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/			
VoIP-SIP			

VoIP - SIP

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IT (ITTL)

(NETC)

+82-31-724-0164

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1. 3

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3. Reference 4

4.

4.1 SIP Interoperability Test 4

4.2 SIP-H.323 Interworking Interoperability Test 62

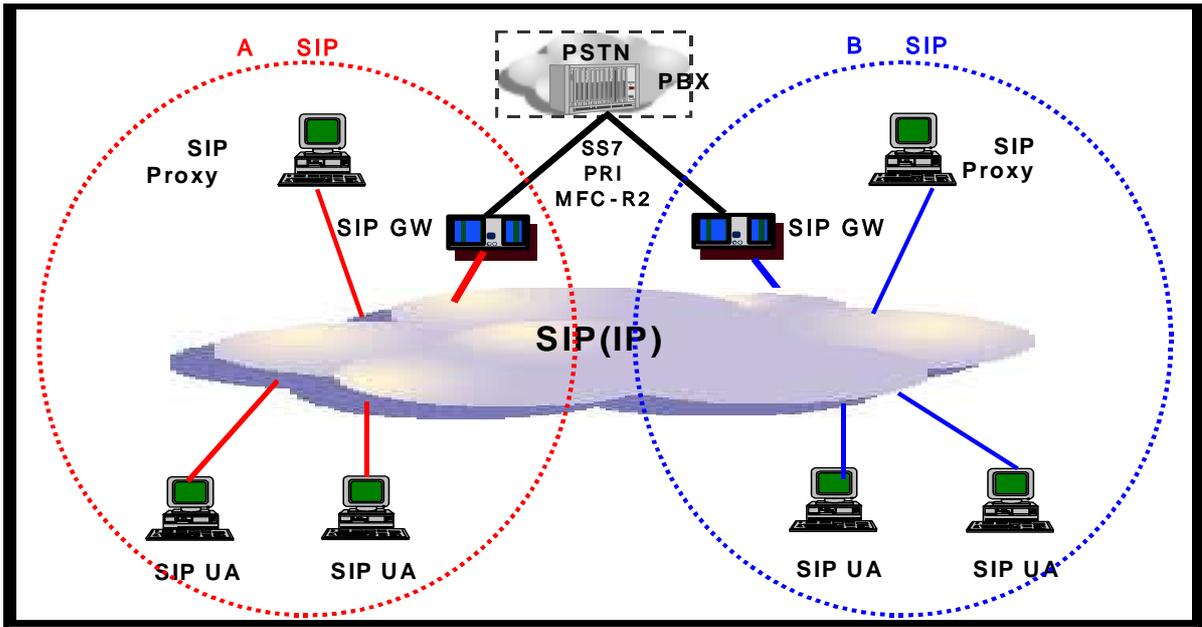
1. () : RFC2543bis-03 ~ 09

2.

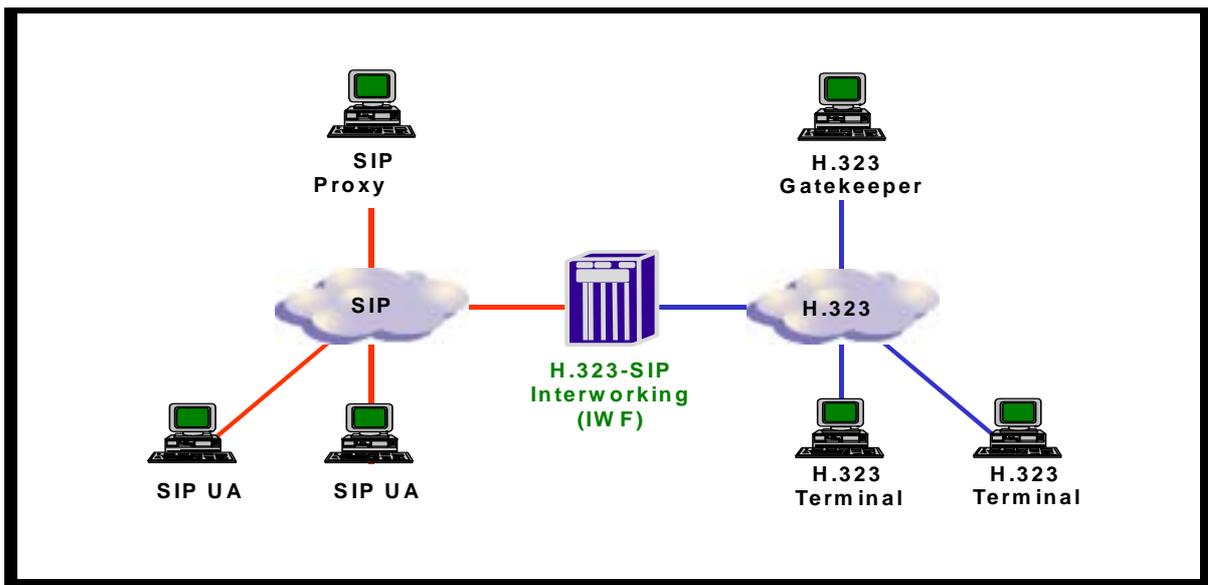
◆ Matrix (A SIP [Proxy. UA] B SIP [Proxy. UA])

◆

✓ SIP Interoperability



✓ SIP-H.323 Interworking





3. Reference (Draft)

- ◆ draft-ietf-sipping-call-flows-00
- ◆ TIPHON Technology Compliance Specifications ; Test Suite Structure(TSS) and Test Purpose(TP)(DTS/TIPHON-060621-2)
- ◆ draft-ietf-sipping-realtimefax-00
- ◆ draft-sinnreich-sipping-device-requirements-00
- ◆ draft-ietf-sipping-e164-01
- ◆ draft-ietf-simple-im-session-00
- ◆ draft-ietf-agrawal-sip-h323-interworking-01
- ◆ Interoperability Testing for SIP(June,1999, Rosenberg/Schulzrinne)
- ◆ SIP Interoperability Scenarios Test Plan-Draft(IMTC, June,2000)
- ◆ SIP/H.323 Inter-Working Requirements for VoIP Applications(IMTC, Oct.2000)

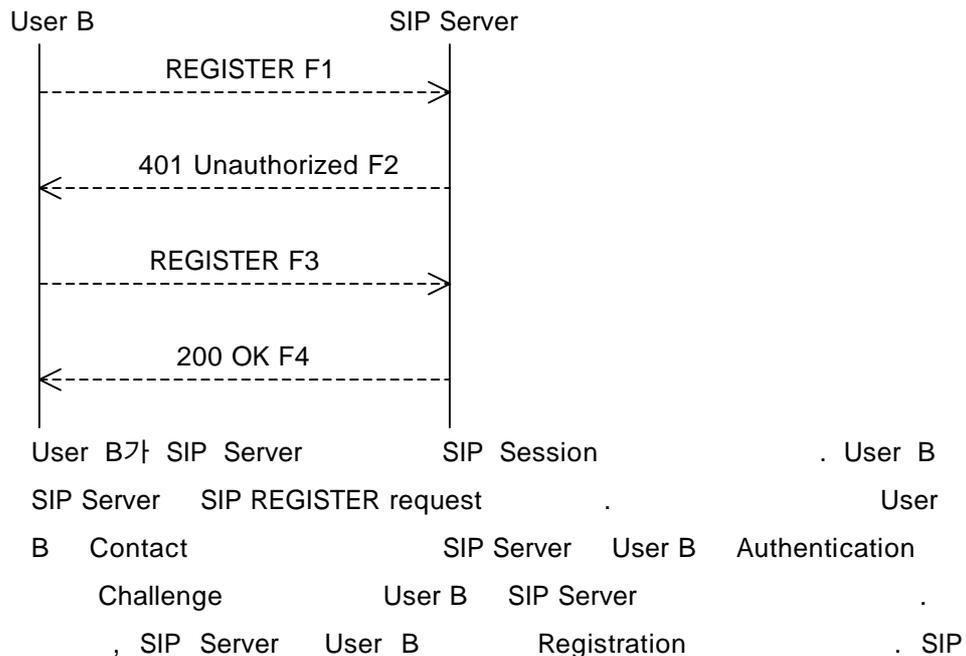
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4.1 SIP Interoperability Test

◆ Registration Services

- ✓ Success Scenarios

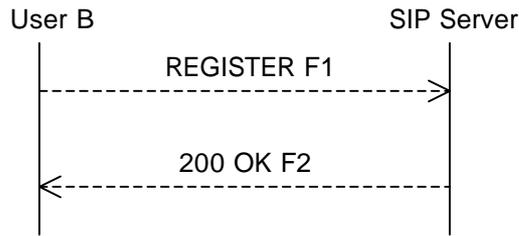
Registraion SIP SIP
 SIP 가 Contact Location SIP
 Flow Authentication 가 . Registration Request가
 SIP Client New Registration





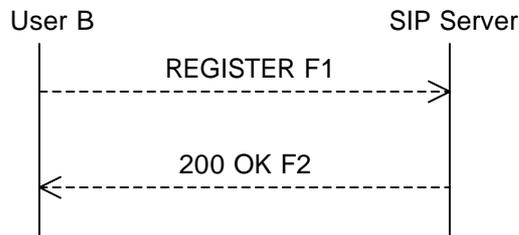
Server Contact DB User B SIP Client 200 OK
 User B Contact
 SIP Authentication SIP Digest User B가 SIP Server
 가
 (F#)

User Update Contact List



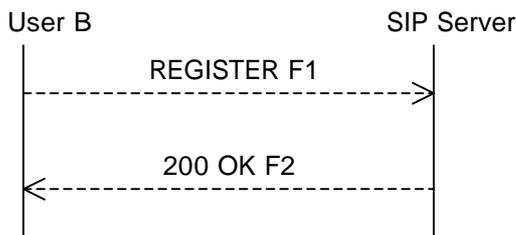
User B 가 SIP Server가 Redirect
 Forward List SIP Server REGISTER
 User B REGISTER Contact
 User B가 Server Authentication Server
 challenge

User Request Current Contact List



User B Proxy Server Contact 가 REGISTER
 , User B가 Contact Server
 User B Authentication , Server
 User B Server 200 OK Contact
 User B Registration

User Cancel Registration





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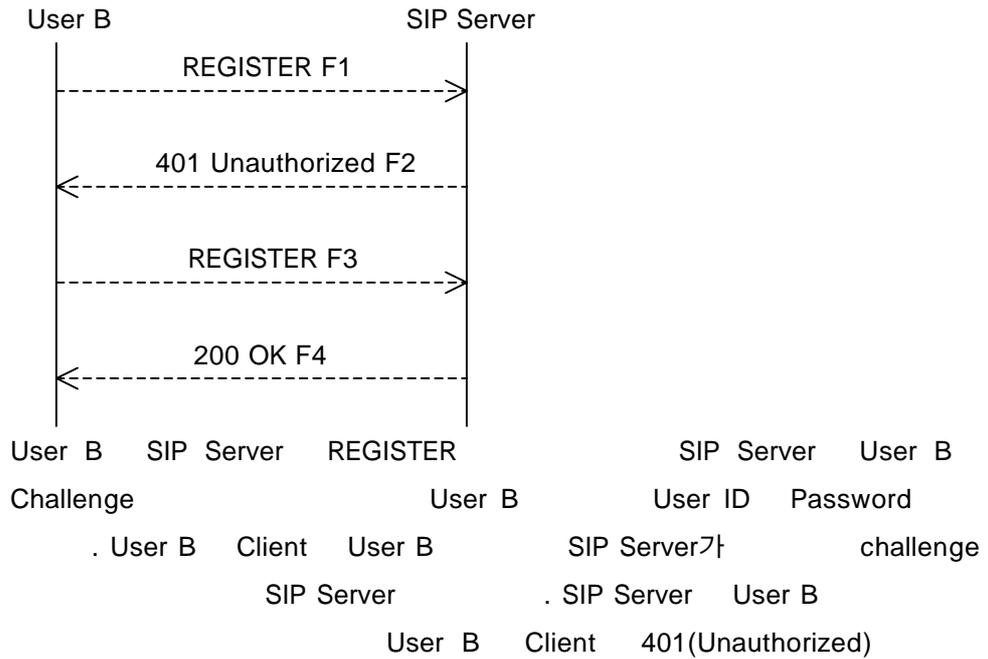
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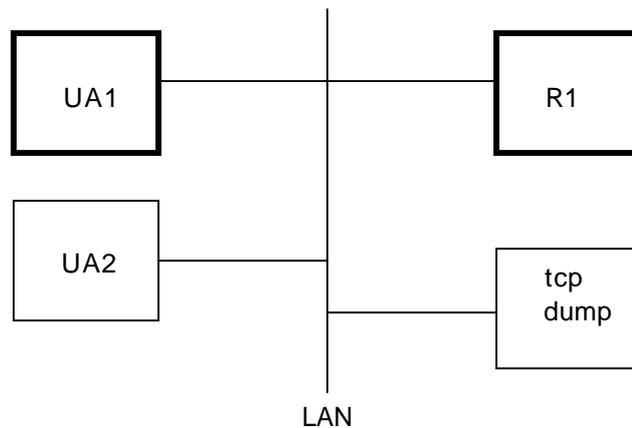
User B SIP Server Registration (Cancel)
 SIP Expiration Period "0" Contact "*" DB
 REGISTER . SIP Server User B Contact DB
 200 OK .

✓ Failure Scenarios

Unsuccessful SIP Registration



◆ (*)Registration



2 : Registration Configuration

Test SIP Registration Interoperability
 2 . Registration SIP UA1 SIP Registrar



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UA2 UA1 Call tcpdump Entity

✓ Basic Registration(REG1)

UA1 Registrar Contact
 UDP REGISTER Registrar Registrar
 Registration processing 200 OK
 가 Test가
 • REGISTER Call-ID
 • REGISTER REGISTER method tag 가 CSeq
 • REGISTER username hostname Request-URI
 • REGISTER UA1 On User To
 • REGISTER UA1 On User From
 • REGISTER UA1 가 URI List Contact
 • 200 OK Request To, From, Call-ID Cseq mirroring To tag 가
 • 200 OK expiration time Expires expire Contact
 • 200 OK Contact Registered URI mirroring
 • UA1 ACK
 Registrar Registration
 INVITE Request-URI To REGISTER To
 UA2가 Registrar(Local Proxy) INVITE Proxy
 Redirect Registrar REGISTER Contact
 Proxy Redirect Test가

✓ Registration Refresh(REG2)

Resistration 가 (1)
 Registration Test 가
 가 REGISTER 200 OK
 Registration checking Client Registration
 REGISTER Registration 가
 Registration Test가
 REGISTER checking



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- REGISTER REGISTER CSeq가
- REGISTER REGISTER Call-ID가

✓ Registration Expiration(REG3)

Test 가 Registration 가
 Test REG1 가 (1)
 Registration Test 가
 가 Registration 가 200 OK
 Client Registration REGISTER
 1 UA2
 REG1 UA1 Call , Registration
 400 class (404 Not Found) Test가

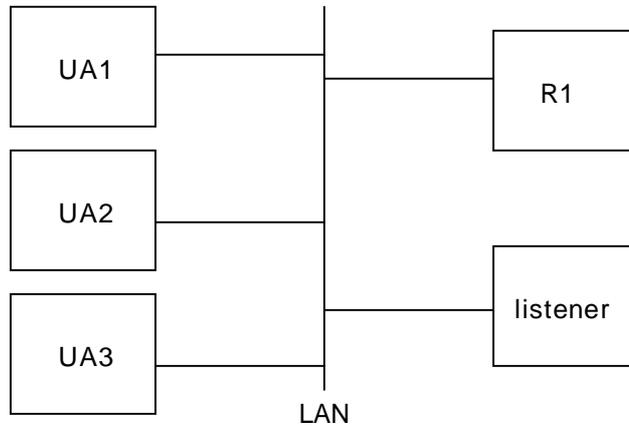
✓ Multicast Registrations(REG4)

Test REG1 REGISTER 가 sip multicast
 address(224.0.1.75) , UA1 Registration
 가 Test가 . REG1
 Criteria가 Test가

✓ TCP Registration(REG5)

Test REG1 REGISTER가 UDP TCP
 TCP 가 Test가 가 REG1 Criteria 가
 Test가
 • REGISTER Via SIP/2.0/TCP
 • REGISTER Contact TCP 가
 • Response
 • Client 200 OK TCP Connection

✓ Multiple Registrations(REG6)



3 : Multiple Registration

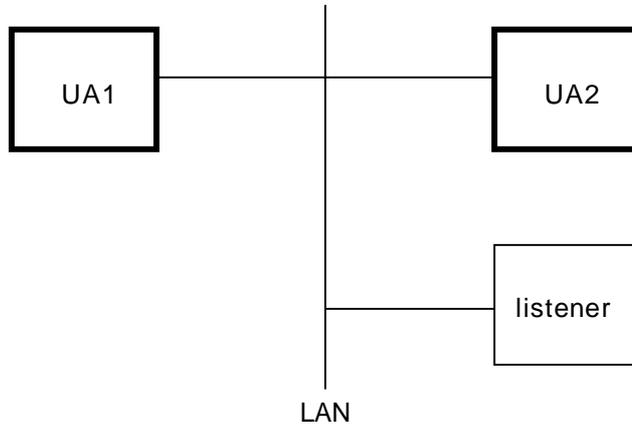
Test REG1 Registraion Test 3 3
 UA(UA1, UA2, UA3)가 . UA1 UA2 UDP
 Registrar REGISTER To .
 Contact .(UA가 UA) UA1
 REGISTER 200 OK UA2가 Registration . UA3
 Registrar Registration To INVITE To
 Request-URI INVITE .
 Registrar Proxy Redirect ,
 UA forking , Contact
 300 class . Test

- UA2 200 Contact UA1 UA2 .
- UA3 INVITE Contact Redirected UA1
- UA2 forking .
- UA2 200 OK UA1 UA1 REGISTER
- UA1 .



