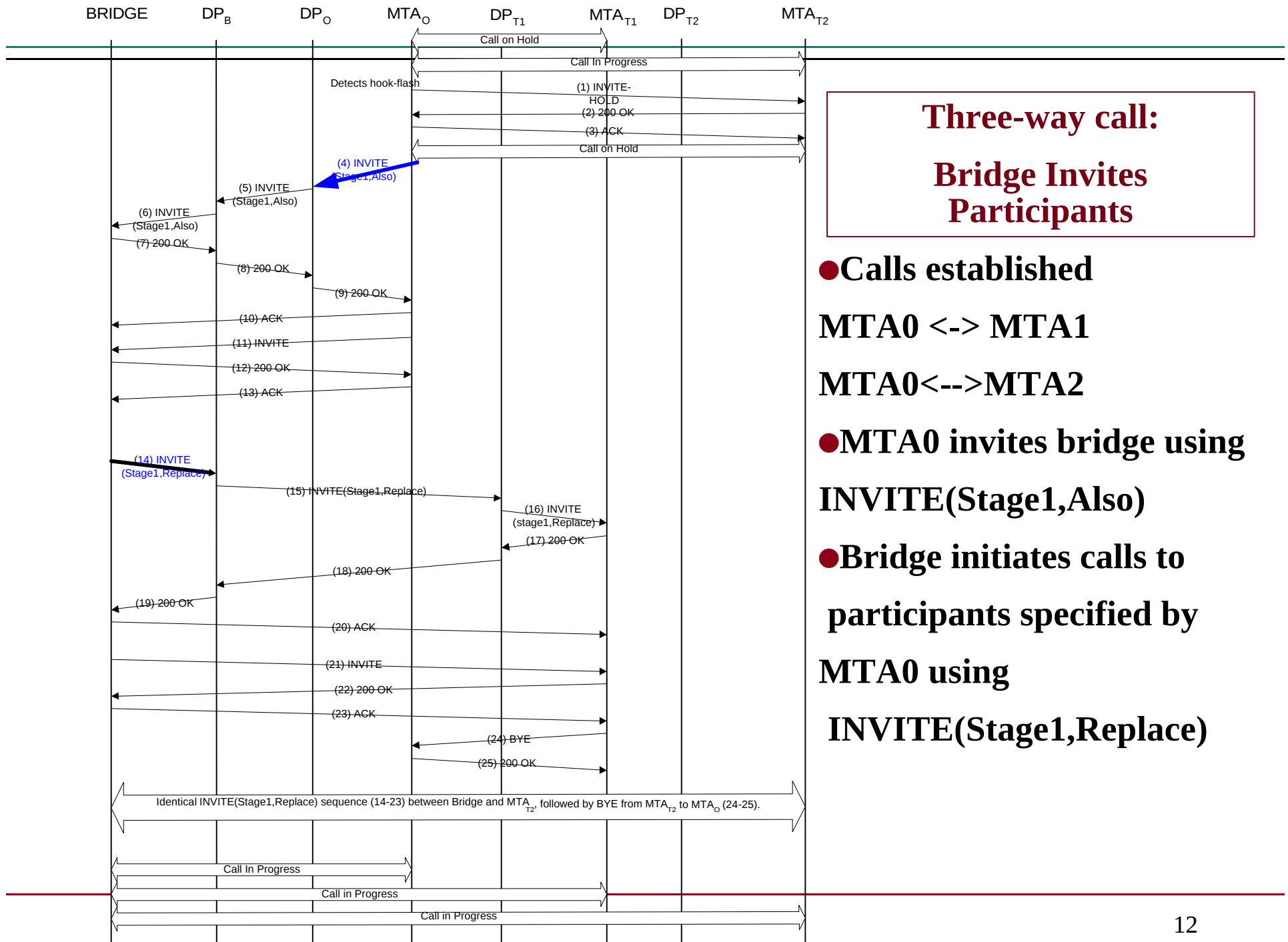
HTTP1.1 Cookies	DCS State
Attribute-value pairs associated with a cookie e.g. comment, domain, max-age, portlist, portnum...	No attributes associated with it.
Implicit “max-age” value carried in set-cookie2 and cookie headers; Servers can terminate connection by setting max-age=0 in responses.	Proxies cannot make use of state headers to terminate sessions.
HTTP client sends the “cookie” header usually after matching the path attribute from user’s request; server may return several “set-cookie2” headers depending on the kind of response.	Proxy Server sends single state header to client in initial INVITE. Client sends state info back in the user-field of the Request-URI when it needs to change characteristics of the call which might include changing the participants of the call.
Cookies used for caching “context” within a HTTP session .	Securely store call state
User-agents have the option of accepting/rejecting cookies.	User agent does not have the option but to save the state header.

