

Use Cases

Assumptions:

1. The load on Gateway is measured in terms of High and Low watermarks which is configurable. For example let's say High and Low values are 90% and 70% (Measured in terms of ports available). What this means is that when load goes above 90%, the Gateway would be considered loaded till the percentage drops below 70%. If the load drops below 70%, gateway would be available again till it goes up to 90%. An LS would receive periodic update from local gateway, however the route information will only be propagated to outside or in the TRIB at these watermarks.
2. The Trip Information Base (TRIB) is maintained in a flat file by LS. RS registers for update notifications on the file with LS. Whenever the file is changed LS notifies RS for update and RS reloads its route cache in memory.
3. The routes are advertised based on the general policy that it is available to every external ITADs. However, in future that could be policies embedded in LS which can dictate which routes need to be advertised to the external ITAD. From the subscriber point of view, the route given is always the best possible least cost route and no preference is given based on the source of the call (Again policies can be implemented in the RS to pick one route over the other).
4. Each Peer LS would be assigned an INET_Marshal group that would serve to calls from that ITAD. Let's say ITAD1 has an inet marshal group IMG1 that serves ITAD2 and has two marshals IMS1 and IMS2 in it. LS1 in ITAD1 would advertise all marshal in that group to LS2 in ITAD2.

(1, SIP, NUMBER, ITAD1, IMS1:5060)

(1, SIP, NUMBER, ITAD1, IMS2:5060)

Any advertisement coming from LS2 with its inet marshal IMS3, will be processed by LS1 and would be kept in the form

(1, SIP, NUMBER, ITAD2, IMG1, IMS3:5060) which then can be translated into RS dial plan as

sip:NUMBER { \$USER@IMS1:5060, @USER@IMS2:5060 } , {
\$USER@IMS3:5060 }.

If LS1 receives a route from LS2 it would process it and create a route with the Marshal group prepended to it to achieve redundancy.

5. LS in a domain would heart-beat INET marshals, so that they know if an INET marshal goes down. If an LS in the domain has advertised the routes using that INET marshal, it will send a TRIP update to remove that route.

Use Cases:

Use Cases are based on the following architecture:

1. LS knows through provisioning knows all the INET marshals in the system and their type. INET marshals either support OSP or not support at all. It would be safe assumption that if an ITAD is advertising its path, that path is trusted and don't have to use Policy for using that path.
2. The LS in an ITAD, through static configuration knows all other LS in other ITAD that it needs to talk to. If ITAD happens to be a ClearingHouse (CH), it advertise the path with a policy enabled INET marshal.
3. The TRIB contains three distinct parts which is a logical organization of the route information received by LS.
 - a) Adj-TRIBS-In - The unprocessed routes received from external LS as well as internal LS. The routes are stored in association of peering LS (A map of peer LS and its advertised routes).
 - b) Ext-TRIB - LS runs route selection algorithm on all the routes in Adj-TRIB-In, selects best route for given destination and stores in Ext-TRIB.
 - c) Loc-TRIB - Local routes that TRIP has selected by applying policies on local routes in Adj-TRIB-In and Ext-TRIB.
 - d) Adj-TRIB-out - All the routes in Loc-TRIB that LS has selected to be advertised outside.