◆ (*)Client to Client Basic

Test Suite 2 UAS(End Systems Gateways)가
가 가



1 : Client to Client Scenario

Test	Setup	1	LAN	2
UA(User Agent)	Caller	Callee	Host	tcpdump utility
	SIP	G.711 audio	G.711	가
	Caller가 call setup			Media Stream
	가			

✓ Initiation(UA1)

Caller	Callee	UDP INVITE	call
Callee	user	Alerting	Caller Provisional Response
		Callee가 call	Caller UDP
	200 OK가	Caller ACK	Callee
Caller	SDP	G.711	Single audio session
200 OK		G.711 Codec	Call SIP
Exchange가		Test	Media가
Client			

Checking

- Request formatted Via Response
- Request formatted To From Response To From Mirroring(가 tag 가



-)
- Application/sdp Content-Type
 - Request line formatting
 - Request CSeq (Method tag INVITE)
 - Request Call-ID Response Call-ID
- Mirroring

✓ Call Termination A to B(UA2)

Call Initiation Caller call 가
 . Caller가 UDP BYE Callee Callee 200 OK
 Caller call accept . Media

SIP Exchange가 Test Media가
 Client

- BYE Call-ID INVITE Call-ID
- BYE CSeq INVITE CSseq
- BYE CSeq method tag BYE
- To From Original INVITE request To From
- BYE request Response mirroring Via

✓ Call Termination B to A(UA3)

Call Initiation Callee call 가
 . Callee가 UDP BYE Caller Caller 200 OK
 Caller accepted . Media

SIP Exchange가 Test Media가
 Clients

- BYE Call-ID INVITE Call-ID
- BYE CSeq method tag BYE
- BYE To Original INVITE From mirroring
- BYE From Original INVITE To mirroring
- BYE Response mirroring Via



- BYE Request-URI INVITE From INVITE
Contact 가 Contact

✓ Call Rejection(UA4)

Call setup Callee가 call
call Caller 600 400 class
Caller Callee ACK . Caller call
가 Media
, Callee UA가 Rejection Types(486 Busy vs. 600 class)
Rejection Type UAC
Rejection Type Test . Call Media
UAC ACK Caller

- Call-ID가 mirroring .
- To From 가 가Tag 가 mirroring .
- CSeq mirroring .

✓ Call Redirection (UA5)

Call setup Callee가 call Rediect
. Callee Caller 300 class ,
Caller Callee ACK . Caller Callee Redirection
Media
Test Redirection Response SIP URI Single
Contact , UA가 Redirection Address Call 가
UAS Test가 . URL UAC parsing
가 User .

✓ Call Redirection (UA6)

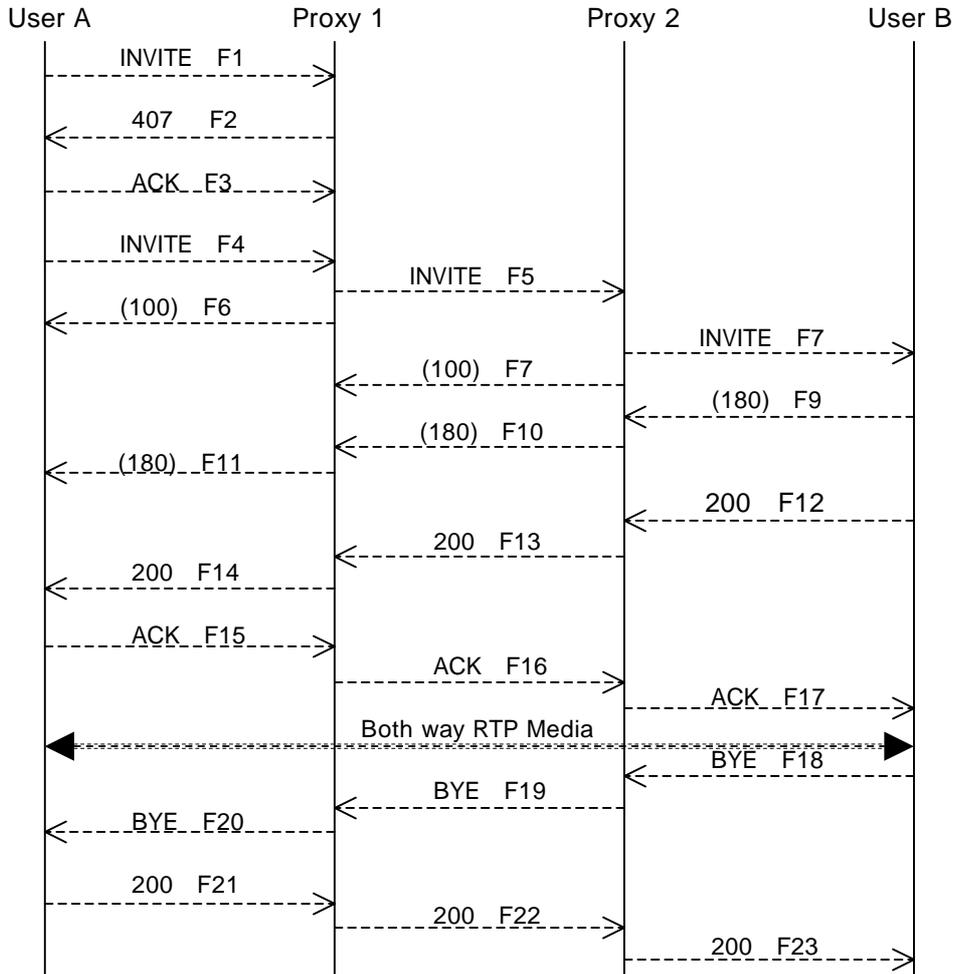
Call Redirection UAS mailto http URL non
SIP URL Redirect Address Redirect . URL UAC parsing
가 User .

✓ Call Redirection (UA7)

Call Redirection UAS Redirect Address



Successful SIP to SIP through two Proxies



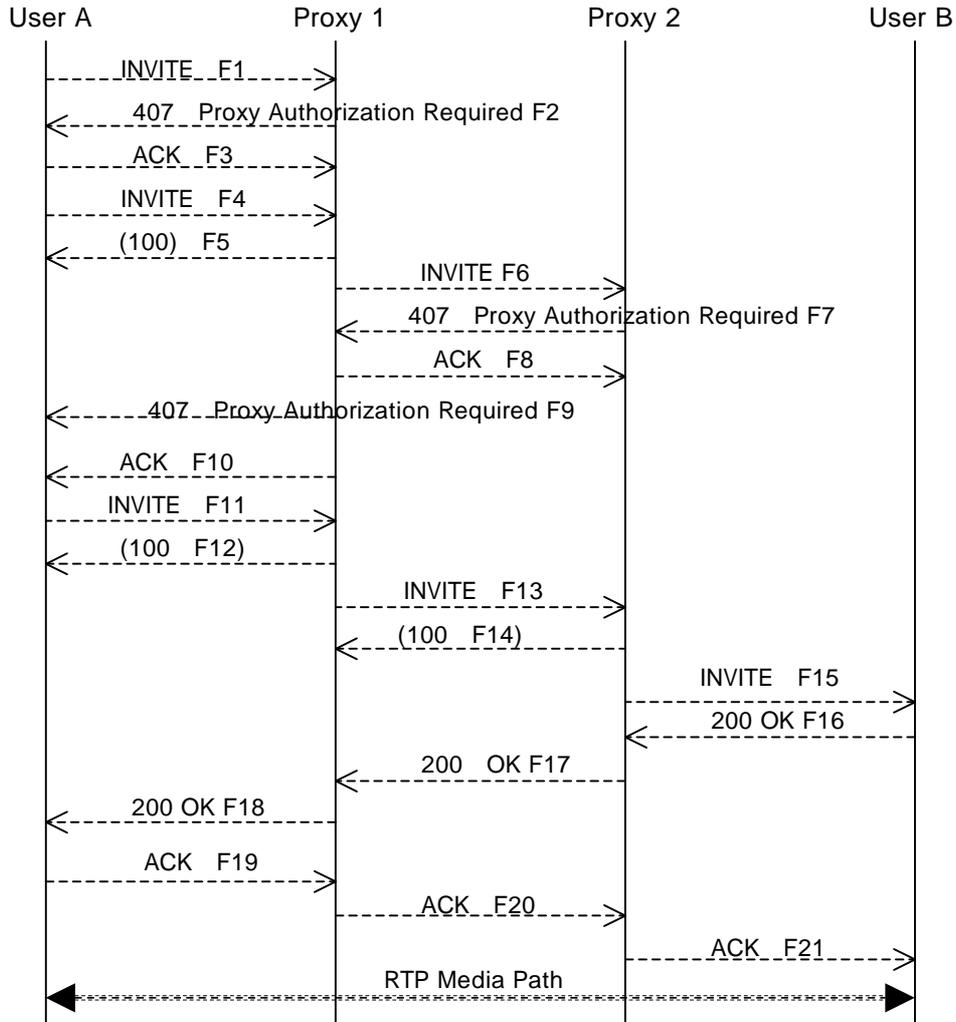
User A가 2 Proxy (Proxy A Proxy B)
 User B SIP call . INVITE(F1) Proxy 1
 Authorization credentials 407(Proxy Authorization)
 Respose . User A가 challenge New INVITE(F4)
 call proceeding . Call User 가 BYE
 . Proxy 1 Proxy 2 가
 INVITE Record-Route 가 . ACK(F15)
 BYE(F18) Route 가 .
 /*F1 Proxy 1 User A Authentication ./
 /*F3 User A INVITE authentication Credential User B
 (re-send) ./
 /*F4 Proxy 1 User A Credential Proxy 2 INVITE
 forward ./



```

/*F17      User A   User B   RTP stream   .
User B   User A   call           CSeq   2가
User A   User B가           Cseq   가           .*/
  
```

Successful SIP to SIP with Multi Proxy Authentication



```

User A   User B   2   Proxy (Proxy 1   Proxy 2)
Call           .           INVITE(F1)   Proxy 1
Authorization Credentials           challenge
407 Proxy Authorization   client           ,   가   Proxy 2
credential           call proceeding           .
Proxy 1   Proxy 2   가           INVITE
Record-Route           가           .
  
```

```

/* F1 Proxy 1   User A   Authentication           ./
  
```

```

/* F3 User A   INVITE   authentication Credential           User B
  
```



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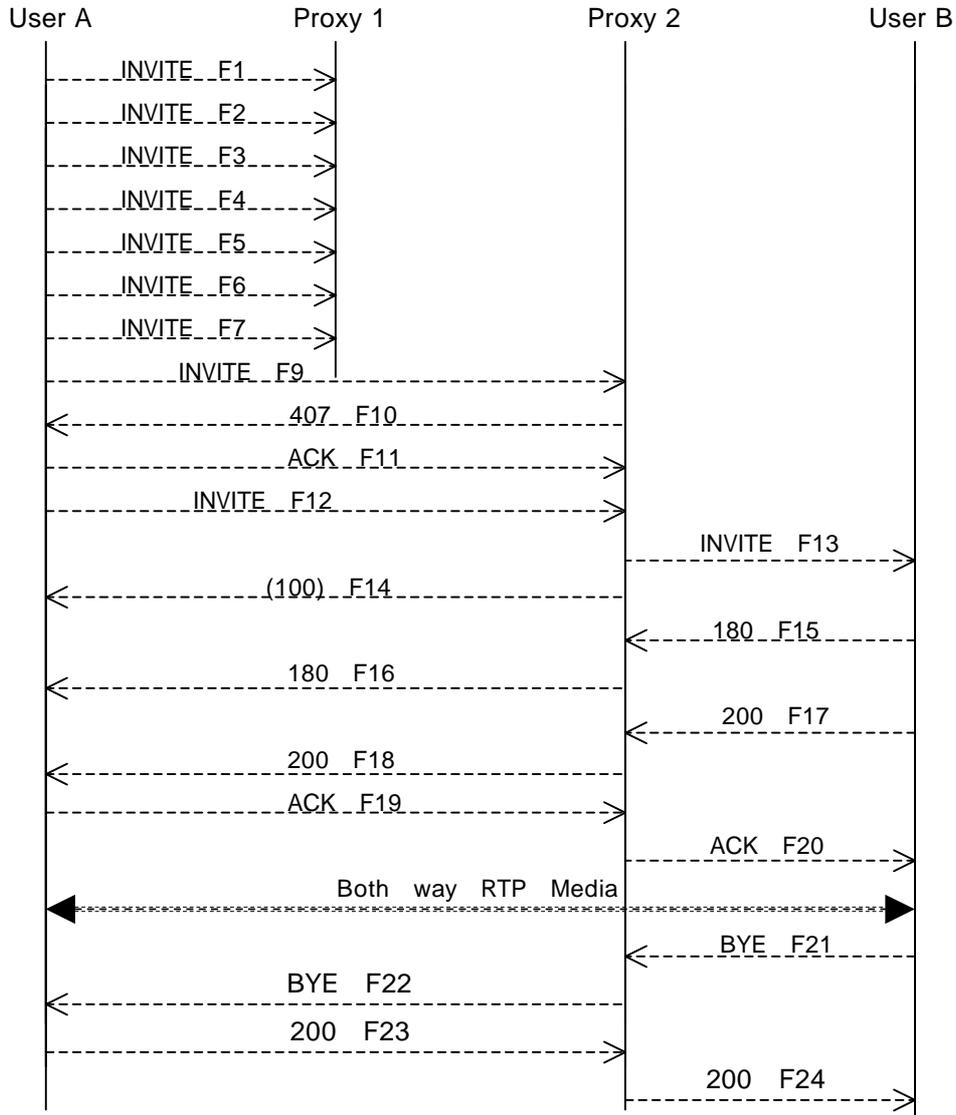
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(re-send) . INVITE Call-ID Cseq 가 . /
/*F4 Proxy 1 User A Credential Proxy 2 INVITE
forward . Proxy 1 IPsec Proxy 2 Athentication
가 Client A port49172
./
/*F6 Proxy 2 User A Authentication ./
/*F8 Proxy 1 Proxy 2 Authentication User
Challenge forward ./
/*F10 User A Proxy 1 Proxy 2 Authentication credential
INVITE ./
/*F11 Proxy 1 Credential User A call
Proxy 2 INVITE forward ./
/*F13 Proxy 2 Credential User A call
User B INVITE forward ./
/*F15 User B call ./



Successful SIP to SIP with Proxy failure

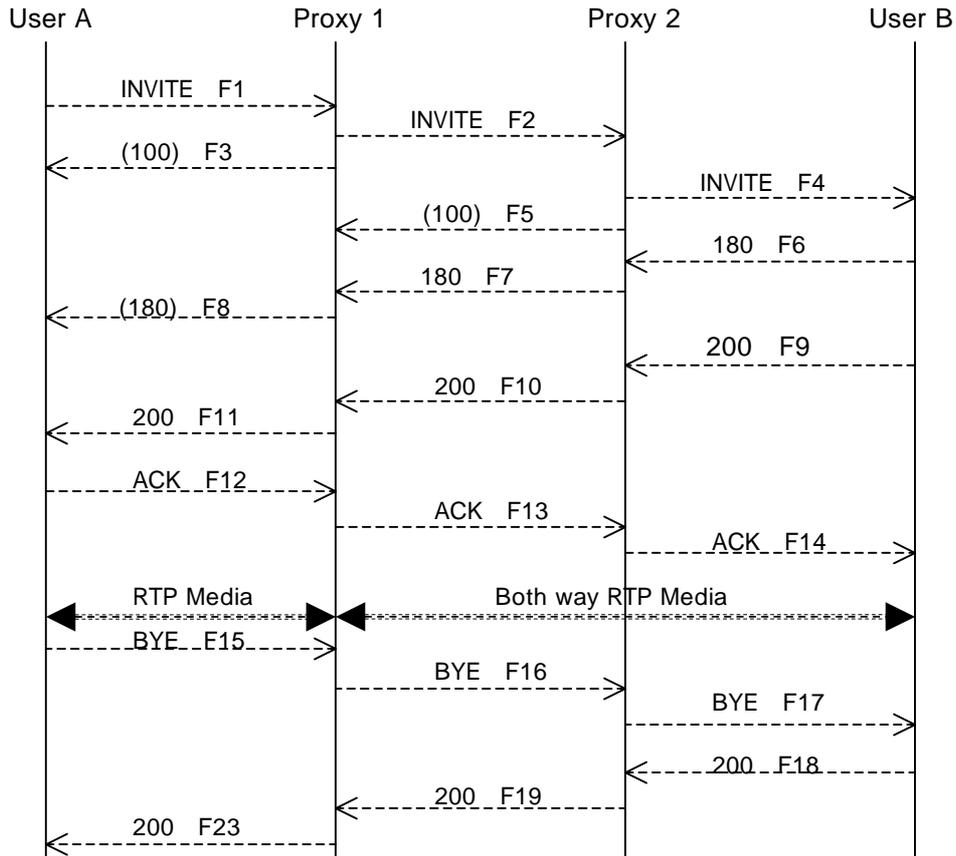


User A (Primary) Server Proxy 1 Server
 Proxy 2 (DNS SRV Proxy 1가 Proxy 2 Location
 가 .) User B SIP Call . Proxy 1
 가 가 User A INVITE
 User A CANCEL Proxy B User B
 call .
 /*F7 User A INVITE Proxy 1 call
 ./
 /*F9 Proxy 2 User A Authentication ./
 /*F11 User A INVITE authentication Credential User B



(re-send) . /
 /*F12 Proxy 2 User A Credential Proxy 2 INVITE
 forward . Client A port49172

