

# INVENTION DISCLOSURE

## 1. Invention Title.

### Methods for link selection and load balancing in SIP based architectures

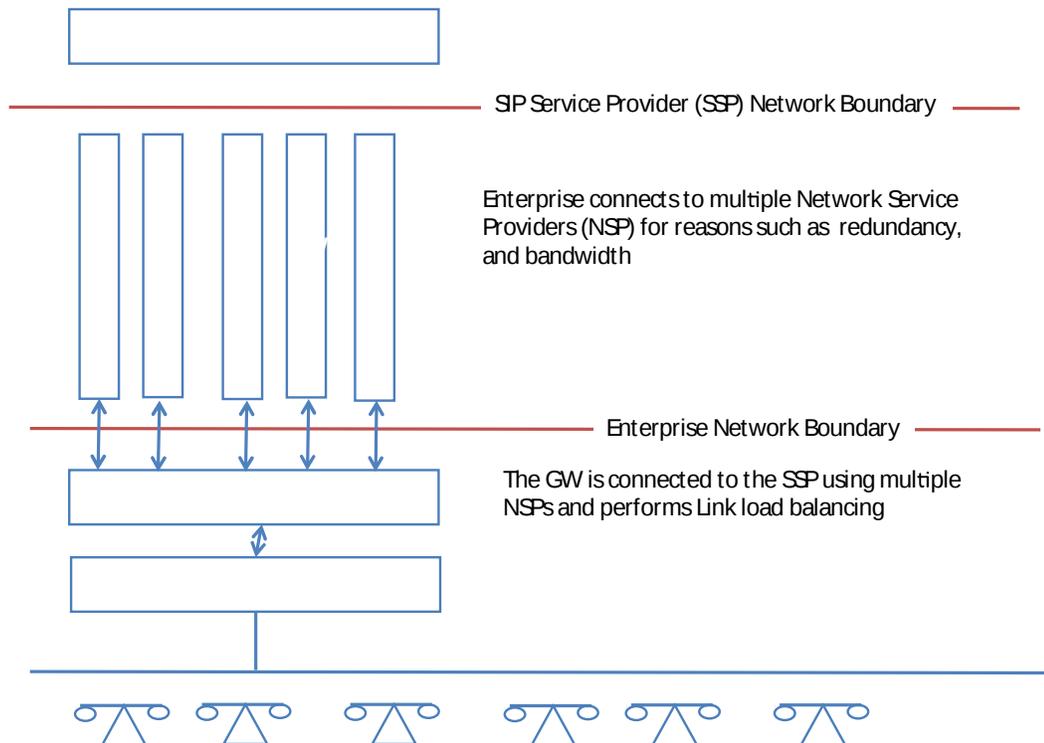
## 2. Invention Summary.

This invention disclosure provides a number of methods a SIP GW can use for link selection and load balancing in a SIP based architecture.

## 3. Invention Description.

### Background:

With the proliferation of wide variety of cheap and ubiquitous access network options, many customers (residential and commercial) are opting to buy connectivity from multiple network service providers (aka ISPs). This choice on customer part provides benefits such as redundancy, resiliency, cost savings etc. The diagram below provides an example where a commercial customer buys network connectivity from multiple network service providers to connect to the SIP Service Provider.



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## What we are disclosing:

1. The GW (e.g. ESG) creates and sends a registration request to the SSP on behalf of the PBX. The GW includes multiple (subset or all the IP addresses that were assigned to it by the NSPs) in the registration message (e.g. Contact header) to let the SSP know that the SIP PBX can reach the SSP or reached by the SSP using any of these IP addresses. This procedure shall allow the SSP to send SIP signaling messages to any of these IP addresses. The SSP network can deploy any algorithm to choose a destination IP address to contact the enterprise.
2. Additionally, the ESG sends multiple registration messages where each registration message is sourced from a different IP address (the ESG can chose a subset or all IP addresses that were assigned to it by the NSPs). This procedure allows the GW (ESG) to communicate with the SSP by sourcing the SIP signaling messages from any of these IP addresses.
3. The GW for the each outgoing (DOD) and Incoming (DID) call chooses a source IP address for media (essentially a NSP link) after taking into consideration the following:
  - **Claim#1:** Current utilization of a link
  - **Claim#2:** Available and provisioned bandwidth on each link
  - **Claim#3:** QoS characteristics (Delay, jitter, etc.) of each link
  - **Claim#4:** Cost of each link (e.g. is the NSP paid for each bit sent and received or is the NSP paid based a lump sum amount each month)
  - **Claim#5:** Level of integration between NSP and SSP (e.g. prefer an NSP with higher level of integration with SSP)
  - **Claim#6:** Results of Voice data and signaling measurements done for the previous user and test calls (e.g. better the results the more likely it should be for the GW to choose the link)
  - **Claim#7:** The GW checks for the presence of Carrier Grade NAT between the GW and SSP, and if the CGN is present the GW should avoid use of that link for voice calls.
  - **Claim#8:** The GW checks the type of IP address and interface (e.g. GULA IPv6, ULA IPv6, Private IPv4, DS-Lite, 6RD etc.) assigned by the NSP to decide which interface to use for outgoing calls. The GW should allow an enterprise to configure the priority order in which the addresses/NSP be chosen in case the NSPs are using different type of addresses.
  - **Claim#9:** For Video and Voice over IP (VVoIP) calls, the GW selects a different links for voice and video portion of the call based on the knowledge it has about characteristics of each link since some networks are more suited for voice vs. video traffic.
  - **Claim#10:** Choose a link (local IP address) based on the remote endpoint media IP address. The GW can choose the local IP address for media based on its knowledge about the remote IP address. The administrative and physical distance between the GW and remote IP address can be different based on the link (e.g. local IP address) it chooses.

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- **Claim#11:** The GW may choose different link based on the audio or video codecs offered by the remote end point.
- **Claim#12:** The GW chooses different local IP address based on the local parameters (e.g. Time of day)
- **Claim#13:** The GW takes into consideration the number of DOCSIS Service Flow and number of grants per Service Flow that are supported by the Cable Modem in deciding what should be the local IP address for media.
- **Claim#14:** The GW should consider the VoIP feature being executed while selecting the Local IP address for media.
- **Claim#15:** The GW chooses different link for different types of calls. Such as
  - **Claim#15.1:** The GW chooses the highest and most reliable link for the Emergency calls.
  - **Claim#15.2:** For the emergency calls, the GW chooses the link that provided it with the location at the time of registration (e.g. DHCP)
- **Claim#16:** The GW measures voice quality of an existing call using methods such as RTCP-XR, RTCP, lost packets, and changes the IP address for media to move to a different/better NSP link.
- **Claim#17:** The GW choose the local IP address for media and signaling based on its knowledge of the security (e.g. encryption, authentication) provided by each link
- **Claim#18:** The GW allows the network administrator to make VoIP test calls where the administrator can either chose a particular link or tell the GW to make a test call using each link and provide statistics such as jitter, delay, voice quality and packet loss.

#### 4. **HOW is this invention different from existing products, processes, systems?**

This disclosure provides a new and efficient method for link selection and load balancing for SIP based architectures. This disclosure provides methods for SSP (e.g. MSOs) to use deploy multiple Cable Modems at an enterprise and use them both for SIP services. Deploying more than one Cable Modem allows the operators to offer higher call capacity than it is possible today with just one Cable Modem. This disclosure also allows enterprise to buy network connectivity from multiple network service provider and use any or all the links to connect to SSP.