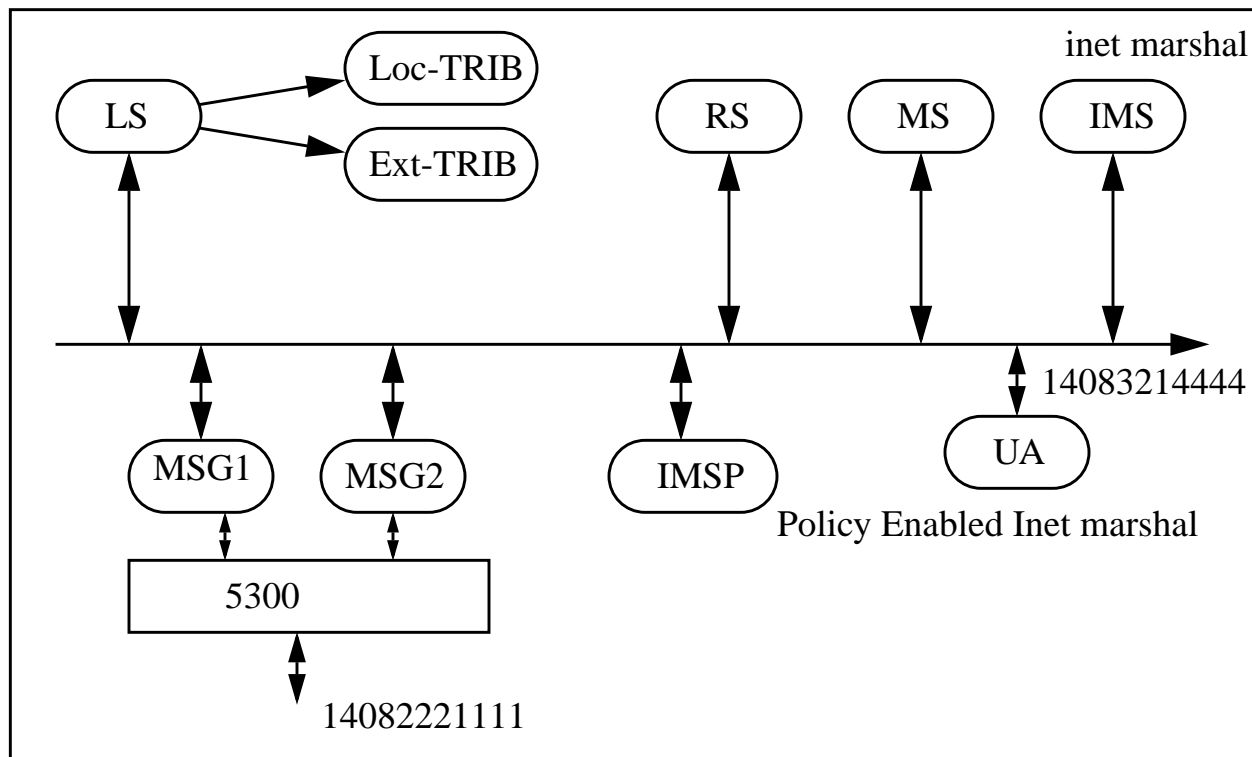


Fig 1.0

Use Case 1:

ITAD1 has its own gateway and gateway marshal, making outgoing PSTN call to number 1408-222-1111 from internal number 14083214444.(Fig 1.0)

Actors: UA, MS(SipMarshal), MSG(Gateway marshal), 5300, RS, LS.

Pre-conditions:

- 5300 (using TRIP) advertised route information to LS.Route in Adj-TRIB-In
 (1, SIP, 1408222*, ITAD1, MSG1:5060)
 (1, SIP, 1408222*, ITAD1, MSG2:5060)
 - LS process the route using route selection and local policy and put the route in loc-TRIB
 (1, SIP, 1408222*, ITAD1, MSG1:5060)
 (1, SIP, 1408222*, ITAD1, MSG2:5060)
- Since there is no other route to 1408222* the Ext-trib would also have
 (1, SIP, 1408222*, ITAD1, MSG1:5060)

3. LS also decides that this route has to be advertised and using information it has about the INET marshal (non-policy, since it is advertising to a trusted ITAD) creates a route in Adj-TRIB-out

(1, SIP, 1408222*, ITAD1, IMS:5060)

4. LS then advertise all the routes in Adj-TRIB-Out.

5. RS would load the loc-TRIB and Ext-TRIB in its cache and would have this routing information. The route in RS would look like

`^sip:1408222* { $USER@MSG:5060, $USER@MSG2:5060 }`

Note: *It is proposed that the contact list in RS be multi-dimensional separated by {} called a group. so contact list may look like*

`^sip:408222* { server1, server2 }, { server3, server 4 }`

Where first entry represent first contact, second represent second contact and so on. Servers within contact group provide the redundancy.

6. MSG1 and MSG2 has been provisioned to know peer sip-5300.

Post-conditions: The call completes to PSTN number 1408-222-1111.