Successful SIP to SIP through SIP ALG



User A가 ALG(Application Layer Gateway) SIP
 Proxy User B SIP Call Signaling
 Successful Simple SIP to SIP Media Stream setup
 end-to-end가 ALG (Media Bridge) .
 INVITE(F1) 200 OK(F10) SDP
 ALG . , SDP 18x ACK Message
 가 .
 Firewall , B2BUA(ALG)
 Codec Media (mu-law A-law) (Anonymizer)
 Component 가 .
 /*F1 User A Client port 49172

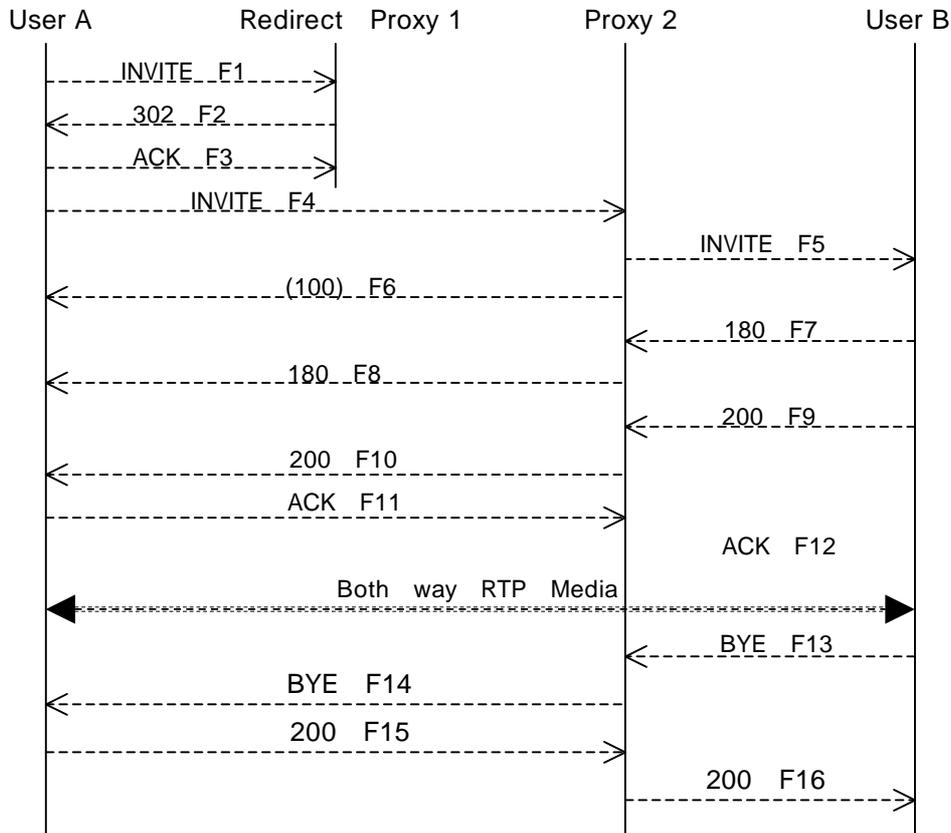


```

./
/*F3 SIP ALG port 200.201.202.203/1000 port 100.101.102.103/4917
2 proxy . Proxy 1 User B Location
Location Service . Location Analysis call User
B forward ./
/*F11 SIP ALG port 200.201.202.203/1000 port 100.101.102.103/34
56 proxy .
/*F14 User A ALG , ALG User B RTP stream .
User A가 User B call ./

```

Successful SIP to SIP SIP via Redirect and Proxy in ACK



```

User A          Redirect Server          SIP Call
Proxy 2 Server call . User A INVITE
가 Redirect Server Redirect server User B SIP
Contact F2(302 Moved Temporarily)
. User A INVITE Proxy Server
User B call proceeding . F5
SDP F11(ACK) SDP Offer/Answer

```



가

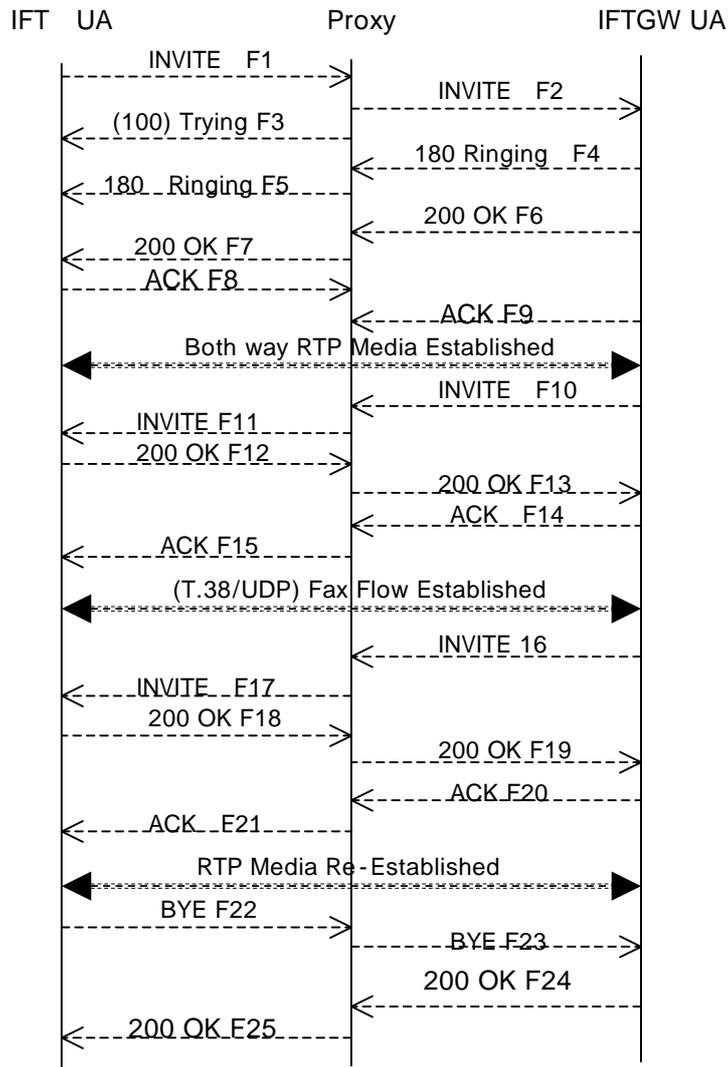
/*F10 User A가 INVITE SDP ACK SDP

./

/*F12 F14 User A User B RTP stream . User A가 User

B call ./

Successful SIP to SIP with re-INVITE(T.38)



Example Session Media Session 2
 PCM Media Session User Agent F1~F9 Message가
 (IFTG UA) Media Session
 (Example Fax
 Media Session T.38 Fax) F11



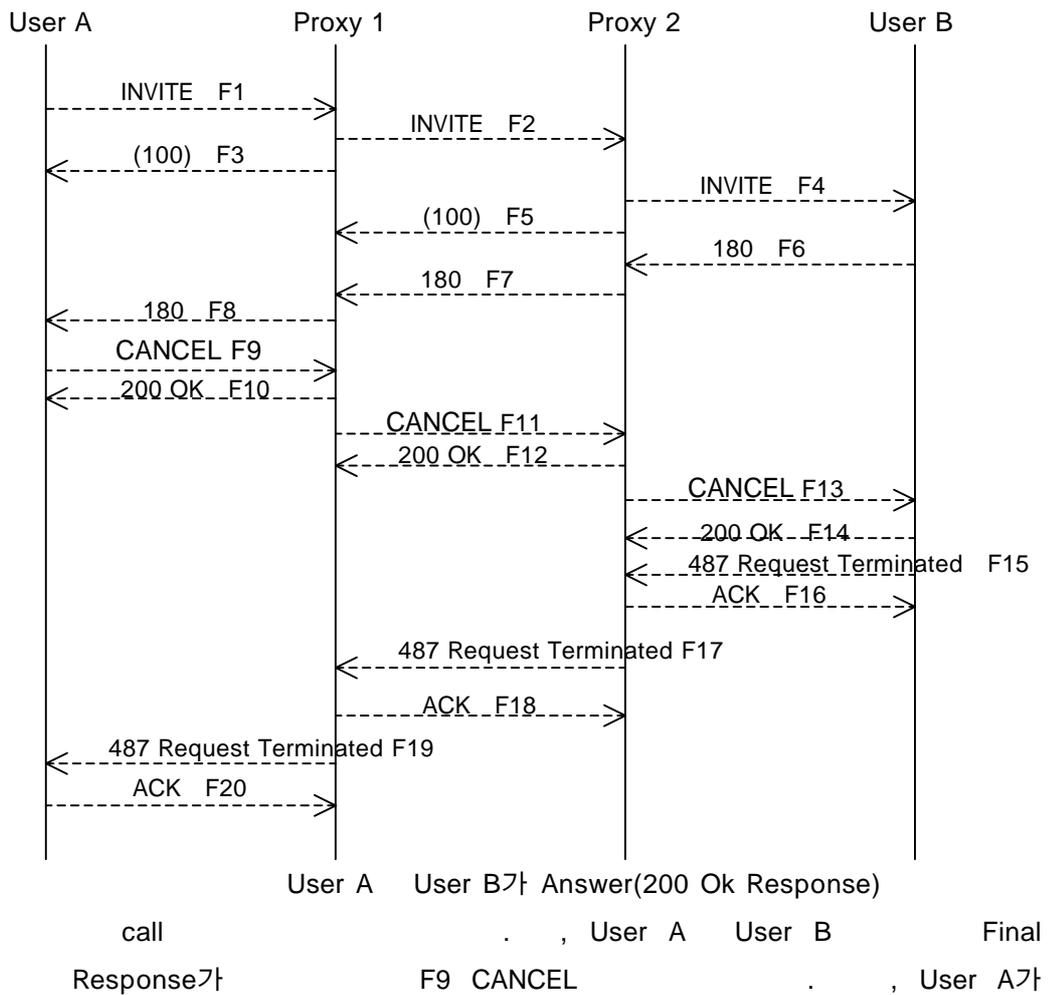
```

re-INVITE      User A      F13 200 OK
F16 INVITE     가          PCM Media Session
                T.38 Fax Media Session      Fax
PCM Media Session      F17 INVITE

/*F9 RTP stream      CNG Fax tone  In-Band
IFT      DSP가 preamble      T.38 IFP
UDP      가 IFTGW      IFTGW      SDP      UDP
                Call-ID 가 re-INVITE      Fax
/*F15 T.38 Fax      PCM Audio Session
Fax      가 Ingress      Egress (IFTGW)
IFTGW      Swotch      ./
    
```

✓ Failure Scenarios

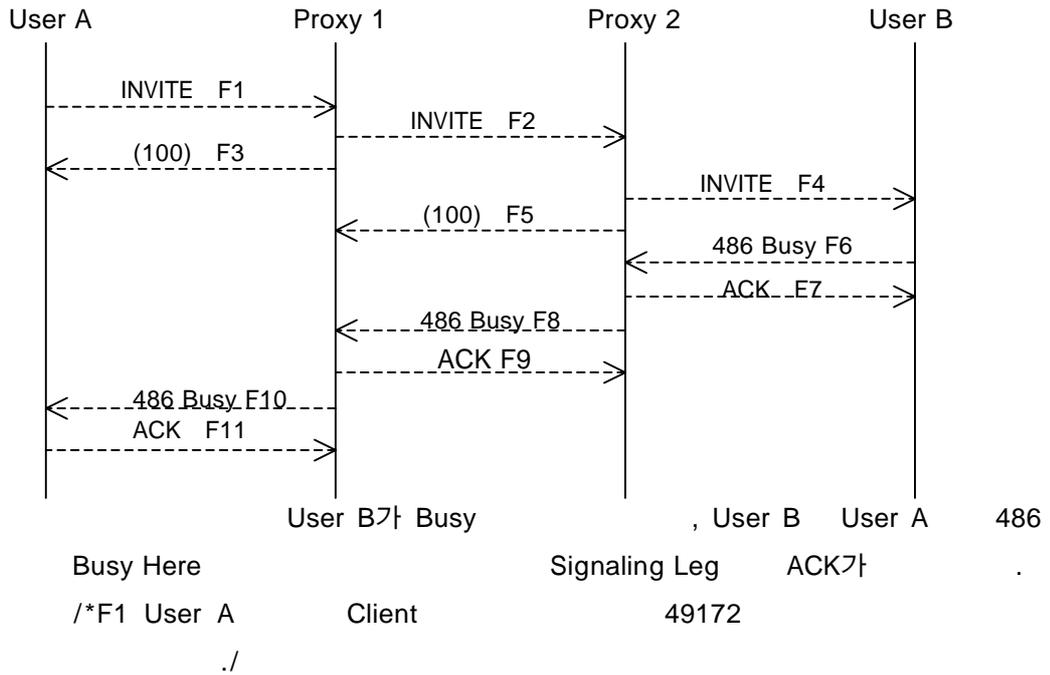
Unsuccessful SIP to SIP no answer



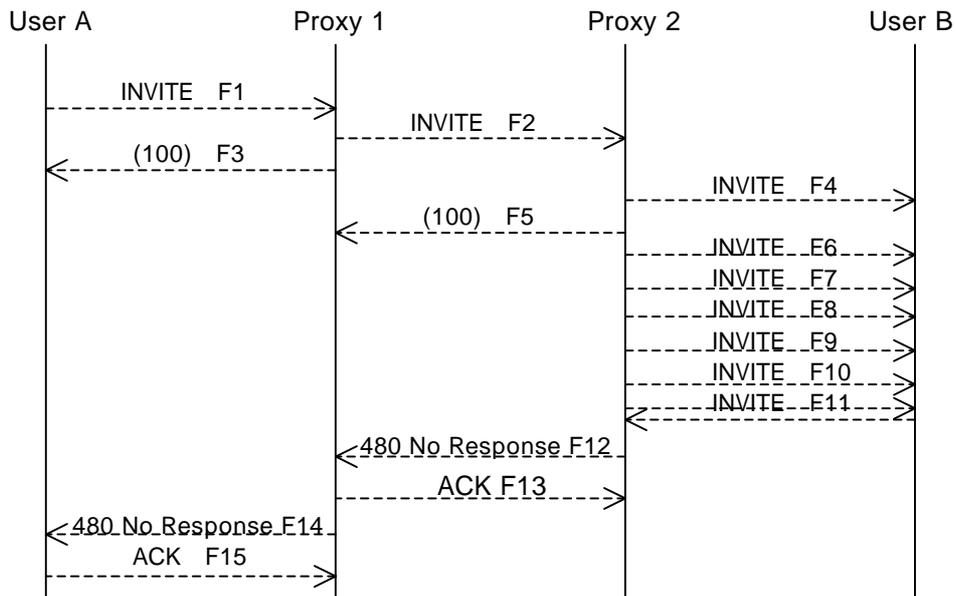


CANCEL User B 200 OK , User A User
 B A call . CANCEL 200 OK
 end-to-end hop by hop 가 .
 /*F1 User A Client 49172
 ./

Unsuccessful SIP to SIP busy



Unsuccessful SIP to SIP no response





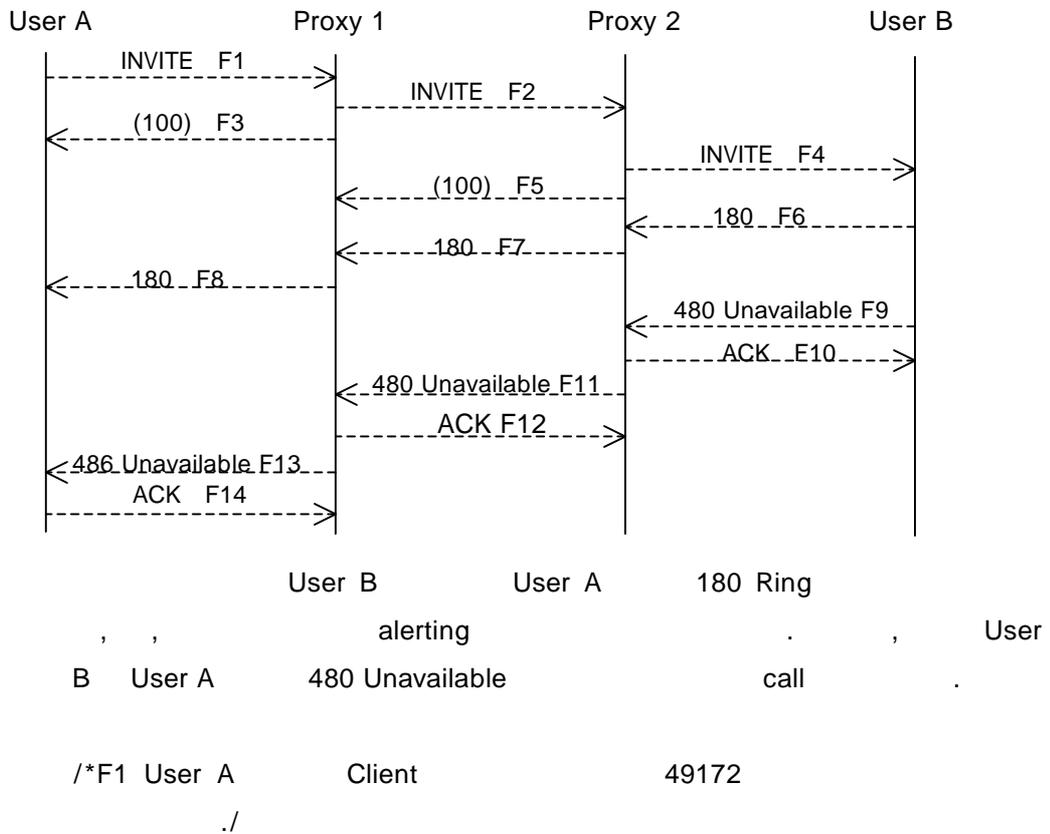
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Example User A User B SIP Call User B
 Proxy 2가 INVITE , 6
 INVITE Proxy Caller 480 No
 Response .
 /*F1 User A Client 49172
 ./