End of DCS Presentations

- Questions?
- Break
- Discussion (session 1)
- Discussion (session 2)

Other Call flows

- Illustrating use of State, Also, Replaces in 3-way calling



Three-way call: Bridge Invites Participants

- Calls established
MTA0 <-> MTA1
MTA0<-->MTA2
- MTA0 invites bridge using
INVITE(Stage1,Also)
- Bridge initiates calls to
participants specified by
MTA0 using
INVITE(Stage1,Replace)

(4) INVITE (Stage1,Also):

INVITE sip: bridge@Host(dp-o) SIP/2.0

Via: SIP/2.0/UDP Host(mta-o.provider)

Caller: John Doe; 555-1111

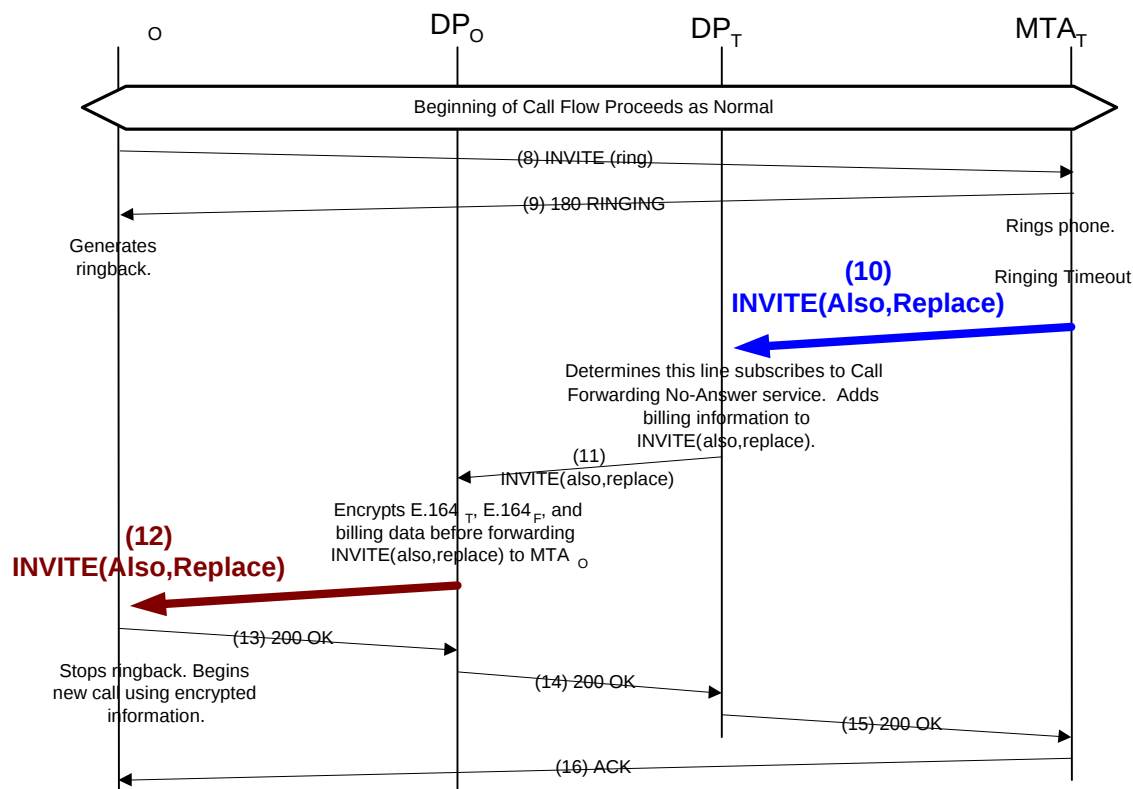
Anonymity: Off

Also: sip:private={**call; 212-555-2222; 212-555-1111; Host(cmts-o.provider): 3612/17S30124; Host(dp-t1.provider),Host(mta-t1.provider)}**}_k@dp-o.provider
? Call-ID= BASE64(SHA-1(555-2222;time=36124033;seq=72))
& Dcs- Replaces=tel:555-1111

Also: sip:private={**call; 212-555-1111; 212-555-3333; Host(cmts-o.provider): 3612/3S10782; Host(dp-t2.provider),Host(mta-t2.provider)}**}_k@dp-o.provider
? Call-ID= BASE64(SHA-1(555-1111;time=36124125;seq=23))
& Dcs- Replaces=BASE64(SHA-1(555-1111;time=36124125;seq=23))

(14) INVITE (Stage1,Replace):		
INVITE sip:private={transfer; 212-555-1111; 212-555-2222 <Host(dp-t1.provider),Host(mta-t1.provider)>; Host(dp-t1.provider):36124033:0381; <timestamp>; Host(rks-t1.provider)<4278-9865-8765-9000/212-555-2222/212-555-1111>; Host(rks-o.provider)<5123-4567-8900/212-555-1111/mcu41.provider>}k@dp-b.provider SIP/2.0		
Via: SIP/2.0/UDP Host(mcu41.provider)		
Dcs-Caller:	Bridge	Service;not-available<sip:mcu41.provider>
Dcs-Anonymity: Off		
Require: DCS		
Proxy-Require: DCS		
From:	sip:BASE64(SHA-1(bridge;time=36124135;seq=311))	
To: sip: participant1		
Call-ID:	BASE64(SHA-1(555-2222;time=36124033;seq=72))	
Contact: sip:Host(mcu41.provider)		
Cseq: 128 INVITE		
Stage1:		
Replaces:tel:555-1111		