Action:

1. UA dials 1-408-222-1111.

2. MS receives request and sends INVITE to RS.

3. RS looks up at the Request URI field, checks if local subscriber, if not checks the routing cache.

4. RS finds the entry in routing cache and finds the contact MSG1:5060 and MSG2:5060.

5. RS checks if MSG1 and MSG2 are provisioned in the system and is alive. If first server in the contact list is not alive pick the other and so on. RS would also check the load and cost matrix for each route, gives the one which is NOT loaded (See assumptions)

6. RS sends 302 to MS with next contact as MSG1:5060.

7. MS sends INVITE to MSG1:5060.

8. MSG1, which is provisioned to have sip-5300) will then send INVITE to sip-5300 which would complete the call.

Exception:

1. In step 5 if RS is not able to find any suitable route, it will send 401 back to the MS and call would end.

Use Case 2:

ITAD has its own gateway and gateway marshal, receiving Incoming PSTN call from number 1408-222-1111 to internal number 1408-321-4444.

Actors: UA, MS(SipMarshal), MSG(Gateway marshal), 5300, RS, LS.

Pre-conditions: 5300 is configured to know its peer Marshal.

Post-conditions: The call completes to internal number 14083214444 from PSTN number 1408-222-1111.

Action:

1. sip-5300 receives the INVITE.
2. sip-5300 sends INVITE to MSG1 or MSG2, based on which is alive
3. MSG1 sends INVITE to RS.
4. RS checks Request URI, checks to see if user is in the subscriber database, if found sends the contact MS to MSG1.
5. MSG1 sends INVITE to MS which then completes the call.

Exception:

1. In step 2 if both MSG1 and MSG2 are dead, the call would terminate.
2. In step 4, if MS is not alive, RS sends 5XX to MSG1 and call terminates.

Use Case 3:

ITAD1 only has softswitch which uses PSTN gateways from ITAD2, making outgoing PSTN call to number 1408-222-1111 from internal number 14083831212. Fig 1.1.

Actors: UA, MS(SipMarshal), MSG(Gateway marshal), 5300, RS, LS, IMS(INET Marshal).

Pre-conditions:

1. 5300 (using TRIP) advertised route information to LS2.Route in Adj-TRIB-In
 (1, SIP, 1408222*, ITAD2, MSG1:5060)
 (1, SIP, 1408222*, ITAD2, MSG2:5060)
2. LS2 process the route using route selection and local policy and put the route in loc-TRIB
 (1, SIP, 1408222*, ITAD2, MSG1:5060)
 (1, SIP, 1408222*, ITAD2, MSG2:5060)
 Since there is no other route to 1408222* the Ext-trib would also have
 (1, SIP, 1408222*, ITAD2, MSG1:5060)
 (1, SIP, 1408222*, ITAD2, MSG2:5060)
3. LS2 also decides that this route has to be advertised and using information it has about the INET marshal IMS2 creates a route in Adj-TRIB-out
 (1, SIP, 1408222*, ITAD2, IMS2:5060)
 (1, SIP, 1408321*, ITAD2, IMS2:5060)
4. LS2 then advertise all the routes in Adj-TRIB-Out to LS1.
5. RS2 would load the loc-TRIB in its cache and would have this routing information. The route in RS would look like
 ^sip:1408222* { \$USER@MSG1:5060, \$USER@MSG2:5060 }
6. LS1 receives the route information from LS and puts it in Adj_TRIB-In.
 (1, SIP, 1408222*, ITAD2, IMS2:5060)
 (1, SIP, 1408321*, ITAD2, IMS2:5060)
7. LS1 processes the route and puts it in loc-TRIB.
 (1, SIP, 1408222*, ITAD2, IMS_GROUP)
 (1, SIP, 1408321*, ITAD2, IMS_GROUP)
8. LS1 would also put routes in Ext-TRIB
 (1, SIP, 1408222*, ITAD2, IMS2:5060)
 (1, SIP, 1408321*, ITAD2, IMS2:5060)
9. RS1 loads the route cache from loc-TRIB and creates a dial-plan
 ^sip:1408222* { \$USER@IMS1:5060 }
 ^sip:1408321* { \$USER@IMS1:5060 }