Unsuccessful SIP to SIP Temporarily Unavailable





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◆ SIP to Gateway Dialing

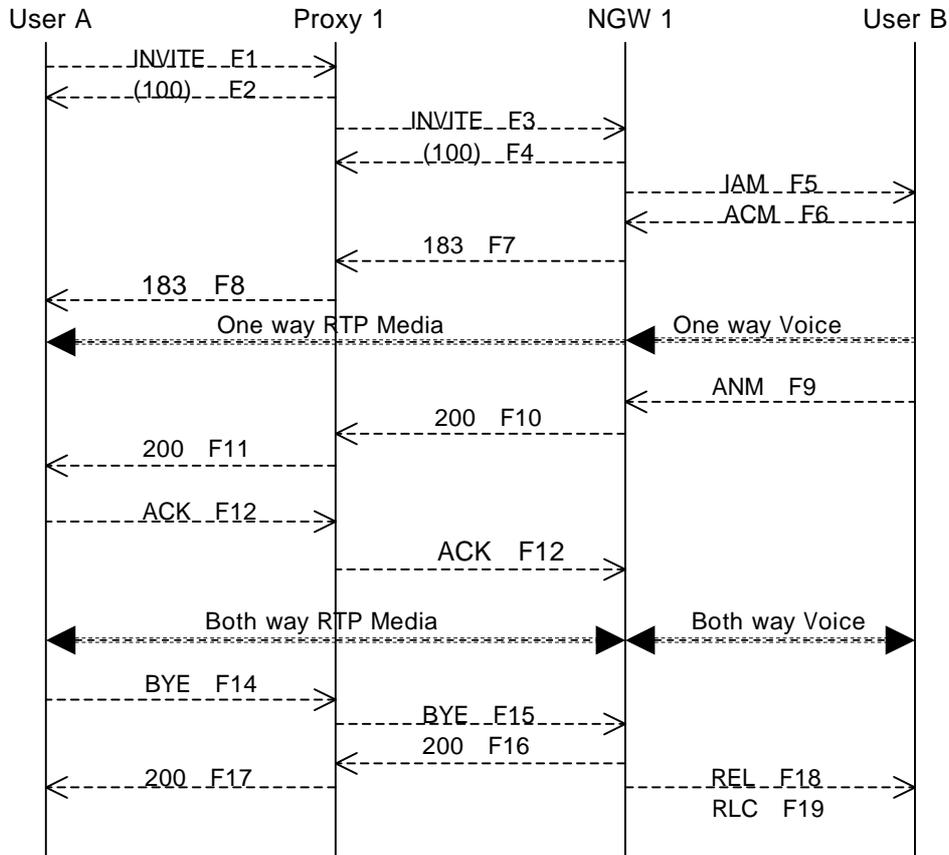
User A(BigGuy sip:UserA@here.com) SIP Phone
 SIP-enable Device , User B(+1-972-555-2222) PSTN
 가 .
 User A Proxy 1 Network Gateway User B Call .
 User A PBX User
 C(Extension 444-3333, Global Number +1-972-555-3333) Call
 , User A Global Telephone Number +1-314-555-111 INVITE
 From . User A Global Telephone Number
 ISUP(CgPN) Calling Party
 Gateway . User A 가 Gateway
 CgPN 가 . User A call
 SIP Network Redirected Back Contact
 SIP URL .

Call Flow , SIP to SIP Call
 Media Path가 200 OK , PSTN
 Speech Path SIP 180 Ringing Response SS7 ACM(Address
 Complete Message) , In-Band Alerting(Ringing Tone, Busy Tone,
 Recorded Announcements) . User A가 Alerting
 Early Media Path . ,
 180 Ringing 183 Session Progress .



✓ Success Scenarios

Successful SIP to ISUP PSTN call



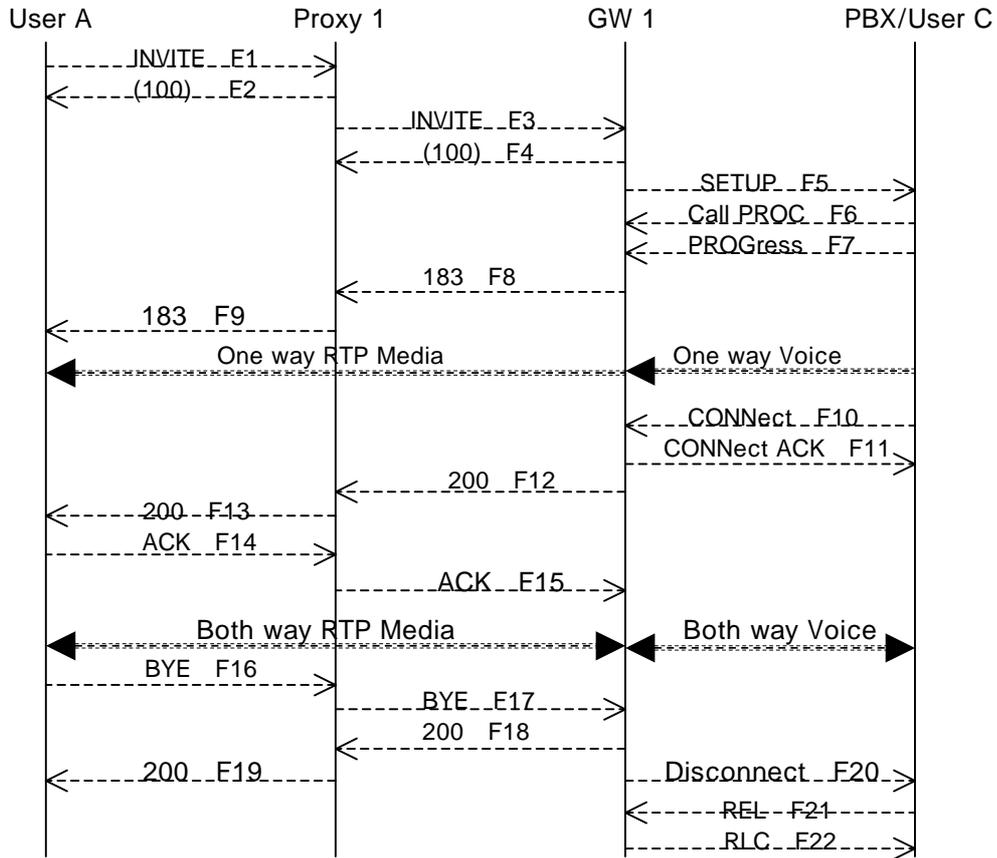
User A E.164 +1-972-555-2222 User B
 , User A Dialing Plan(가,) SIP User Agent
 Client digit Global Number SIP URL .
 User A SIP Address(sip:UserA@here.com) SIP Telephone
 Number(sip:+ [+1-314-555-1111@ss1.wcom:user=phone](tel:+1-314-555-1111@ss1.wcom:user=phone)) From
 가 . Telephone Number가
 NGW 1 User B call CgPN(Calling Party Identification
) . , SS7 가
 User B가 Call Answer User B가 Call Disconnect

/*F2 Proxy 1 User B Location Location Service
 . Location Analysis call NGW 1 forward . User A
 Client 49172 ./
 /*F7 NGW1 User A RTP PSTN audio ./



/*F13 User A User B RTP stream . User A User B call
./

Successful SIP to ISDN PBX call



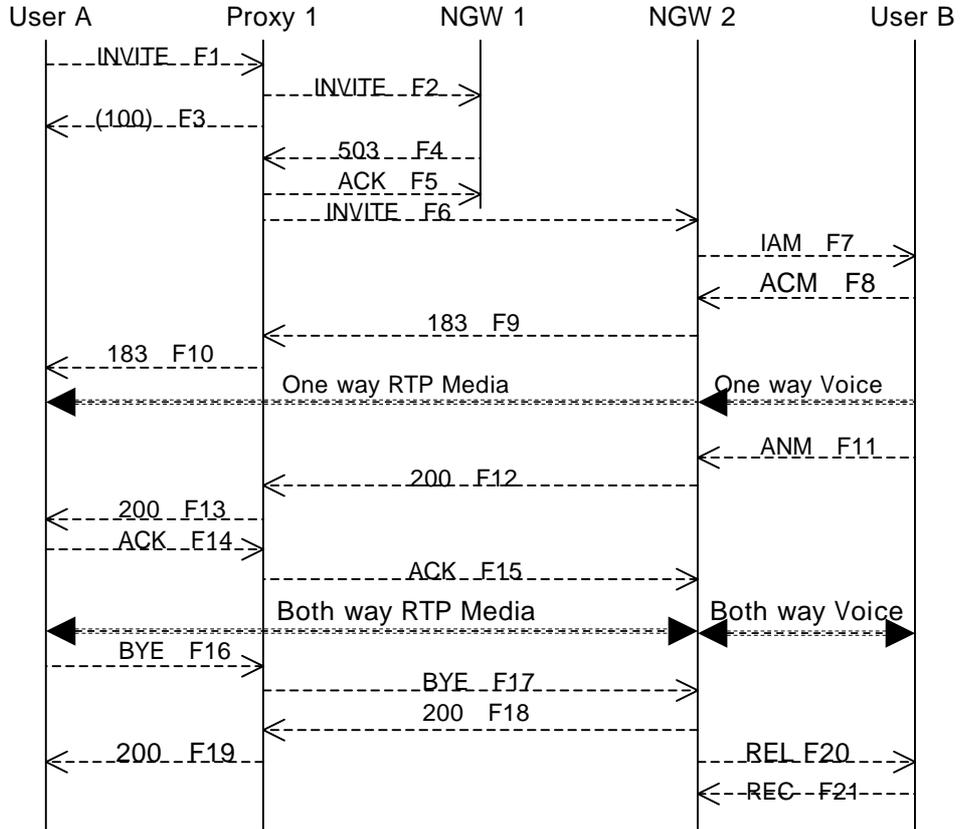
User A SIP Device call Enterprise Gateway(GW 1) PBX
 User C , PBX ISDN Trunk . User A User C
 918-555-3333) SIP URL .
 INVITE F3 Message Request-URI Host Private Number(444-
 3333)가 Context(Customer,Trunk Group Line)
 . , INVITE 가 GW 1 forwarding
 Digit call routing .
 Proxy 1 User C가 Enterprise gateway(GW 1)
 . User C GW 1 Request-URI Extension
 (444-3333) .
 User A 183 Session Progress Media
 Gateway Ringing .

/*F9 GW 1 RTP PSTN audio(ringing) ./



/*F15 User A User B RTP stream . User A User B call
./

Successful SIP to ISUP PSTN call with overflow



User A Proxy 1 User B Call Proxy 1 NGW 1
routing . NGW 1 Service 가
Proxy Server 503 Service Unavailable(F4) call NGW 2
routing . User B가 Call Answer가 User A가
disconnect call .

/*F1 Proxy 1 User B Location Location Service
. Proxy 1 Primary route NGW1 Secondary route NGW2
(NGW 1 .)/
/*F5 Proxy 1 NGW 2 Secondary route ./
/*F9 Audio(, ring tone) RTP GW User A ./
/*F15 User A User B RTP stream (GW) . User A
User B call ./



✓ Failure Scenarios

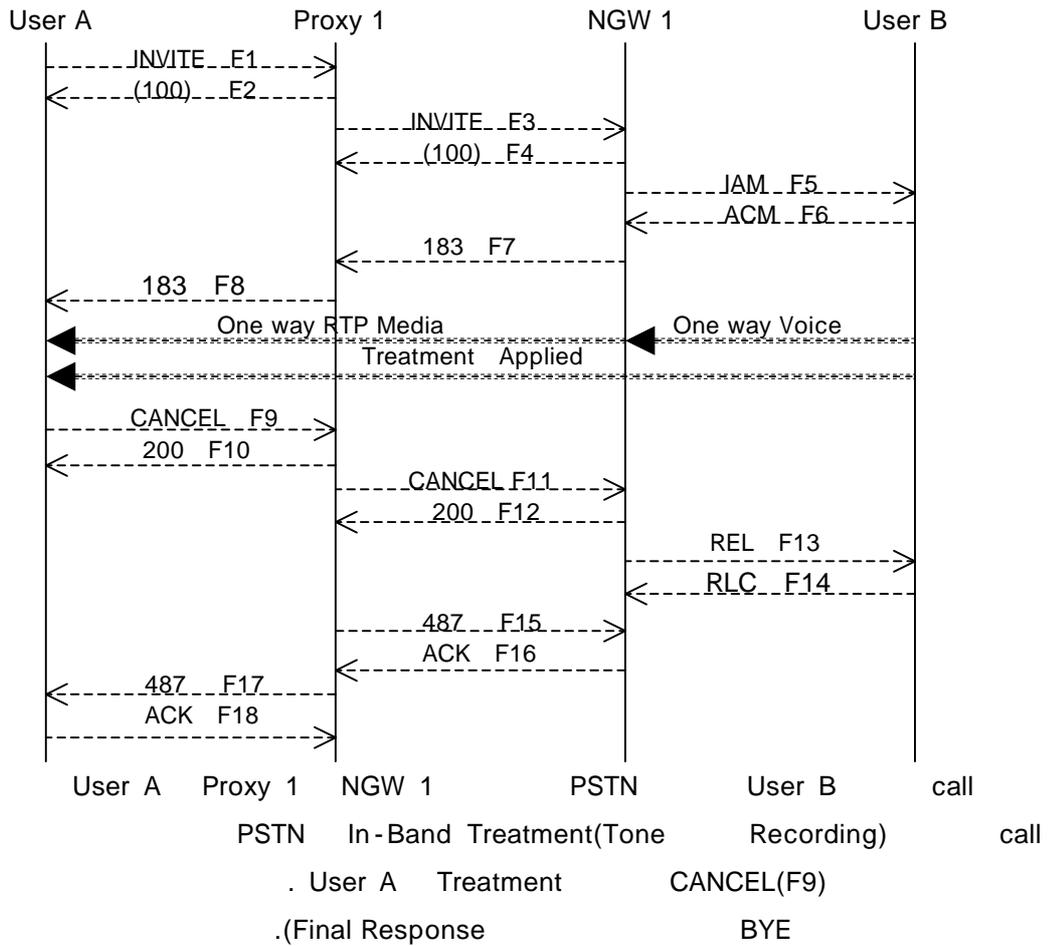
Call Failure
 Media Stream
 PSTN In-Band (Busy, Reorder Tones Announcements- "The number you dialed has changed. The number is...")

Early Media Path SDP Media 183 Session Progress
 Caller User A Call (Disposition)

가
 Media Stream Tone/Announcement가 () Gateway
 Timer가

Failure Cause Code 가 SS7 Release 가 SIP Response mapping Early Media Path Failure Code SIP User Agent Client Caller

Unsuccessful SIP to PSTN call : Treatment from PSTN





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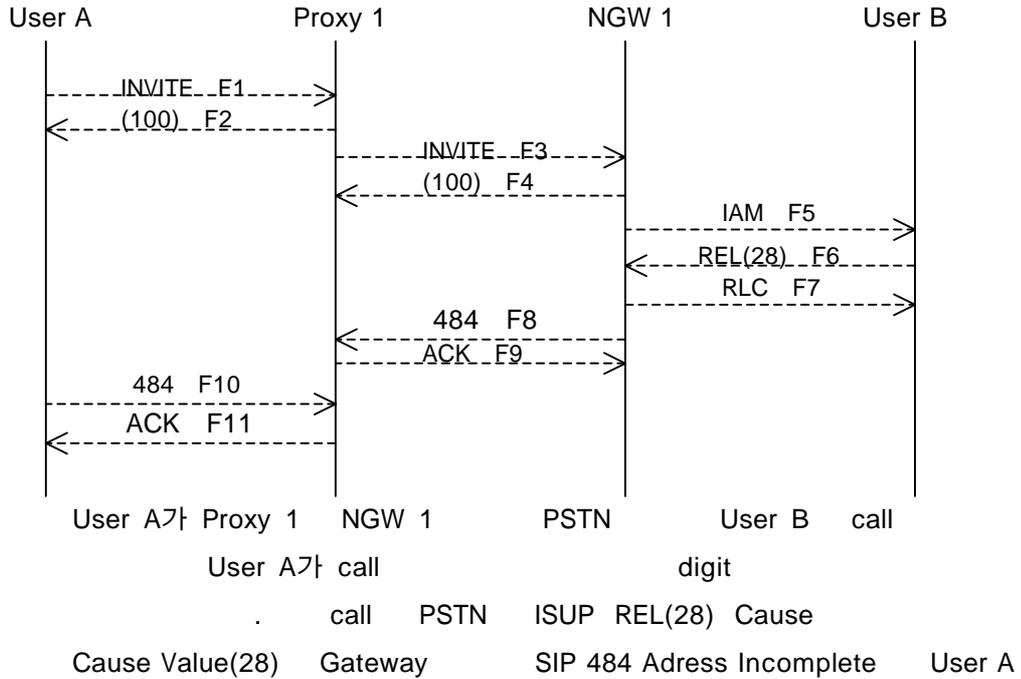
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```

/*F2 Proxy 1 User B Location Location Service
. Location Analasys call NGW 1 forward . User A
Client 49172 ./

```

Unsuccessful SIP to PSTN : REL w/Cause from PSTN



```

/*F2 Proxy 1 User B Location Location Service
. Location Analasys call NGW 1 forward . User A
Client 49172 ./