Call Forwarding No Answer



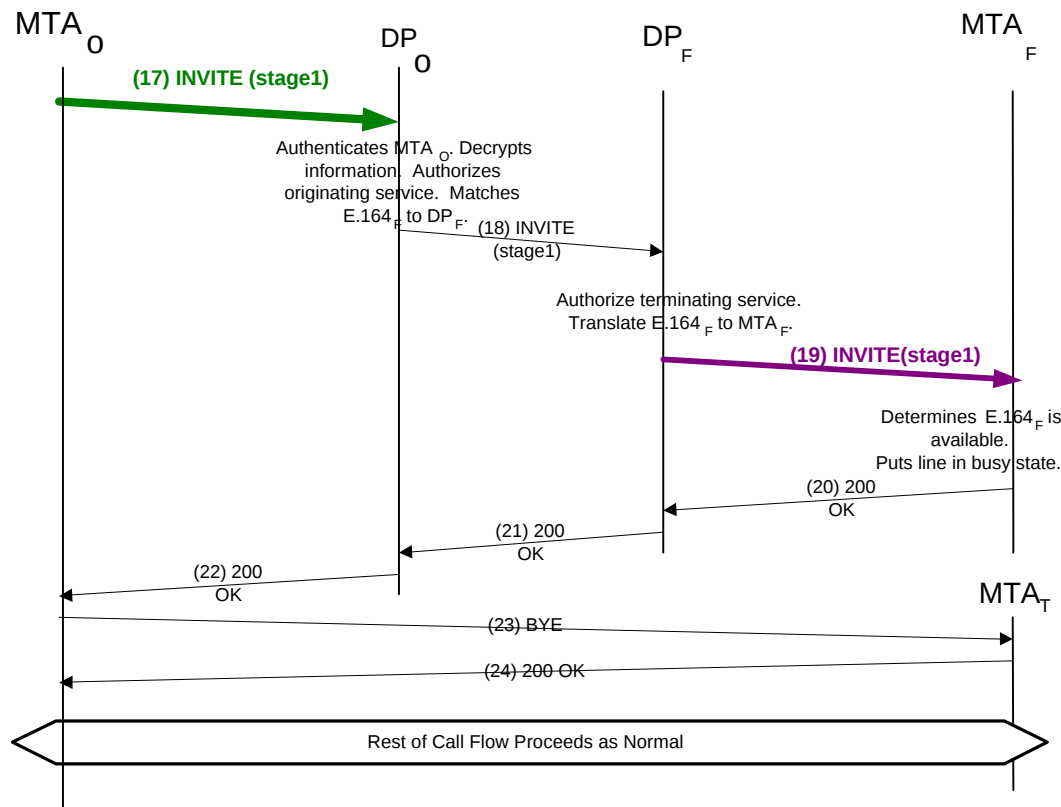
(10) INVITE(also,replace):

INVITE sip: private={call; +1-212-555-1111; +1-212-555-2222; Host(cmts-t.provider): 4321/31S14621; Host((dp-o.provider),Host(mta-o.provider))
k@Host(dp-t.provider) SIP/2.0
Via: SIP/2.0/UDP Host(mta-t.provider)
Dcs-Also: tel:555-3333
Require: DCS
Proxy-Require: DCS
Dcs-Replaces:sip:BASE64(SHA-1(555-2222; time=36123E5B; seq=73))

(12) INVITE(also,replace):

INVITE sip: Host(mta-o.provider) SIP/2.0
Via: SIP/2.0/UDP Host(dp-o.provider), a
Dcs-Also: sip:private={transfer; 212-555-2222; 212-555-3333; Host(dp-o.provider): 36123E5C:0152;<timestamp>; Host(rks-o.provider)<5123-0123-4567-8900/212-555-1111/212-555-2222>; Host(rks-t.provider)<4278-9865-8765-9000/212-555-2222/212-555-3333>}k@Host(dp-o.provider)
Require: DCS
Proxy-Require: DCS
Dcs-Replaces: sip:BASE64(SHA-1(555-2222; time=36123E5B; seq=73))

Call Forwarding No Answer (Originator -> Forwarded destination)



(17) INVITE (stage1):

INVITE sip:private={transfer; 212-555-2222; 212-555-3333; Host(dp-o.provider): 36123E5C:0152;<timestamp>; Host(rks-o.provider)<5123-0123-4567-8900/212-555-1111/212-555-2222>; Host(rks-t.provider)<4278-9865-8765-9000/212-555-2222/212-555-3333>}_K@Host(dp-o.provider) SIP/2.0

(19) INVITE (stage1):

INVITE sip:+1-212-555-3333@Host(mta-f.provider); user=phone SIP/2.0
 Via: SIP/2.0/UDP Host(dp-f.provider); branch = 1, a
 Dcs-Caller: John Doe; 212-555-1111
 Dcs-Gate: 22S21718
 Dcs-State: {212-555-1111;212-555-3333; Host(cmts-f.provider): 4321/22S21718; - Host(dp-o.provider),Host(mta-o.provider)}_K