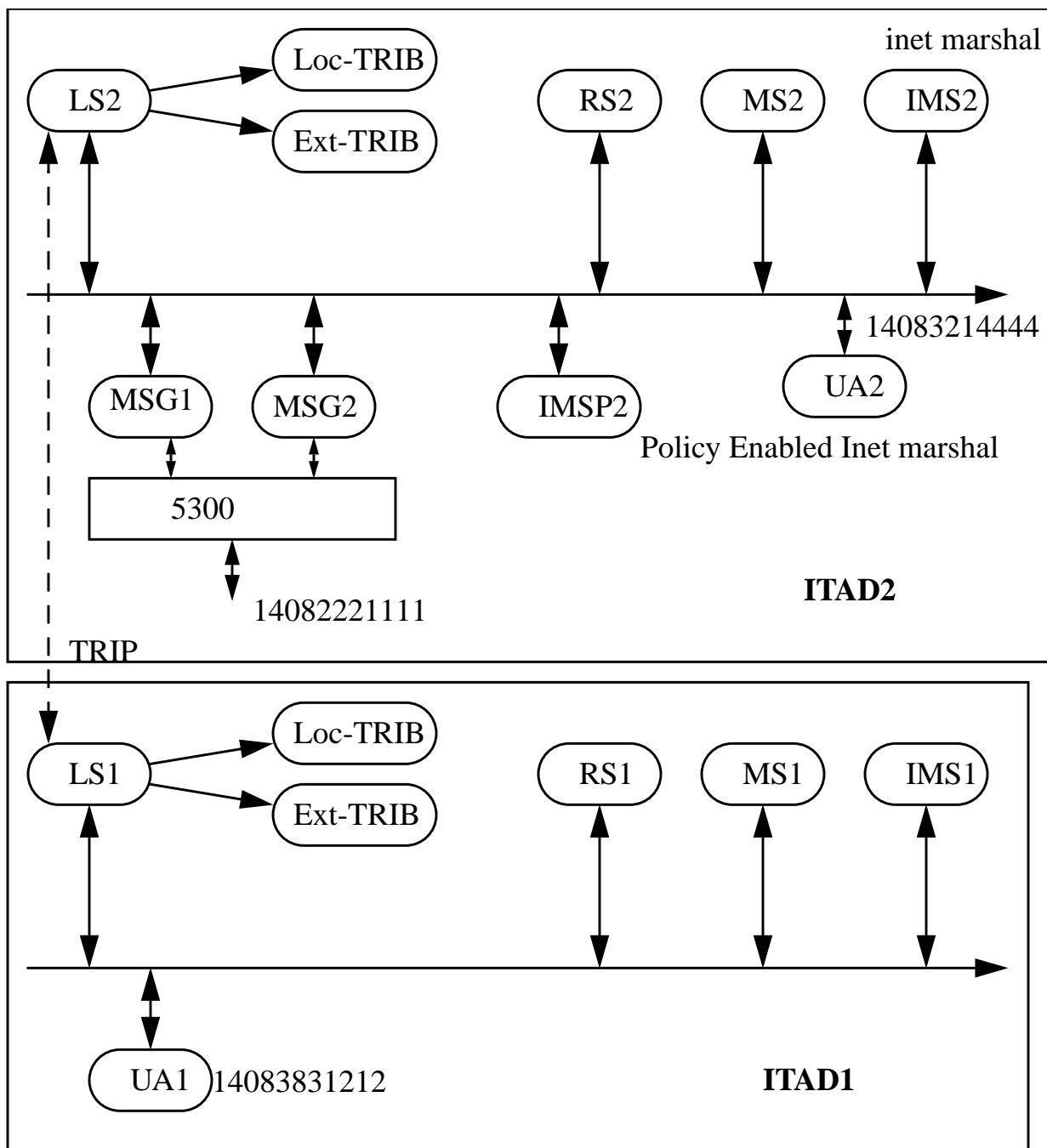


Fig 1.1

Post-conditions: The call completes to PSTN number 1408-222-1111.