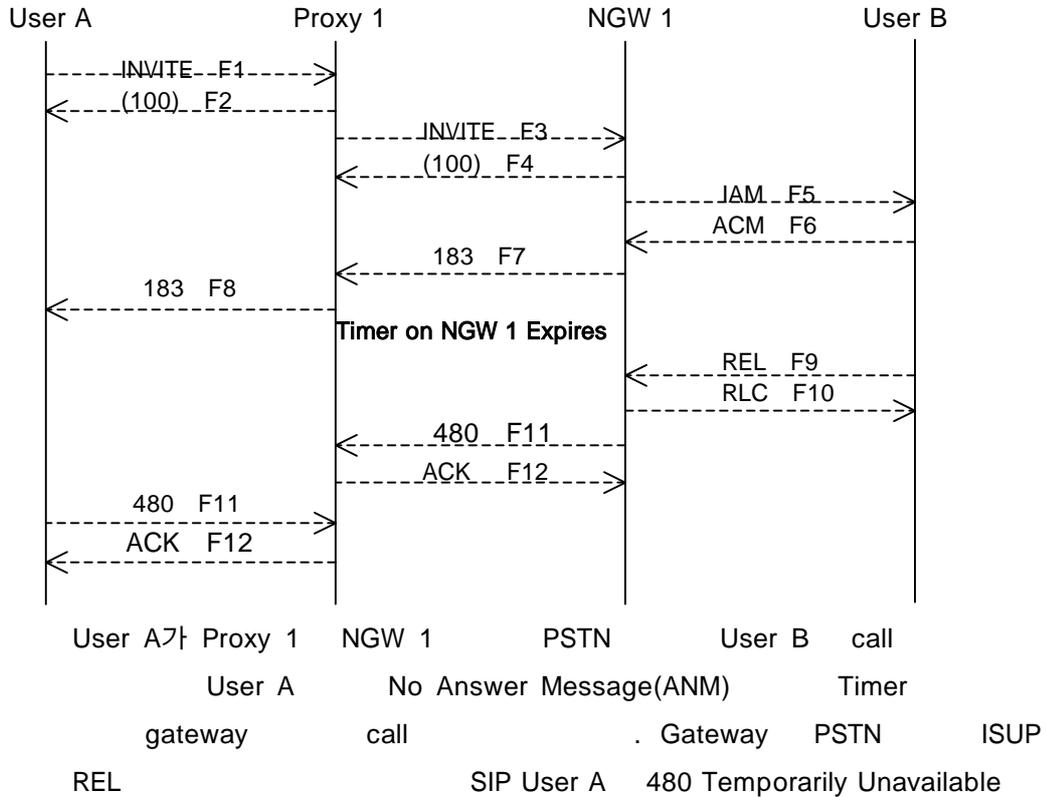
```

/*F7 Network Gatewayrk CauseValue=28 SIP 484 address Incomplete

./



Unsuccessful SIP to PSTN : ANM Timeout



/*F2 Proxy 1 User B Location Location Service
 . Location Analysis call NGW 1 forward . User A
 Client 49172 ./

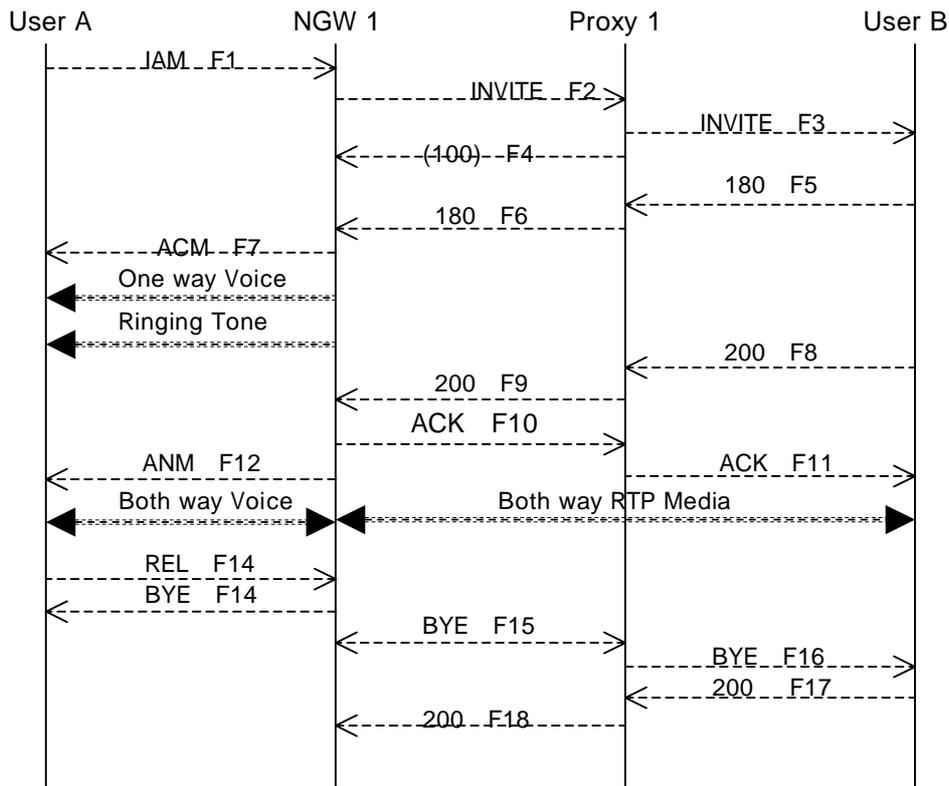
/*F8 NGW 1 Timer가 , Network Gateway ISUP REL
 SIP 480 ./



◆ Gateway to SIP Dialing

✓ Success Scenarios

Gateway to SIP Dialing Success PSTN User A가 SIP
 User B call , User A가 Switch
 Network Gateway(NGW 1) ISUP Signaling
 Callee SIP User Agent가 In-Band Signaling
 , Early Media Path가 call (IP) 183 Session
 Progress
 , NGW 1 call PSTN Caller Ringing
 One Way Speech Path .(MW 1 Tone Recording)
 call NGW 1 PSTN Speech Path IP Media Path
 가 Announcement Server Call
 Redirect 가 .
 Successful PSTN to SIP call



PSTN User A가 NGW 1 Proxy 1 User B
 call User B가 Answer call Media Path
 end-to-end . User A call
 ISUP REL NGW 1 mapping BYE User
 B call .



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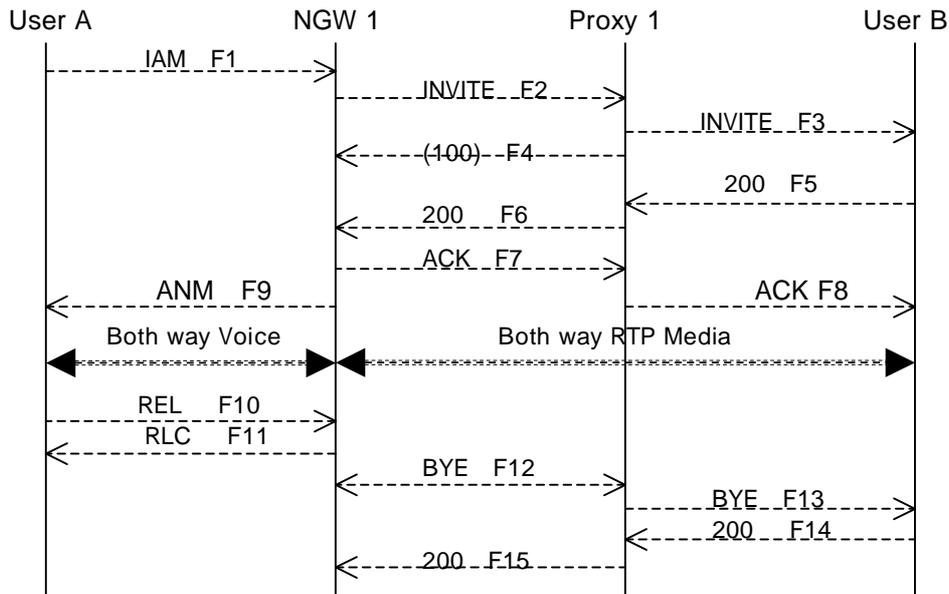
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```

/*F2 Proxy 1 User B Location Location Service
. Location Analasys call NGW 1 forward . NGW 1
User A 3456 ./
/*F12 User A User B RTP stream (GW ) . User A
User B call ./
  
```

Successful PSTN to SIP call, Fast Answer



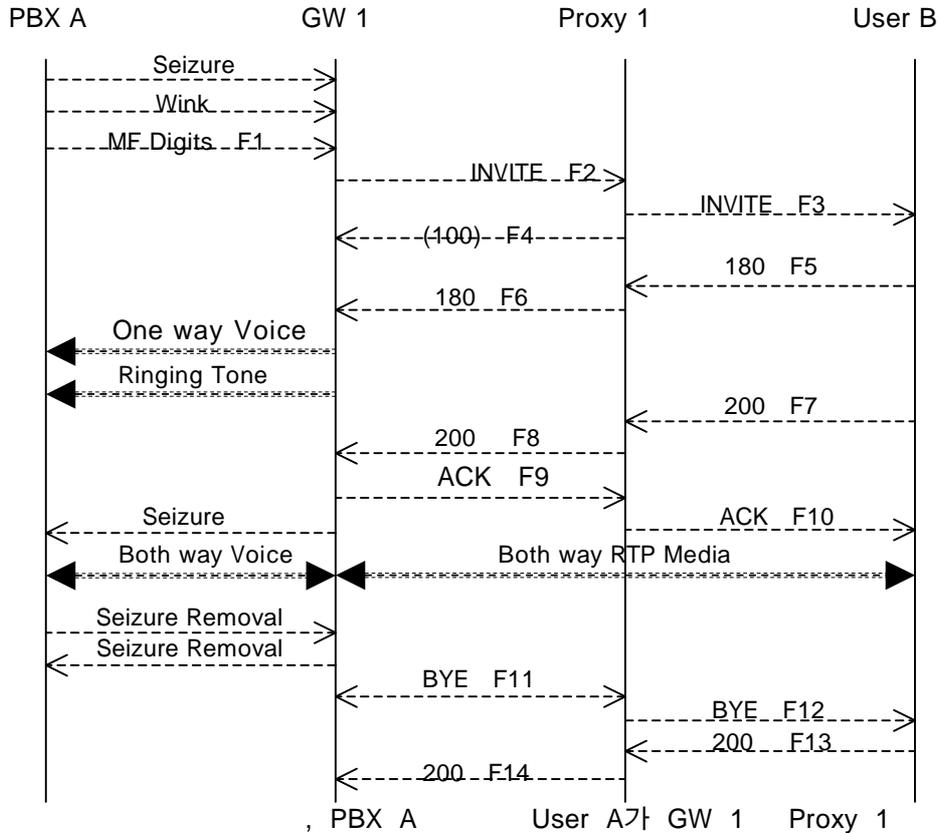
“Fast Answer” User B가 call
 “Successful PSTN to SIP call” , User B가
 180 Ringing 200 OK
 Gateway ACM ANM User A

```

/*F2 Proxy 1 User B Location Location Service
. Location Analasys call User B forward . User B
User A 3456 ./
/*F9 User A User B RTP stream (GW ) . User A
User B call ./
  
```



Successful PBX to SIP call

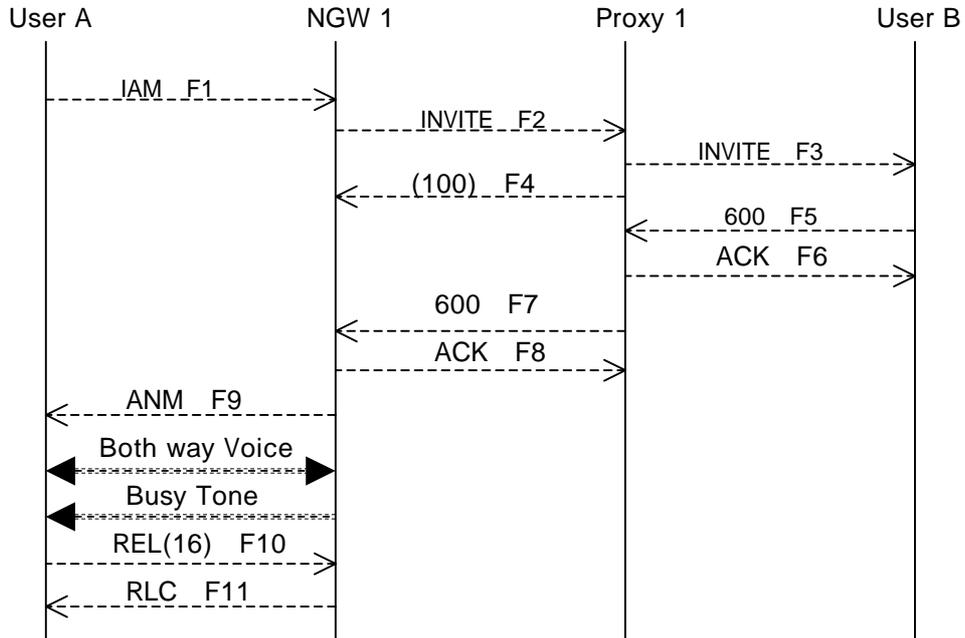


User B call PBX A GW 1 FBG(Feature Group B) CAS . GW 1 User B 180 Ringing
 User A Ringing Tone .
 User B 200 OK call , User A

/*F2 Proxy 1 (+1-972-555-2222) Location
 Location Service . Location Analysis call SIP
 User B forward ./
 /*F6 Ringing One way Voice Path가 GW PBX ./
 /*F10 User A User B RTP stream (GW) . User A
 User B call ./



Unsuccessful PSTN to SIP, SIP error interworking to tones

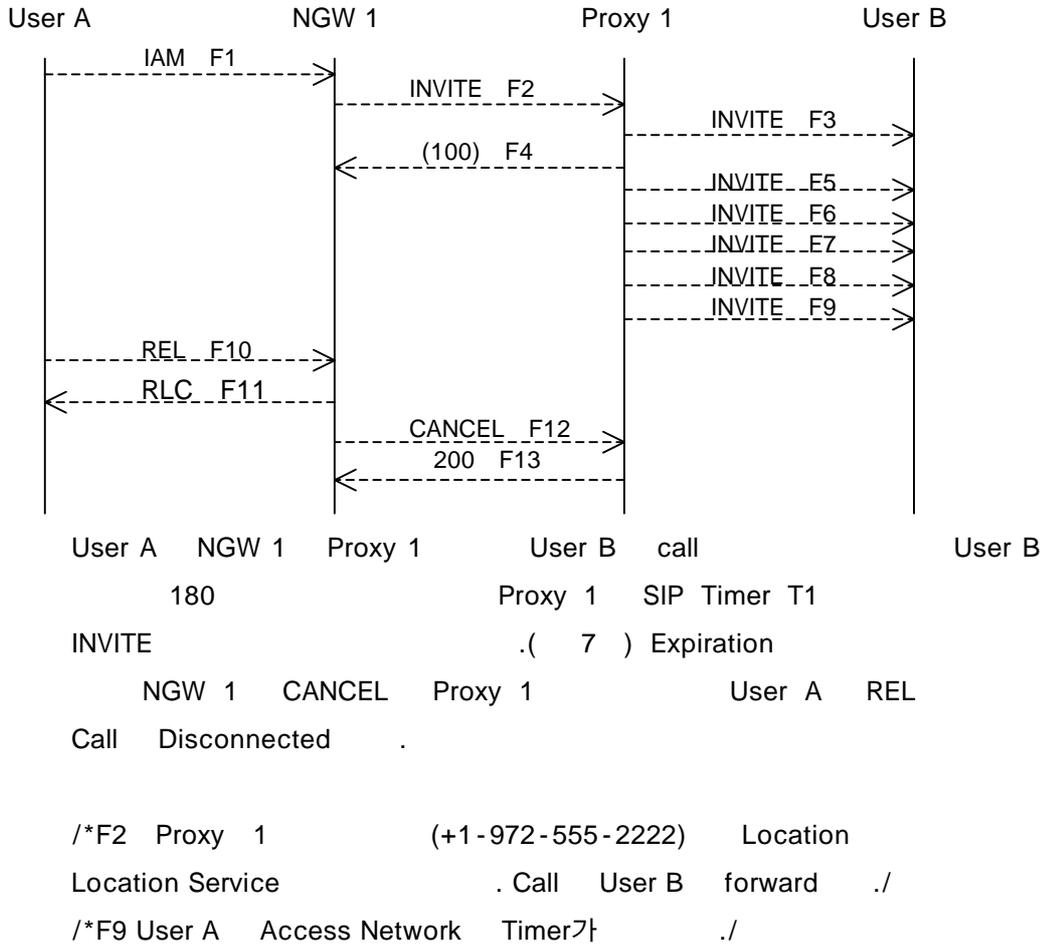


User A NGW 1 Proxy 1 User B call User B
 F5 600 Busy Everywhere call
 , F1 IAM Interworking
 NGW 1 User A Voice Path Busy Tone
 . Timeout SIP 600 REL(17) User
 A .