Action:

1. UA1 dials 1-408-222-1111.

2. MS1 receives request and sends INVITE to RS1.
3. RS1 looks up at the Request URI field, checks if local subscriber, if not checks the routing cache.
4. RS1 finds the entry in routing cache and finds the contact IMS1:5060.
5. RS1 sends 302 to MS1 with contact as IMS1:5060.
6. MS1 sends INVITE to IMS1.
7. IMS1, which has Ext-TRIB loaded in its cache, looks up the route and finds IMS2:5060 as the next contact and sends INVITE to IMS2.
8. IMS2 contacts RS2.
9. RS2 looks up Request URI, checks subscriber database, does not find it and looks up in the route cache finds MSG2 and MSG3
10. RS2 checks if MSG1 and MSG2 is alive. Sends 302 to IMS2 with contact as MSG1:5060 and MSG2:5060.
11. IMS2 then can choose to send INVITE to MSG1:5060 or MSG2:5060.
8. MSG1/2, which is provisioned to have (sip-5300) will then send INVITE to sip-5300 which would complete the call.

Exception:

1. In step 4 if RS1 is not able to find any suitable route, it will send error back to the MS1 and call would end.
2. In Step 9, if RS2 does not find a alive contact, it will send error back to IMS2 and call will end.

Use Case 4:

ITAD1 only has softswitch making outgoing INET call to number 1408-321-1111 in ITAD2 from internal number 14083831212.

Actors: UA, MS(SipMarshal), IMS(Inet marshal), RS, LS.

Pre-conditions: Similar to use case 3.

Post-conditions: The call completes to INET number 14083214444 in ITAD2.

Action:

1. UA1 dials 1-408-321-4444.
2. MS1 receives request and sends INVITE to RS1.

3. RS1 looks up at the Request URI field, checks if local subscriber, does not find the user in subscriber database and checks the routing cache.
4. RS1 finds the contact as IMS1:5060 in routing cache.
5. RS1 sends 302 to MS1 with contact as IMS1:5060.
6. MS1 sends INVITE to IMS1.
7. IMS1 , which has Ext-TRIB loaded in its cache, looks up the route and finds IMS2:5060 as the next contact and sends INVITE to IMS2.
8. IMS2 contacts RS2.
9. RS2 looks up Request URI, checks subscriber database, finds the user in subscriber database and get the contact as MS2.
10. RS2 checks if MS2 is alive. Sends 302 to IMS2 with contact as MS2:5060.
11. IMS2 sends INVITE to MS2:5060.
12. MS2 then completes the call.

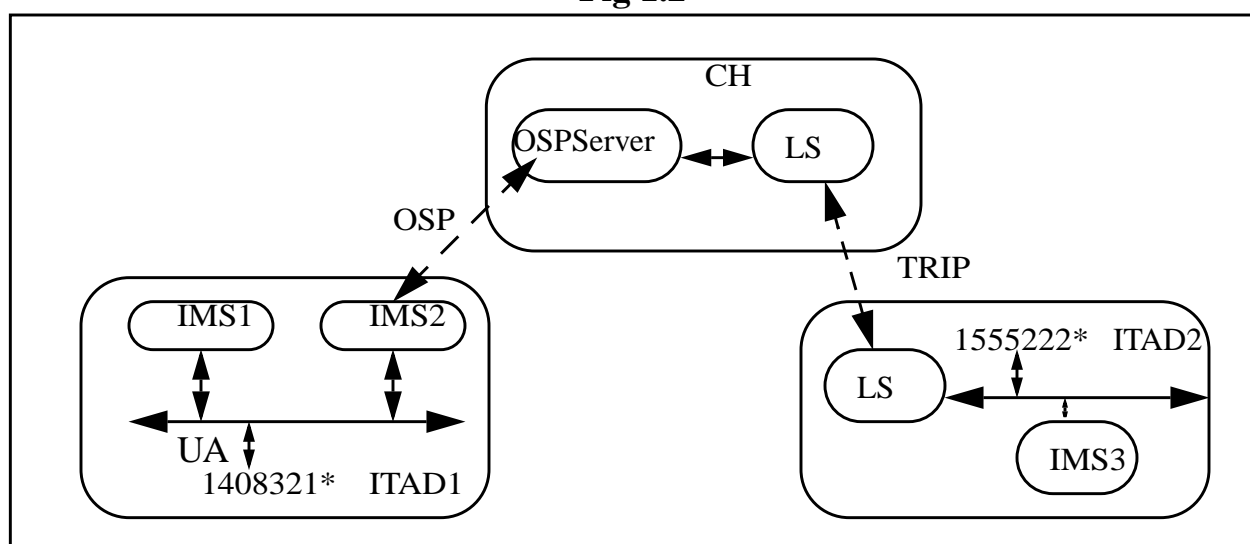
Exception:

1. In step 4 if RS1 is not able to find any suitable route, it will send error back to the MS1 and call would end.
2. In Step 9, 10, if RS2 does not find a alive contact , it will send error back to IMS2 and call will end.

Use Case 5:

ITAD1 only has softswitch making outgoing INET call to number 1555-222-1111 in ITAD2 from internal number 14083214444 with routing information provided by clearinghouse (CH). Fig 1.2

Fig 1.2



Actors: UA, MS(SipMarshal), IMS(Inet marshal), RS, LS, CH.

Pre-conditions:

1 ITAD1 has two INET marshals(IMS1 and IMS2) can terminate calls to 1408321* numbers.

2.ITAD2 has one INET marshal IMS3 an can terminate calls to numbers 1555222*.

3. ITAD2 is member of clearing house and advertise following route to CH.

(1, SIP, 1555222*, ITAD2, IMS3:5060)

4.RS has IP plan for number 1515 provisioned in the system.

`^sip:1555* { $USER@IMS1:5060;user=ip, $USER@IMS2:5060;user=ip }`

Post-conditions:The call completes to INET number 1555-222-1111 in ITAD2.

Action:

1.UA dials 1-555-222-1111.

2.MS receives request and sends INVITE to RS.

3.RS looks up at the Request URI, checks if local subscriber, if not checks the IP plan.

4.RS finds the entry in IP plan and finds the contact IMS1:5060 and IMS2:5060.

5.RS checks if IMS1 or IMS2 is alive.If the first contact is not alive, second server from the contact list is picked and so on.

6.IMS1 is alive, RS sends 302 to MS1 with next contact as IMS1:5060.

7. MS1 sends INVITE to IMS1:5060.

8.IMS1 does the authentication using CH.

9, CH authenticates the call, sends the token back along with the next contact IMS3:5060 to IMS1.

10.IMS1 embeds the token in INVITE and sends INVITE to IMS3:5060.

9. IMS3 in ITAD2 does token validation and then uses local signaling to reach to 15552221111.

Exception:

1.In step 4 if RS is not able to find any entry in IP plan, it will send error back to the MS and call would end.

2. In step 5 if RS is not able to find any live server in the contact list, it will send errorback and call will end.

These set of use cases are mainly for SIP->MGCP and SIP->H.323. Since both of them have similarities in terms of signalling, I am taking the case of SIP-MGCP. The use cases can also be applied to sip->H.323.

Use Case 6:

ITAD1 only has softswitch making outgoing INET call to number 1555-222-1111 in ITAD1 from internal number 1556-222-4444. Number 1555-222-1111 is terminated at the MGCP gateway. Fig 1.3

Actors: UA, MS(SipMarshal), RS, LS, MGCP gateway, Call Agent(CA)

Pre-conditions:

1. LS1 queries the list of subscribers from the provisioning and for each user creates a route entry. LS1 aggregates the routes and create a single route entry for range of provisioned users in Ext-TRIB and Adj-TRIB-OUT.

(1, SIP, 1555222*, ITAD1, IMS1:5060).