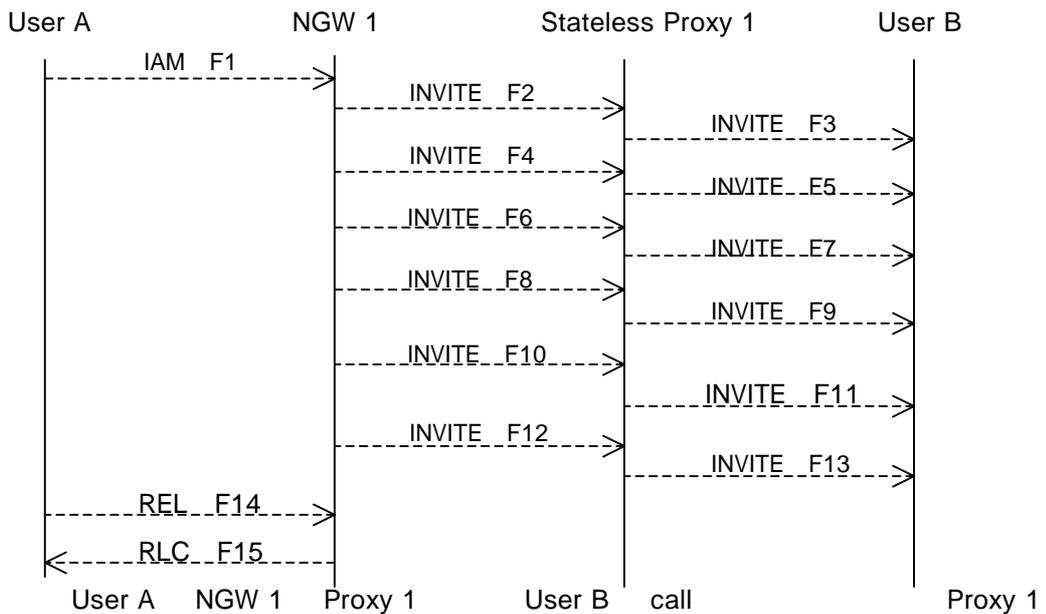
/*F2 Proxy 1 (+1-972-555-2222) Location
 Location Service . Call User B forward ./
 /*F9 User A User B Two Way Speech path가 (GW) .
 User A User B call ./



Unsuccessful PSTN to SIP, ACM timeout

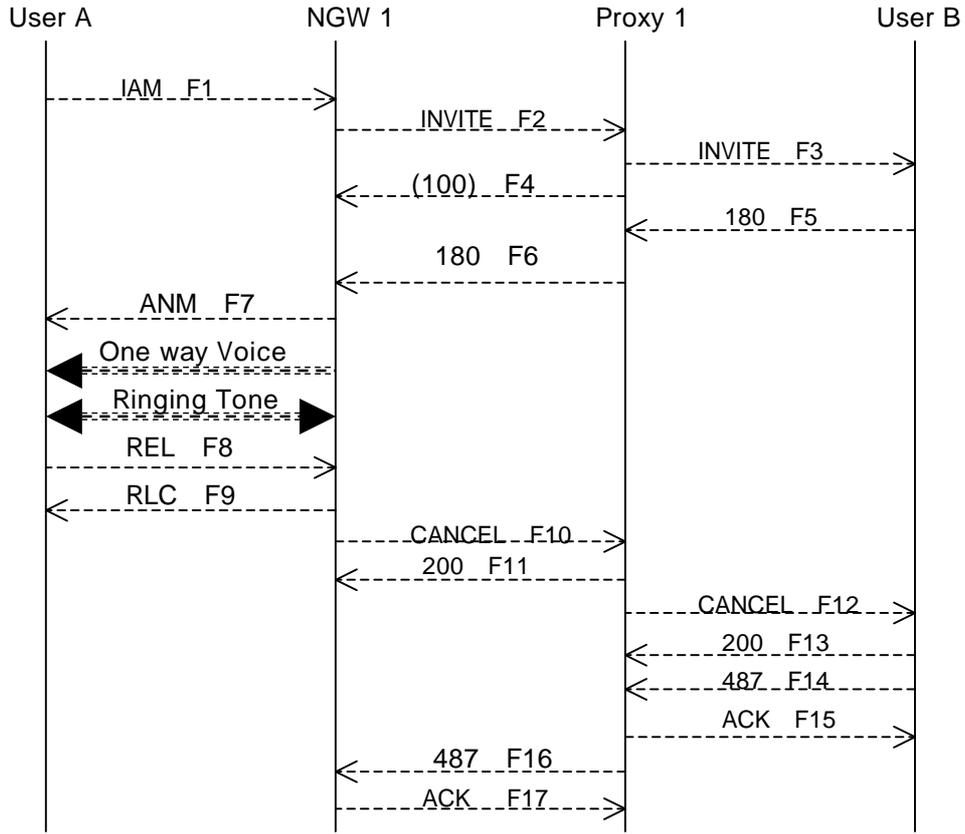


Unsuccessful PSTN to SIP, ACM timeout, stateless Proxy





Stateless Proxy 100 Trying NGW 1
 , NGW 1 SIP Timer T1 INVITE
 .(7) Expiration User A REL
 Call Disconnected .
 Unsuccessful PSTN to SIP, ANM timeout



User A NGW 1 Proxy 1 User B call user B
 가 200 OK , ACM Interworking
 NGW 1 Ringing Tone . User A CANCEL
 REL NGW 1 , NGW 1 CANCEL
 Proxy 1 . REL User B 200 OK
 NGW 1 ACK BYE call Disconnected

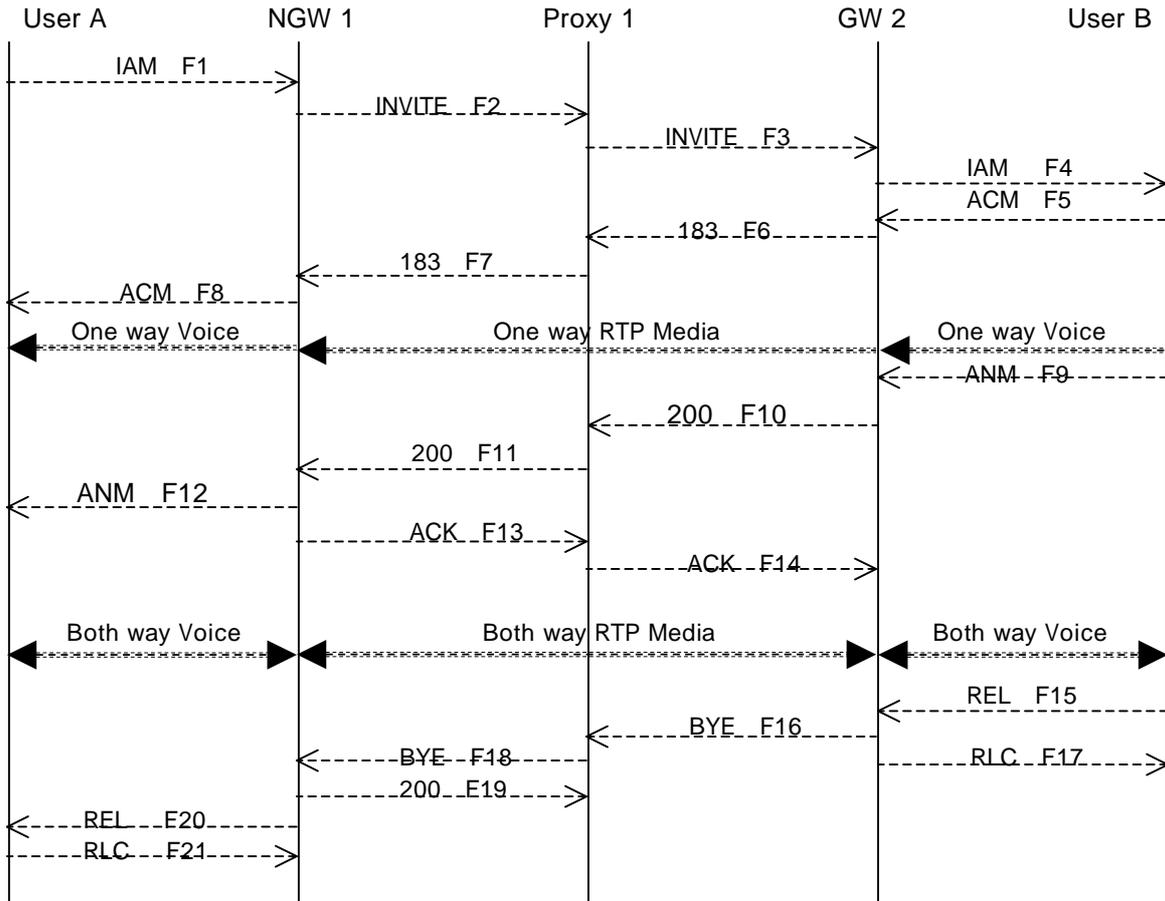
/*F2 Proxy 1 (+1-972-555-2222) Location
 Location Service . Call User B forward ./
 /*F7 User A가 call ./



◆ Gateway to Gateway Dialing via SIP Network

Caller Telephone Network Proxy
 Callee가 call 2 Gateway Location
 PSTN 가 Gateway
 PBX 가 Proxy

✓ Successful ISUP PSTN to ISUP PSTN call



PSTN User A가 PBX 가 User C call ,
 가 가 Switch NGW 1, GW 2 SS7 Signaling
 . CdPN CgPN NGW 1 SIP URL
 To From . Proxy 1 Request-URI Dialed
 Digit GW 2 PBX Mapping . INVITE F3
 Request-URI Private Dialing Plan 가 Host
 . Early Media Path end-to-end User A PBX C
 Ringing Tone .

/*F2 Proxy 1 Location Service Request-URI



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0.1

Private ./

/*F5 PROGRESS GW 2 183 . In-Band Call

Progress Indication NGW 1 User A ./

/*F7 NGW 1 NGW 2 encoded ringback, tone audio
. NWG 1

Trunk ./

/*F8 User B가 call ./

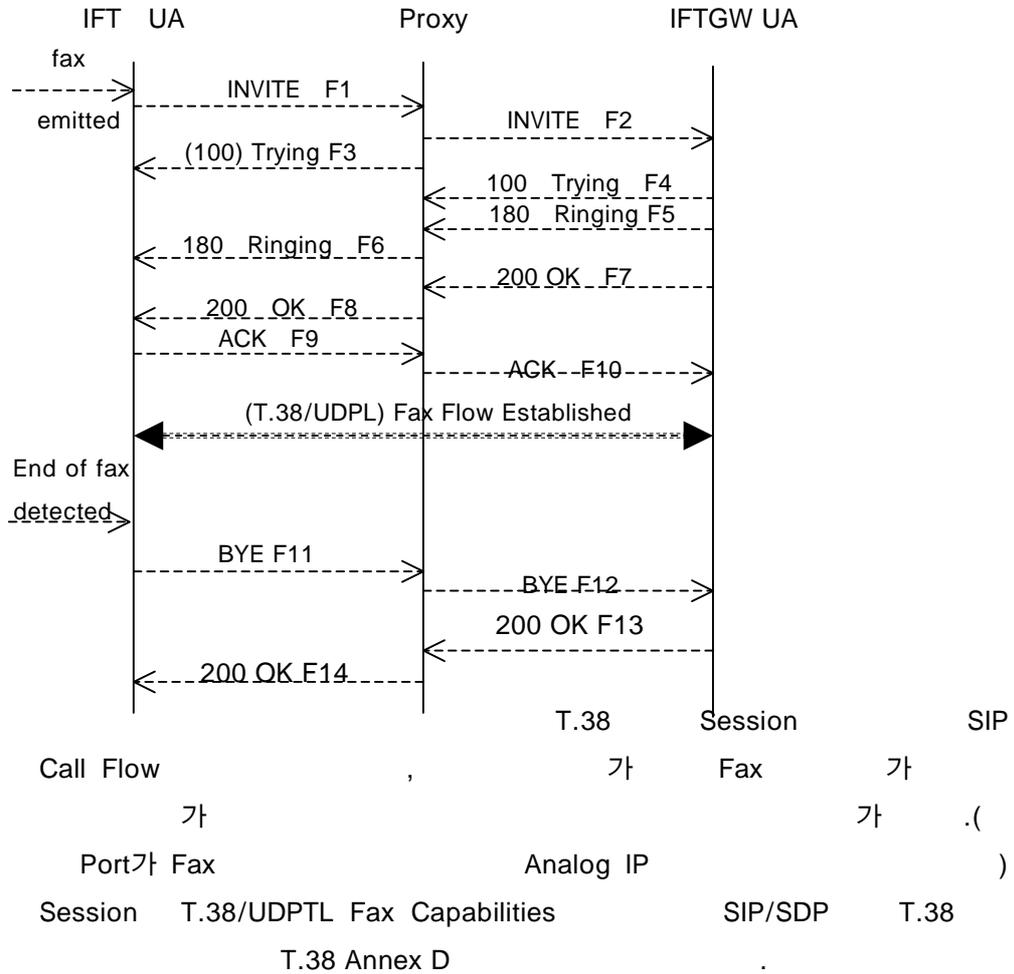


◆ SIP Test Messages(INVITE,REGISTER,OPTIONS,200 OK, Headers...)

◆ SIP T.38 Fax

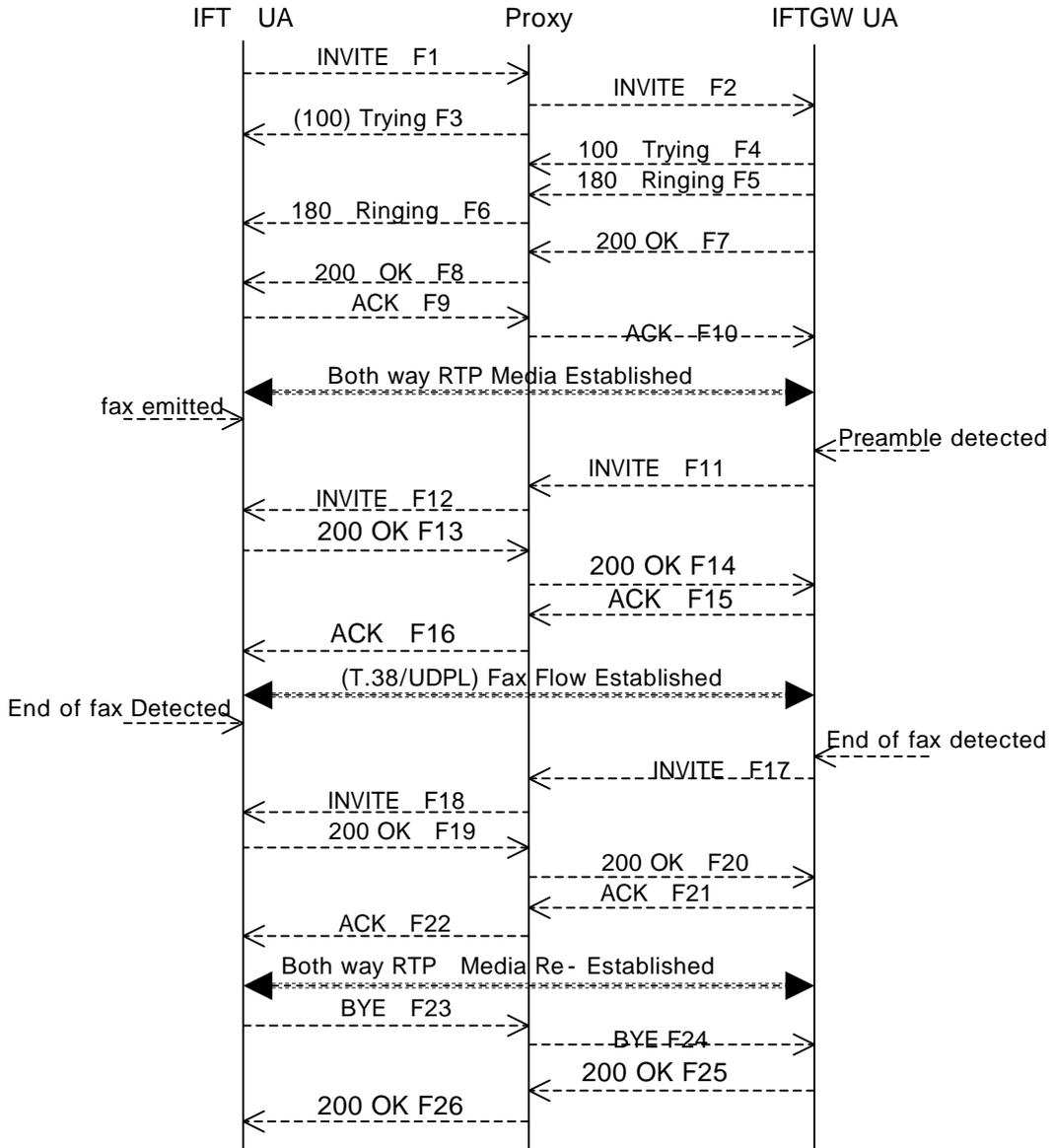
✓ Successful SIP T.38 Fax call Scenarios

Internet Fax device Fax only support





SIP T.38 Fax call : Fax stream replace voice stream



Section T.38 Fax Session SIP Call
 Flow (Fax Detection Terminating),
 Session Audio Capabilities T.38 Fax Mode(T.38/
 UDPTL)

1. Audio connection
2. Terminating Gateway "Preamble", T,38 Fax Media connection 가 Session Parameter SIP INVITE Emitting Gateway INVITE T.38 SDP



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0.1

3. Session T.38 IFP Fax packet UDP
 Audio ,

4. Fax Audio Capability가 call .

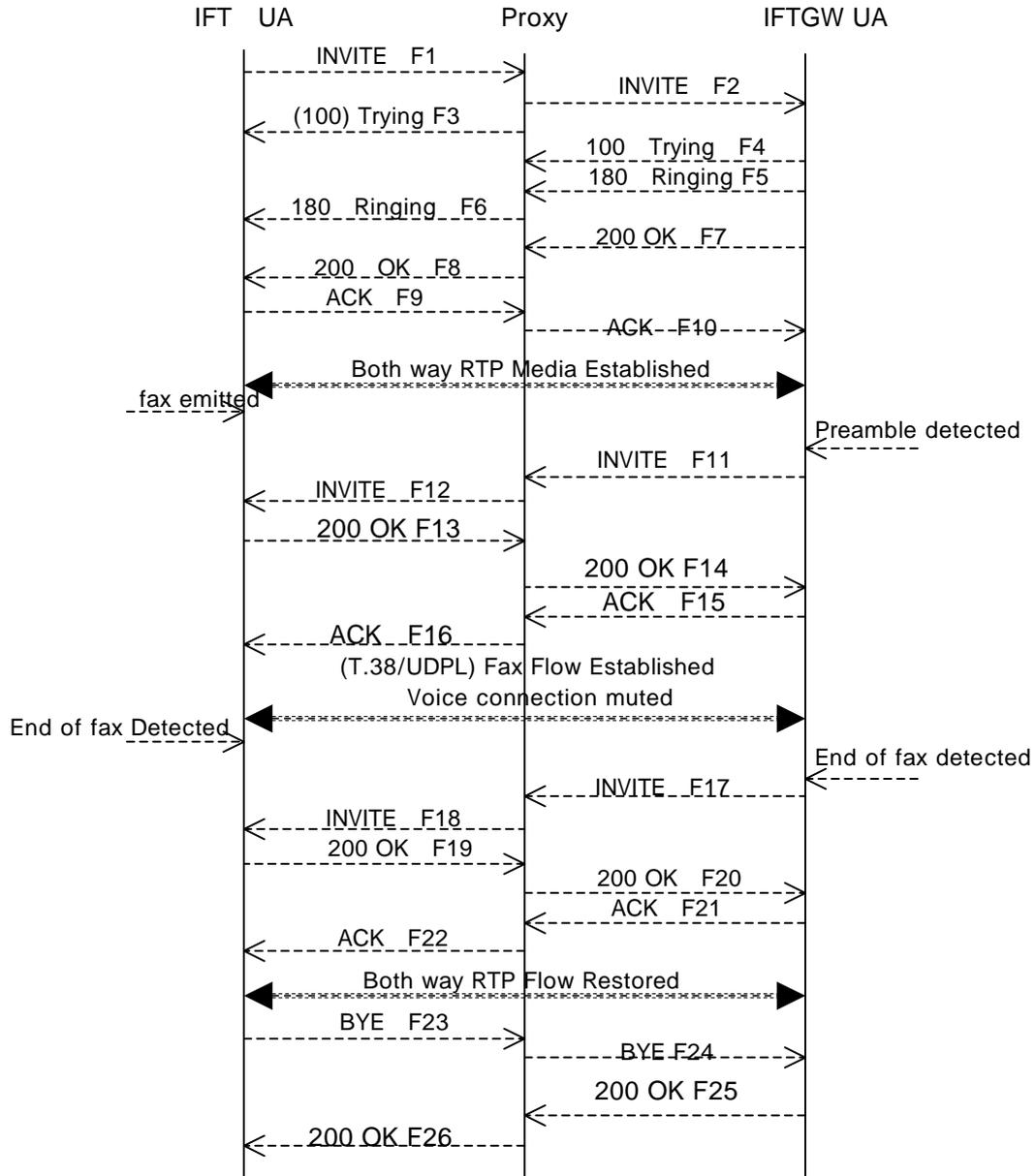
/*F10 RTP Stream CNG Fax Tone In-Band .
 IFT Gateway DSP가 Preamble . UDP 가 T.38
 IFP IFTG open , IFTGW SDP UDP 가
 re-INVITE Switch Fax ./

/*F16 T.38 Fax . Fax
 가 Ingress Egress (IFTGW) . IFTGW Switch
 Voice 가 .

/*F22 Voice Stream ./



SIP T.38 Fax call : Fax stream added to voice stream



Section T.38 Fax Session SIP Call
 Flow (Fax Detection Terminating Receiving
), Session Audio Capabilities T.38 Fax
 Detection Voice Stream 가 Fax Stream

1. Audio Connection .
2. Terminating Gateway "Preamble" , T.38 Fax Media
 connection 가 Session Parameter



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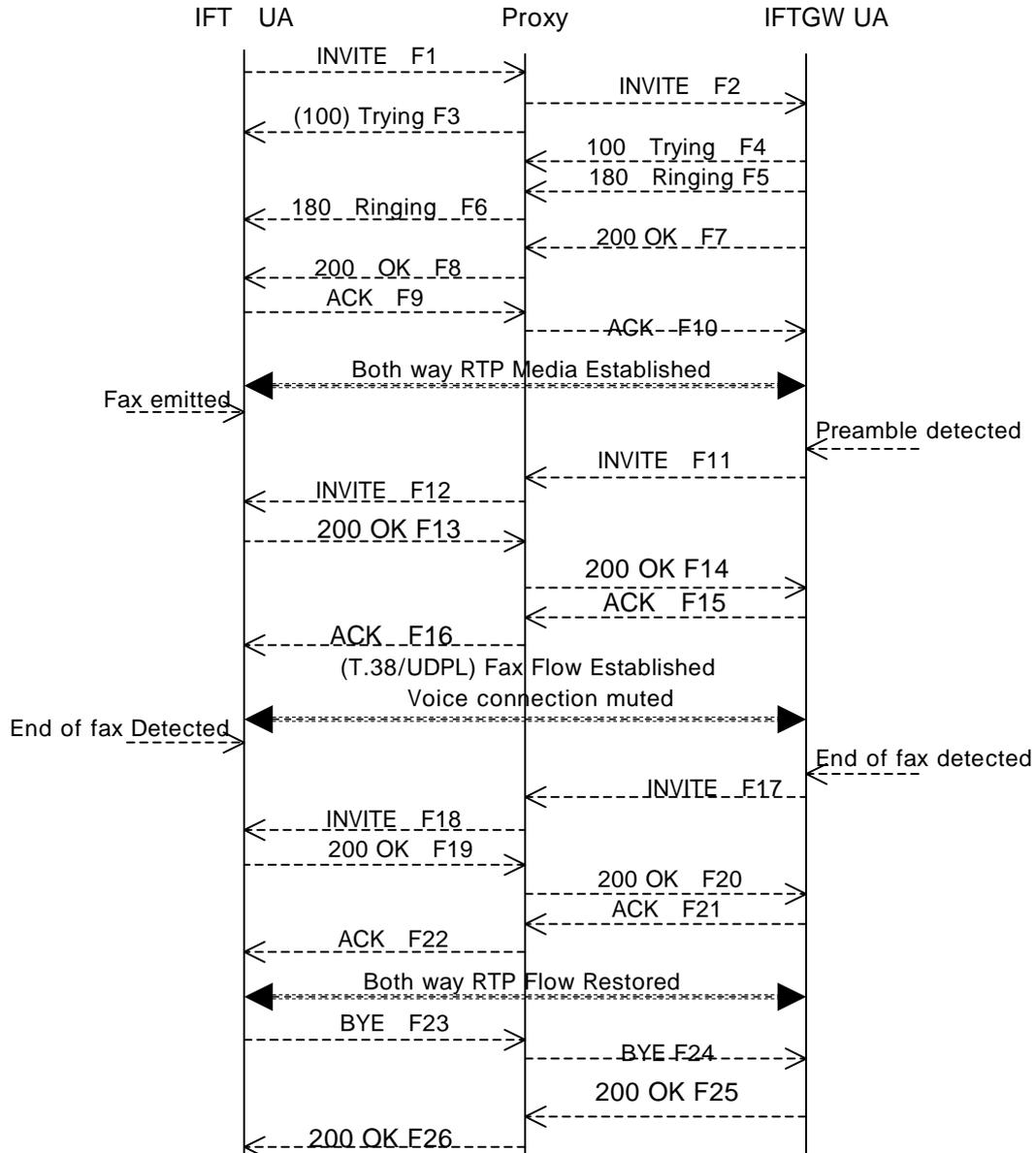
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0.1

SIP INVITE Emitting Gateway . Connection Data
 Session-level Media Description ,
 Audio Stream T.38 Fax Stream 가 가
 .(T.38 Fax Active Audio)
 INVITE T.38 가 SDP .
 3. Fax Session Voice Pipe .
 Session T.38 IFP Fax packet Audio RTP UDP
 UDP ,
 4. Fax Audio Capability가 call .
 /*F10 RTP Stream CNG Fax Tone In-Band .
 IFT Gateway DSP가 Preamble . UDP 가 T.38
 IFP IFTG open , IFTGW SDP UDP 가
 re-INVITE Switch Fax ./
 /*F16 T.38 Fax Voice Stream
 . Fax 가 Ingress Egress
 (IFTGW) . IFTGW Switch Voice 가 .



SIP T.38 Fax call : Fax stream forced to replace voice stream



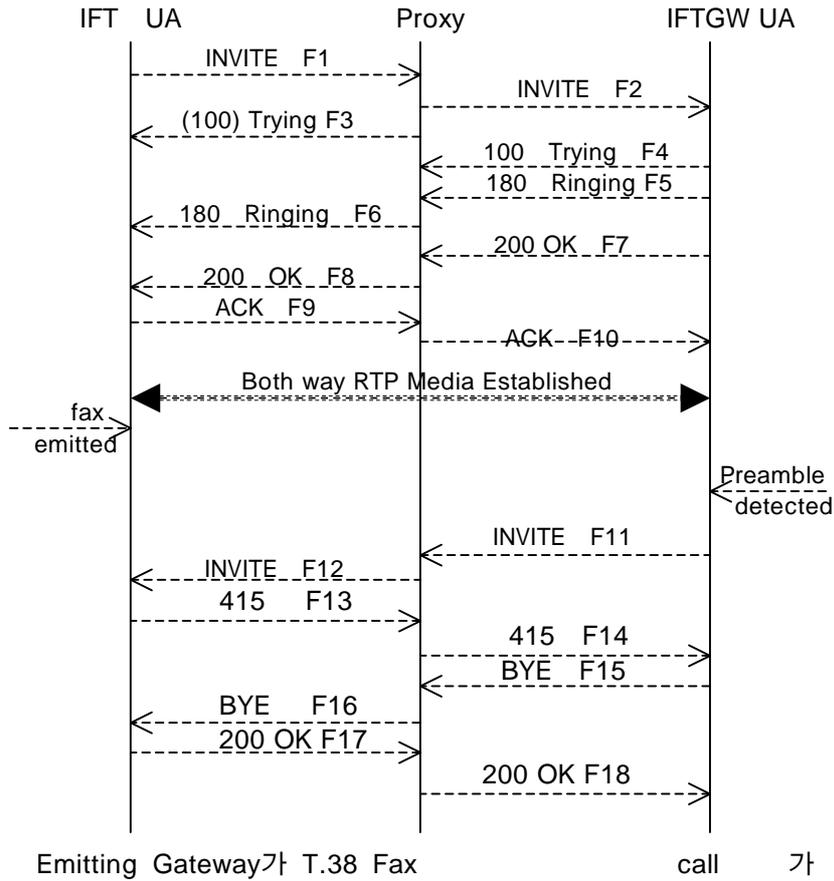
1. Audio connection
2. Terminating Gateway "Preamble", T.38 Fax Media connection 가 Session Parameter SIP INVITE Emitting Gateway INVITE 가 T.38 SDP . Fax Session Voice Pipe
3. Emitting Gateway Audio Fax Stream 가 Fax Media Stream . Session T.38 IFP Fax packet UDP Audio



- 4. Fax Audio Capability가 call
- * Call Sequence Diagram "Fax Stream added to voice stream"

✓ Unsuccessful SIP T.38 Fax call Scenarios

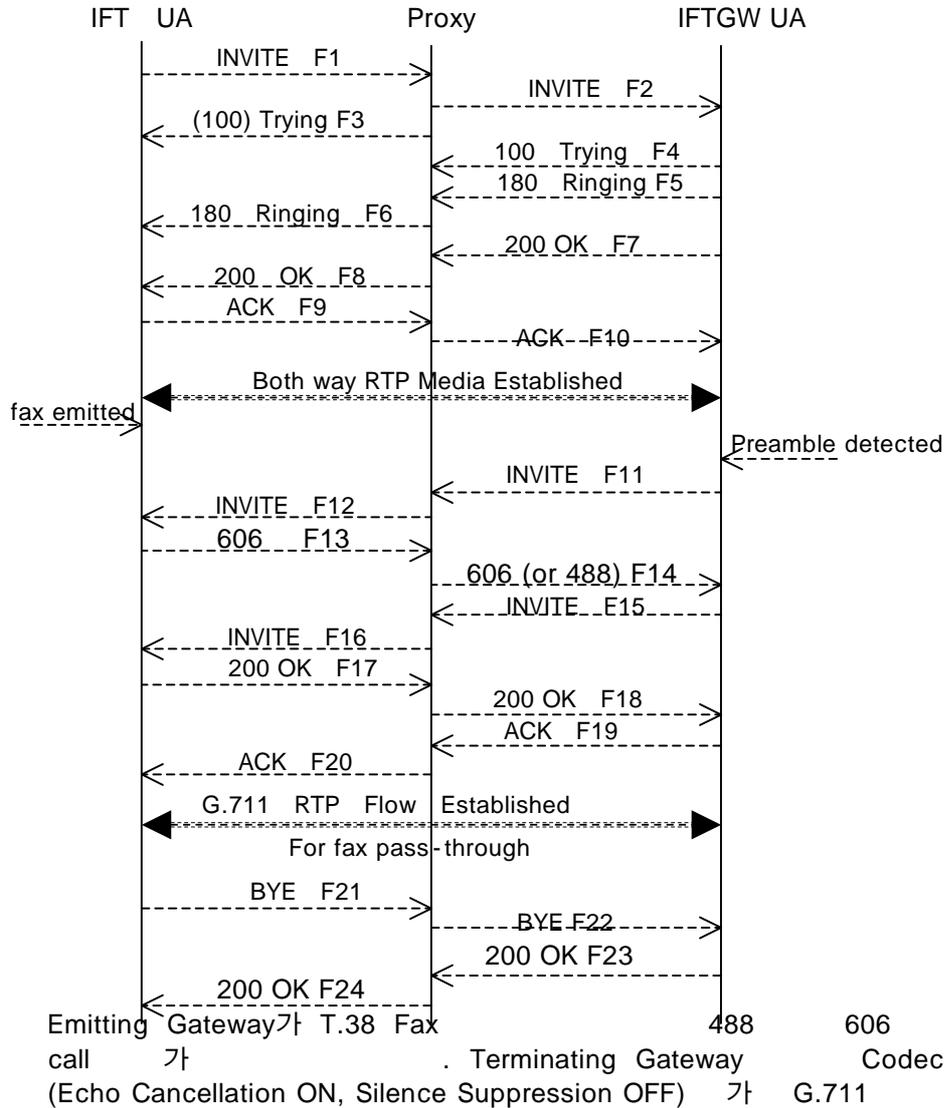
Unsuccessful SIP T.38 Fax scenario no support for T.38



1. Audio connection
 2. Terminating Gateway "Preamble", T.38 Fax Media connection 가 Session Parameter SIP INVITE Emitting Gateway INVITE T.38 SDP
 3. Emitting Gateway re-INVITE 415 Unsupported Media Type
 4. call
- *F1~F12 Sequence가 Fax Stream replace voice stream"



Unsuccessful SIP T.38 Fax scenario 488/606 response & G.711 fallback



* F1~F12 Sequence가 Fax Stream replace voice stream”

1. Audio connection
2. Terminating Gateway “Preamble” , T,38 Fax Media connection 가 Session Parameter SIP INVITE Emitting Gateway INVITE T.38 SDP
3. Emitting Gateway re-INVITE 488 606 Terminating Gateway Fax Stream G.711

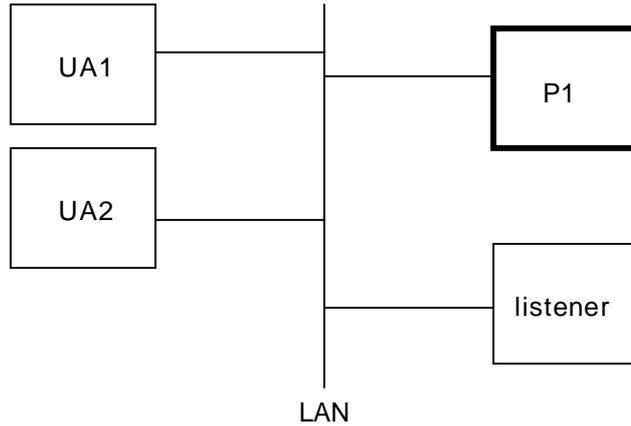
4. call

*F1~F12 Sequence가 Fax Stream replace voice stream”



◆ (*)Proxy Tests

UA Proxy Interoperability Test
 Test UAC가 Local Proxy
 ✓ Basic Stateful Proxy



4 : Multiple Registration

Proxy 4 UA(UA1, UA2) Proxy
 P1 UA2 Registraion Static
 P1 tcpdump machine UA1 P1, UA2 P2
 UA1 P1 UDP INVITE Local Proxy
 INVITE P1 P1
 UA2 P1 Request UA2 Proxy UA2
 cCall 200 OK P1 UA1 UA1
 ACK UA2 (UA2가 Contact
 가) P1 Test

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
method tag
- P1 UA2 proxed INVITE UA1 가 Via UDP
가 Via 가
- P1 Request UA1 100
- P1 200 Ok UA1 Forwarding Via
- P1 200 Ok Retransmit UA2
Upstream forwarding
- ACK 가 P1 UA2 forwarding Via
가



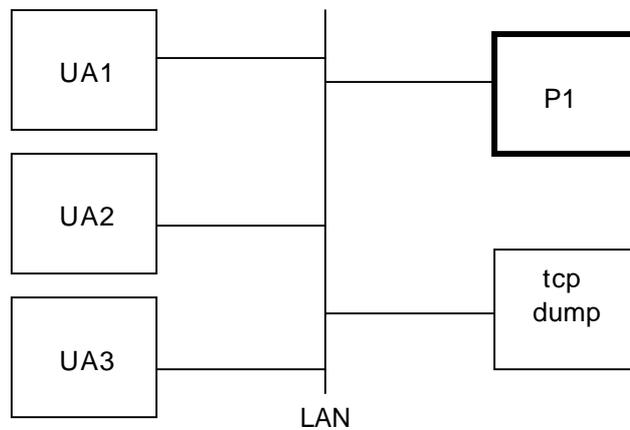
- UA1 User Call
UA1 UA2 Media Test

✓ Proxy with Rejecting UAS(PS2)

P1 Test가 call
400,500,600 UA2가 call P1 ACK UA2
UA2가 UA1 forwarding UA1 P1 ACK
Test가

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
method tag
- P1 UA2 proxed INVITE UA1 가 Via UDP
가 Via 가
- P1 Request UA1 100
- UA2 P1 Rejection
- Rejection To tag 가
- P1 UA2 ACK
- P1 UA2 ACK Via P1
- P1 UA1 forwarding
- P1 UA1 UA1 Via
- UA1 P1 ACK
- P1 UA1 UA2 ACK forwarding
- UA1 User Call Rejection

✓ Parallel Forking Proxy(P3)



5 : Forking proxy Configuration

Test 5 3 UA(UA1, UA2, UA3) Proxy P1



. P1 X가 UA1 UA2 . P1
 Parallel Search Forking Proxy .
 UA1 Address X(Request URI To Field) INVITE P1
 P1 INVITE UA2 UA3 forking . UA2 400,
 500 class (600 class가) call Reject . , 5
 가 UA3 call 200 OK P1 P1 200 OK
 UA1 Upstream . UA1 UA3 ACK
 P1 UA3 ACK .
 Test .
 • UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
 method tag .
 • P1 UA2 UA3 proxed INVITE UA1 가 Via
 UDP 가 Via 가 .
 • P1 UA2 UA3 Request Via
 Branch Request Branch가 .
 • P1 Request UA1 100 .
 • UA2 P1 400/500 .
 • UA2 UA1 400/500 P1 forwarding
 .
 • P1 UA2 ACK .
 • P1 UA2 ACK Via P1 .
 • UA3 To Tag 200 OK P1 .
 • P1 Via 200 OK UA1
 forwarding .
 • UA1 ACK P1 UA3 ACK .
 • UA1 P1 ACK .
 • P1 200 OK UA3 UA1
 retransmission forwarding .
 ✓ Parallel Forking Proxy with CANCEL(P4)
 P3 forking Test가 400/500 call UA2
 600 class call . , P1 UA3 CANCEL
 . UA3 CANCEL 200 OK User alerting .
 P1 UA1 600 forward UA1 ACK .
 Optional P1 UA3 CANCEL 가 가



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0.1

Test

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
method tag
- P1 UA2 UA3 proxed INVITE UA1 가 Via
UDP 가 Via 가
- P1 UA2 UA3 Request Via
Branch Request Branch가
- P1 Request UA1 100
- UA2 P1 600
- P1 UA2 가 Via ACK UA2
retransmission
- P1 UA3 가 Via CANCEL
- CANCEL INVITE CSeq 가 method tag CANCEL
- UA3 CANCEL To, From, CSeq, Call-ID mirroring 200 OK
P1 P1 CANCEL
- UA3 User alerting
- P1 UA3 INVITE Request
- P1 Via 600 UA1 forwarding
- UA1 600 User call
- UA1 P1 ACK P1 600

✓ Parallel Forking Proxy with multiple 200 OK(P5)

- Test P3 UA2 UA3가 call
- P1 CANCEL UA1 200 OK
가 가 (1)UA1
- 2 call leg 2 Request ACK
, (2) 200 OK ACK
call leg BYE
- (1)P1 200 OK CANCEL Configuration
- (2)UA1 multiple 200 Ok Test

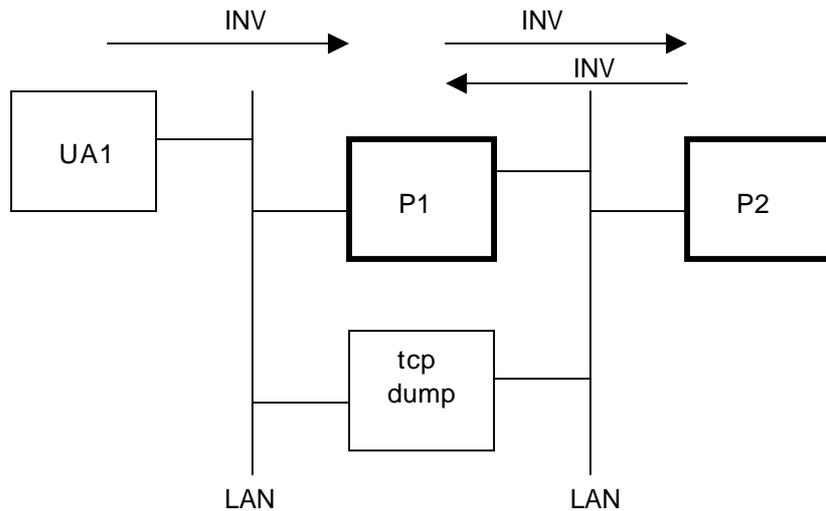
Test

- UA1 INVITE Call-ID, To, Via, From, CSseq INVITE
method tag



- P1 UA2 UA3 proxed INVITE UA1 가 Via
UDP 가 Via 가 .
- P1 UA2 UA3 Request Via
Branch Request Branch가 .
- P1 Request UA1 100 .
- UA2 P1 To tag 200 .
- P1 UA2 200 OK ACK .
- P1 UA1 Upstream 200 OK forward .
- UA3 P1 To tag 200 .
- P1 UA3 200 OK ACK .
- P1 UA1 Upstream 200 OK forward .
- UA1 UA2 UA3 200 OK ACK
- UA1 200 OK ACK BYE
- call leg
- UA2 UA3 media UA1 200 OK
UA2/UA3 2 media Test

✓ Loop Detection(P6)



6 : Loop Detecion Scenario

Test Proxy Loop Detection Test
 6 UA(UA1) Proxiy (P1, P2)
 UA1 Request URI To Address X INVITE



P1 . P1 Address X P2 served Address Y mapping
 , P2 Address Y P1 served Address Z
 mapping . P2 loop detected error P1 P1

Test Proxy P1 P2가 next hop server DNS lookup
 mapping 가 .

Test .

- P1 P2 482 error .
- P1 Via ACK P2 .
- UA1 P1 482error .
- UA1 P1 ACK .

✓ Record Route(P7)

Test Resord Route Route 가 UA Proxy가 packet

4 Basic Proxy Test

. , P1 Request가 P2 proxying Record Header 가
 . UA2 가 call Record-Route 가 200 OK P1
 UA1 . UA1 ACK ACK Route
 가 P1 UA2 , call
 UA2 BYE가 BYE Route .

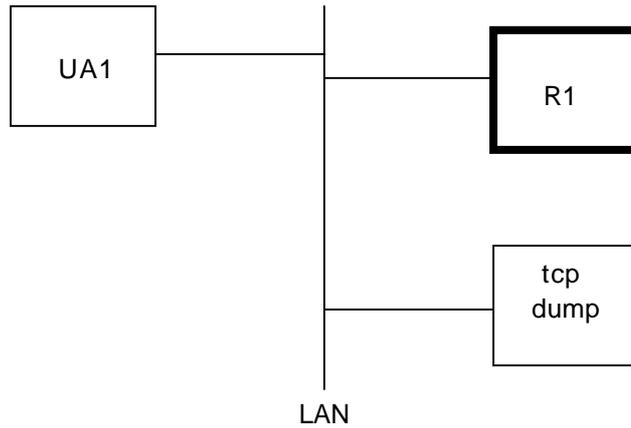
Test .

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
 method tag .
- P1 UA2 proxed INVITE UA1 가 Via UDP
 가 Via 가 .
- P1 UA2 proxed INVITE P1 Requet-URI
 , Record-Route 가 .
- UA 2 200 OK P1 , Record-Route INVITE mirroring
 .
- P1 200 OK UA1 forward .
- UA1 Route ACK P1 . Route 1st
 Address maddr tag P1 IP Address 가
 , Request-URI . , UA2가 200 OK Contact 가
 ACK 2nd Route .
- P1 Top Route UA2 ACK forward .
- Call UA1 BYE , BYE ACK

Route

- P1 Top Route BYE UA2 forward
- UA2 P1 200 OK
- P1 UA1 200 OK

◆ (*)Redirect Server



7 : Redirect Configuration

Test	UA	Redirect	Interoperability
,	7	UA(UA1)	redirect

✓ Basic Redirection(RED1)

Test	UA1	R1	Address X	Y1	Y2	2	address mapping
INVITE	R1	Request URI	To				address X 가
300 class	UA1	Redirect				R1	Registration
Static Configuration		Mapping					가

Test

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE method tag
- R1 To, Call-ID, CSeq, Via, From mirroring 300 , To tag 가
- 300 class Y1 Y2 Contact
- UA1 R1 ACK , Retransmission

✓ Advanced Redirection(RED2)



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Test R1 non-SIP URL , http URL redirect ,
 Redirect 가 Redirect non-SIP URL Test가 가
 UA URL SIP URL

Test

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
method tag
- R1 To, Call-ID, CSeq, Via, From mirroring 300
, To tag 가
- 300 class http URL Contact
- UA1 R1 ACK , Retransmission

SIP URL Browser http URL 가 가

✓ Redirection with Bodies(RED3)

Test Redirect 가 Contact Body
 Redirection , Body User display Text
 UA Body 가 Redirection

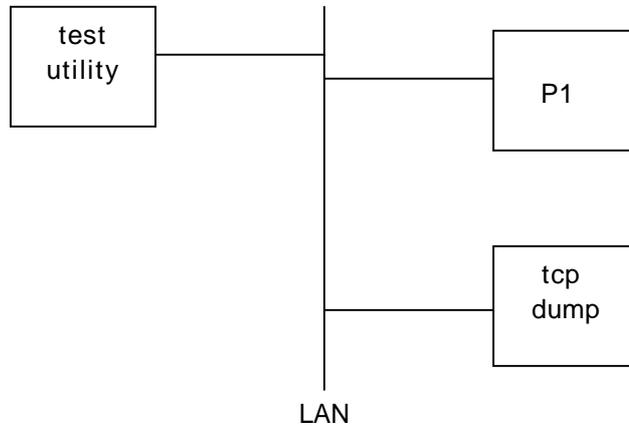
Redirection

Test

- UA1 INVITE Call-ID, To, Via, From, CSeq INVITE
method tag
- R1 To, Call-ID, CSeq, Via, From mirroring 300
, To tag 가
- R1 To, Call-ID, CSeq, Via, From mirroring 300
, To tag 가
- 300 class no Contact
- 300 class Body
- 300class text/plain Content-Type Content-Length
- UA1 R1 ACK , Retransmission

SIP URL Content Browser 가 가

◆ (*)OPTIONS(OPT1)



8 : Test Instrument Configuration

Test OPTIONS Request Proxy UA가 가
 UA가 OPTION Request
 Testing Tool OPTION Request . Test 8
 test utility가 OPTIONS Proxy P1 To Request URI
 X . Proxy P1 Address X UA2 Address Y
 , P1 OPTIONS UA2 forward . UA2 200 OK P1
 P1 test instrument

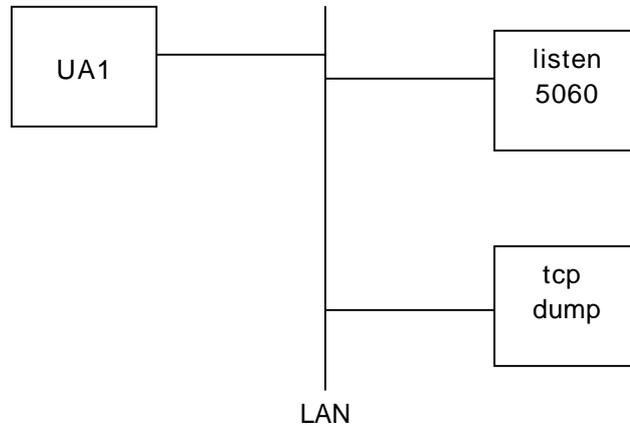
Test

- P1 Via UA2 OPTIONS proxy
- UA2 200 OK
- 200 OK Allow , OPTIONS가 UA2 가
- P1 200 OK test instrument forward

가 UA 가

- UA2 codec SDP가
- UA2 Body Type 가 SDP Body
- UA2 Encoding Type 가 Accept-Encoding
- UA2 Language 가 Accept-Language

◆ (*)UDP Reliability



9 : INVITE Reliability Configuration

UDP Reliability Mechanism

✓ INVITE request Retransmission(REL1)

9 UA가 SIP port(5060) listening test utility
 Address Request ICMP가
 Response UA (exponential back-off)
 Request 500ms 7 2
 가
 Test

- UAC가 INVITE 7
- INVITE request 500ms 2 가
- UAC 7 User error

✓ BYE request Retransmission(REL2)

Test "Client to Client Basic", UA1 UA2 Call
 UA2가 UA2 call
 Test utility UA2가 machine port 5060 listen
 UA1 call, UA2 BYE BYE
 Test

- UA1 UA2 BYE
- BYE 7



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0.1

- Interval 500ms 2 가 4s

✓ INVITE/100 Retransmission(REL3)

Test "Client to Client Basic" , UAC가 provisional
 . UA1 UA2 Call
 , UA2 INVITE provisional
 , UA1 Request

Test

- UA2가 UA1 Provisional
- UA1 provisional Request

✓ INVITE response retransmission(REL4)

Test "Client to Client Basic" , UAS가
 exponential backoff INVITE

Test UA1 UA2 INVITE UA2 provisional
 UA1 UA2 call UA2
 200 OK UA1

Test

- UA2가 200 OK
- 200 OK 7
- Response retransmission 500ms
 2 가

◆ (*)Security

Basic Digest Security Mechanism Interoperability

✓ Basic for REGISTER(SEC1)

Test "Client to Client Basic" , UA(UA1)
 Registration Registrar R1 UA1 R!
 REGISTER , R1 Registration Basic
 Authentication 가 UA1 401 Unauthorized
 , UA1 User Name Password R1
 R1 User 가 200 OK
 , R1 REGISTER Name Password
 가

Test

- UA1 R1 REGISTER



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0.1

- R1 REGISTER 401
- 401 Scheme Basic Realm WWW-Authenticate 가
- UA1 Name Password User Dialog Realm
- UA1 가 CSeq Authorization REGISTER
- R1 REGISTER 200 OK
- ✓ Digest for REGISTER(SEC2)
- Test SEC1 Basic Authentication Digest
- Authentication Test가
- UA1 R1 REGISTER
- R1 REGISTER 401
- 401 Scheme Digest, Realm Nonce WWW-Authenticate
- 가
- UA1 Name Password User Dialog Realm
- UA1 가 CSeq Authorization REGISTER
- R1 REGISTER 200 OK
- ✓ Basic Proxy Authorization for INVITE(SEC3)
- Test Basic Proxy Authorization Interoperability
- , Proxy(P1) , UA1 P1 INVITE
- P1 Proxy Authorization , 407 Proxy Authorization Required
- UA1 UA1 User Name Password R1
- . INVITE Request P1 UA2 proxy .
- Test P1 UA1 Name Password
- Proxied Request Basic Authentication
- Test가
- UA1 P1 INVITE
- P1 4017 UA1
- 407 Scheme Basic Realm Proxy-Authenticate 가
- UA1 Name Password User Dialog Realm



User

- UA1 가 CSeq Proxy-Authorization (Basic) INVITE
P1
- P1 INVITE UA2 Proxy
- UA2 call P1 200 OK
- P1 200 OK UA1 proxy
- UA1 ACK

✓ Digest Proxy Authorization for INVITE(SEC4)

Test Digest Proxy Authorization Interoperability

, Proxy(P1) , UA1 P1 INVITE

P1 Proxy Authorization , 407 Proxy Authorization Required

UA1 UA1 User Name Password R1

. INVITE Request P1 UA2 proxy

Test P1 UA1 Name Password

Proxied Request Digest Authentication

Test가

- UA1 P1 INVITE
- P1 407 UA1
- 407 Scheme Digest, Realm Nonce Proxy-Authenticate
가
- UA1 Name Password User Dialog Realm
User
- UA1 가 CSeq Proxy-Authorization (Digest) INVITE
P1
- P1 INVITE UA2 Proxy
- UA2 call P1 200 OK
- P1 200 OK UA1 proxy
- UA1 ACK

◆ DTMF

◆ RTP(RTCP) Media

◆ ENUM

✓ Gateway ENUM Functionality(PSTN -> IP)

✓ Clent ENUM Fuctionality(IP -> PSTN)

◆ IM(Instant Message) & Presence



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0.1

- ✓ MESSAGE
- ✓ REGISTER
- ✓ SUBSCRIBE
- ✓ NOTIFY
- ✓ REFER

: (*) Interoperability Testing for SIP(June,1999, Rosenberg/Schulzrinne)

4.2 SIP-H.323 Interworking Interoperability Test

- ◆ H.323 SIP Call
 - ✓ Fast Start H.323 origination to SIP
 - ✓ Non-Fast Start H.323 origination to SIP
- ◆ SIP H.323 Call
 - ✓ SIP origination to Fast Start H.323
 - ✓ SIP origination to Non-Fast Start H.323
- ◆ Media(RTP, DTMF)
 - ✓ Full Duplex Audio(Codec) end-to-end between H.323 Terminal and SIP UA
During steady state call
 - ✓ In-band DTMF from H.323 Terminal to SIP UA during steady state call
 - ✓ Out of-band DTMF from H.323 Terminal to SIP UA during steady state call
 - ✓ In-band DTMF from SIP UA to H.323 Terminal during steady state call
 - ✓ Out of-band DTMF from SIP UA to H.323 Terminal during steady state call
- ◆ T.38 FAX
- ◆ Call Clearing(Teardown)
 - ✓ SIP Initiated Disconnect after steady state call
 - ✓ H.323 Initiated Disconnect after steady state call