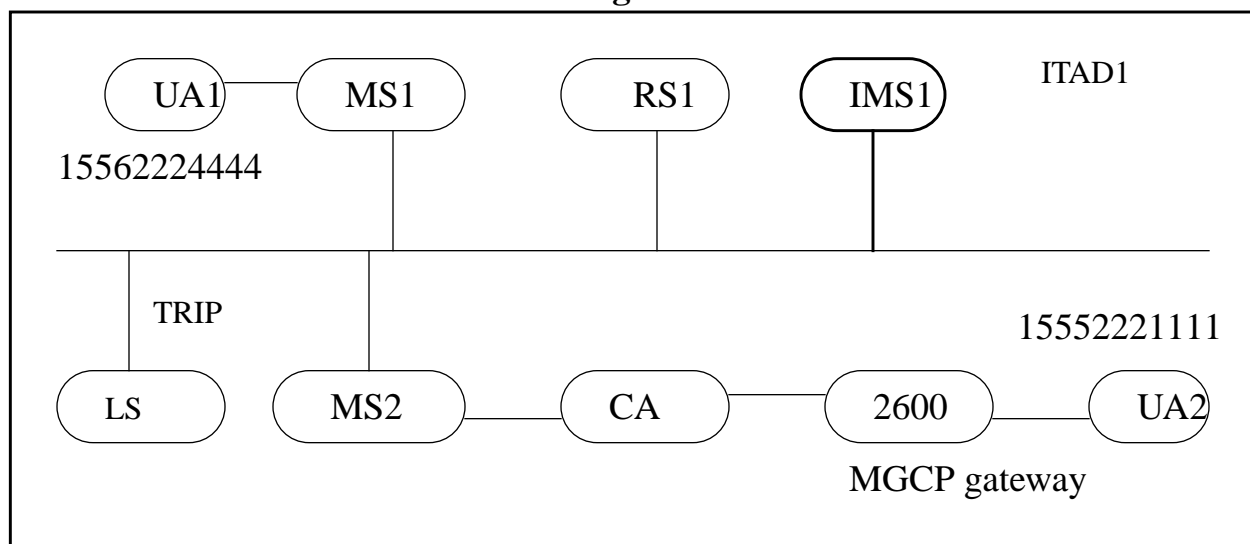
No entry in the loc-TRIB.

2. LS1 advertise the route to external LSs.

3. RS dial plan is not affected.

Post-conditions: The call completes to INET number 1555-222-1111.

Fig 1.3



Action:

1. UA1 dials 1-555-222-1111.

2. MS1 receives request and sends INVITE to RS1.

- 3.RS1 looks up at the Request URI, checks if user is provisioned.Finds the user and contact MS2:5060.
- 4.RS1 sends 302 to MS1 with contact MS2:5060.
- 5.MS1 sends invite to MS2.MS2 through provisioning knows the address of CA and sends invite to CA.
- 6.CA then completes the call to 15552221111.

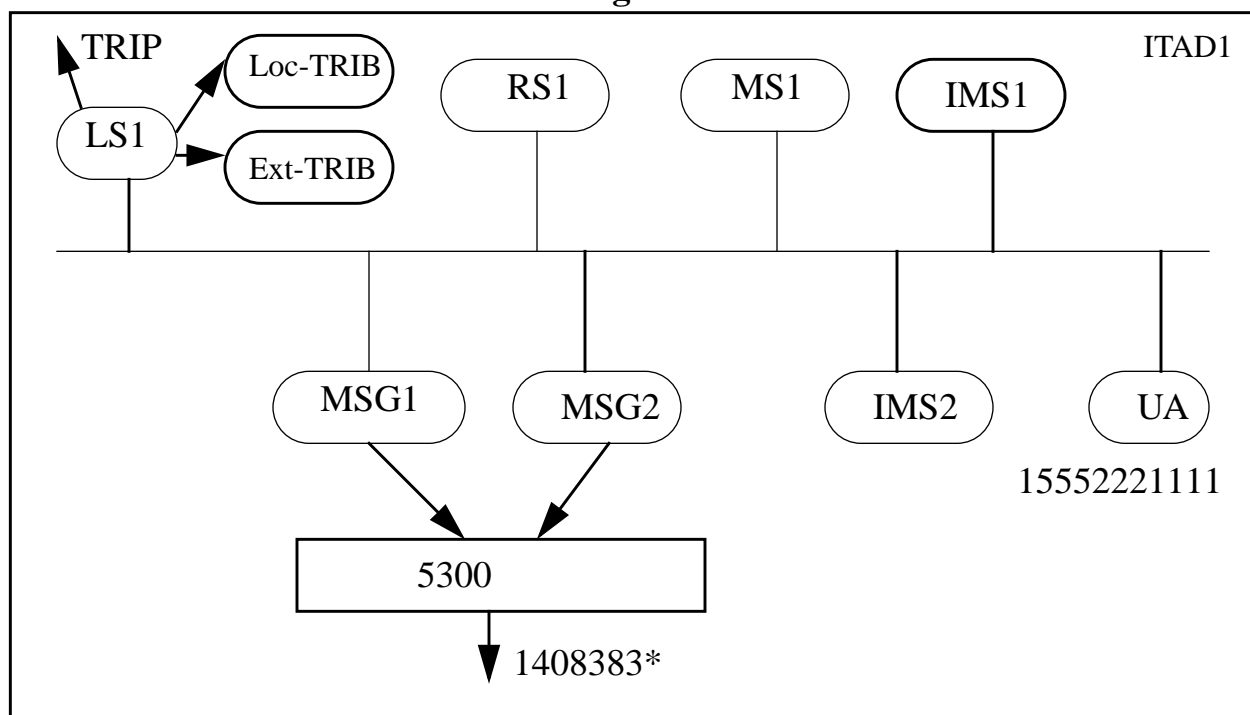
Exception:

1. In step 3, id RS1 does not find subscriber , sends error back to MS1 and call ends.

Use Case 7:

ITAD1 is a softswitch with PSTN gateways termination calls on 1408383*. It also advertise the routes to external LS using redundant INET marshals.The use case describes the events that would take place when routes are changed dynamically.fig 1.4

Fig 1.4



Actors: UA, MS(SipMarshal), RS, LS, IMS(Internet Marshal), 5300, MSG(Gateway marshal)

Pre-conditions:

1. 5300 (using TRIP) advertised route information to LS1.Route in Adj-TRIB-In
 (1, SIP, 1408222*, ITAD1, MSG1:5060)
 (1, SIP, 1408222*, ITAD1, MSG2:5060)
2. LS1 process the route using route selection and local policy and put the route in loc-TRIB
 (1, SIP, 1408222*, ITAD1, MSG1:5060)
 (1, SIP, 1408222*, ITAD1, MSG2:5060)
 Since there is no other route to 1408222* , after doing the best route selection, the Ext-trib would also have
 (1, SIP, 1408222*, ITAD1, MSG1:5060)
 (1, SIP, 1408222*, ITAD1, MSG2:5060)
3. LS1 also decides that this route has to be advertised and using information it has about the INET marshal IMS1 and IMS2.Creates a route in Adj-TRIB-out
 (1, SIP, 1408222*, ITAD1, IMS1:5060)
 (1, SIP, 1408222*, ITAD1, IMS2:5060)
4. LS1 then advertise all the routes in Adj-TRIB-Out to external LSs.
5. RS1 would load the loc-TRIB in its cache and would have this routing information.The route in RS would look like
 ^sip:1408222* { \$USER@MSG1:5060, \$USER@MSG2:5060 }

Post-conditions:The routes are updated dynamically and advertised.

Action:

- 1.MSG1 marshal goes down.
- 2.RS1 would detect it via heart-beat and remove it from its contact list for any incoming/outgoing call.RS dial plan would change to
 ^sip:1408222* { \$USER@MSG2:5060 }
- 3.Since route advertised does not depend on MSG1, no advertisement would be sent out to external LSs.
- 4.IMS1 went down.
- 5.LS1 would detect IMS1 failure through heart-beat mechanism.
6. LS1 would go through the routes in Adj-TRIB-out, finds the route using IMS1.
7. LS1 removes the route from Adj-TRIB-out and sends UPDATE message to external LSs to withdraw the route.

Exception: