Testbeds Landscape Team

Assessment and Next Steps, Version 2

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As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

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This report of the ATIS Testbed Landscape Team (TLT) was developed for the Technical and Operations (TOPS) Council, and is subject to change. It should be noted that the use cases described in this document reflect the state of the IP transition as it existed at the time of publication. The Landscape Team acknowledges that, as the evolution to all-IP continues, these use cases may not remain applicable or relevant and new use cases may be introduced.

This report and its recommendations of this Landscape Team represent the consensus view of its members; however, the consensus views expressed herein do not create a requirement or obligation for any ATIS Member Company to purchase or implement any capability or method.   .

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1   Executive Summary

A number of industry organizations have recognized the important role that a testbed could play in understanding how key mechanisms may evolve to support the all-IP transition. The Technology and Operations Council (TOPS) Testbeds Landscape Team (TLT) was organized to evaluate the feasibility of combining multiple single-use testbeds to assist Service Providers (SPs) when preparing their testbed capabilities related to the migration to all-IP. The cost and complexity of establishing single-use testbeds has presented challenges, and identifying and recommending where SPs can combine testbeds that utilize common infrastructure may guide, and hence enable, some SPs to also build a multi-functional testbed capability to assist in their network preparation for the migration to all-IP. To accomplish this, SPs and vendors interested in utilizing a multi-functional testbed approach identified test "use cases" based upon their testing needs and interest. These use cases have been categorized below into the following categories:

- Numbering: mechanisms to support Individual and 1000's-block Number Assignment to identify areas warranting further study.
- Routing: mechanisms that could be used for routing Session Initiation Protocol (SIP) sessions using telephone numbers (TN) and/or aggregate TN constructs as identifiers.
- Provider-to-provider metadata: mechanisms for provisioning, securely exchanging, and validating metadata associated with TNs for a variety of applications including, but not limited to, draft Internet Engineering Task Force (IETF) mechanisms to prevent spoofing of caller-ID.

Building upon the candidate use cases, the TLT analyzed high-level requirements and assessed interest from service providers and vendors to potentially provide personnel, equipment, systems, or prototypes to participate in testing. It is worth noting that although TLT participants have expressed interest, as of yet this effort has been landscape only; there has not been any discussion of detailed configurations or formal commitment to participate in testing.

This report provides an initial assessment and indication of interest by TLT member companies to participate in one or more of the testbed use cases identified in this report. The next step is to develop a formal recommendation for an action plan based on further analysis of potential use case synergies, formal expression of interest in participating in testing and providing the required software, equipment, and personnel for the actual testing. The recommendations would propose a timeline with a focus on the initial tests and identify responsibilities for key deliverables, both in terms of technical primes and project management.

2   Background

As a result of the Federal Communications Commission (FCC) Technology Transitions Order, FCC 11-161[1], an all-day workshop was hosted on March 25, 2014 by the FCC's CTO to facilitate the design and development of a Numbering Testbed. The primary goal of the Numbering Testbed described in the workshop announcement[2] was to "provide common resources to enable research into numbering in an all-IP network, unencumbered by the constraints of the legacy network and technologies and ensuring that there is no disruption to them."

At the workshop, the Commission's CTO indicated his interest was ultimately in the development of a policy-agnostic flexible platform that would integrate numbering lifecycle management functions such as

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[1] Available from the Federal Communications Commission at: < https://apps.fcc.gov/edocs_public/attachmatch/DA-13-1016A1.pdf >.

[2] Available from the Federal Communications Commission at: < https://apps.fcc.gov/edocs_public/attachmatch/DA-14-290A1.pdf >.

resource allocation, porting, and dissemination of routing information for all types of numbers. Such a platform should also facilitate implementation of anti-spoofing solutions for verifying caller identity and thus addressing the growing problem of robocalls and phishing calls. The CTO further expressed interest in the possibility that the platform might be distributed, supporting a federated, competitive model similar to the white space databases.

As participants in the workshop started to consider how to progress this envisioned testbed, the TOPS Council recognized that individual testbeds may focus on just one specific aspect of the IP transition, but duplicate many functions that are common to multiple testbed(s). The ATIS TOPS Council established the TLT to evaluate the feasibility of providing options for SPs when building their all-IP migration testbeds. Multiple, single-use testbeds that focus on one specific aspect of the migration to IP are likely inefficient in that they duplicate common functions. As a result, the use of single-use testbeds by some SPs introduces unnecessary challenges as they prepare for the transition to all-IP.

The TLT was tasked to:

- Evaluate existing testbed activities and proposals.
- Determine if there would be value in combining separate activities into a common testbed support capability.
- Identify use cases that would benefit from a common testbed infrastructure.
- Prepare a report to the TOPS Council recommending next steps.

3 Scope of Effort

The TLT issued an open invitation to industry stakeholders inviting suggestions for testbed use cases. The scope was expanded beyond numbering to include many aspects of the migration to an all-IP environment. Vendors and providers were invited to contribute "use cases" of interest within the following broad categories:

- Numbering use cases.
- Routing use cases.
- Provider to provider specific use cases which include anti-spoofing use cases.

The scope of the use aases solicited by the TLT covered a wide spectrum from "proof-of-concept" to "validating a specific capability" and their inclusion in this report or testbed(s) does not represent industry consensus to implement a new capability or method.

The scope of the testbed(s) was dependent upon the level of support for the practical use cases that lead to the proposed use case text included in this paper since vendor and/or provider infrastructure are required to conduct the testbed(s). Use cases may showcase a particular product or service under development by a vendor or provider and its inclusion in a testbed(s) does not obligate any ATIS member company to purchase or implement any capability or service during or after the testbed(s) activity.

To remain transparent and eliminate any perception of vendor favoritism, there was no limitation to type or scope of use cases and inclusion in this report or testbed(s) is not an acknowledgement for a future purchase or need of a product or service.

Based on the agreement and acceptance of the use cases, high-level test plans were developed that included four phases:

- Phase 1:
  - o High Level System Description of Use Case.
  - o Reference Architecture.
  - o Core Components.
  - o Companies that are interested.
- Phase 2:
  - o Development of High Level Test Plan.

- Phase 3:
    - o Intra/Inter -Carrier tests.
- Phase 4:
    - o Reports.

This document includes the completion of the Phase 1 portion of the test plans. Phase 2 of the test plans will be documented and completed by the companies participating in the Use Cases. Phase 3 will be when the actual tests are conducted and Phase 4 will provide a Report based on the outcome of the trial.

4   Applicability

This report is the result of a voluntary effort by ATIS member companies and reflects the consensus view of those participating. The use case recommendations and testbed(s) specifications are not intended as mandates; participation in this effort does not indicate any obligation or intention by specific members to purchase or implement any capability or method described in this report. Decisions regarding the implementation of, or compliance with, these specifications will appropriately be made by individual companies. Finally, it should be noted that the recommendations and specifications are not intended for use in certifying equipment and/or services.

5   High Level Landscape Use Case Assessment

5.1 Numbering Use Case

5.1.1 Numbering Use Case 1 – Just-In-Time (JIT)/ Internal Transaction Number (ITN) Assignment for Individual TN & Block Allocation

Description: Explore allocation of numbering resources on a just-in-time, per customer basis within the framework of a converged platform for numbering lifecycle management

Registry: The registry would enforce numbering resource policies and provide utilization reports for regulatory authorities. The key question is whether there will be a single applications programming interface (API) that everyone can test against, or independent implementations of the API for the registry. In any case, this test is likely to involve prototype equipment rather than production equipment.

Service Providers/Vendors: Provisioning systems would be used to query the registry for availability of numbers and to provision information for a number once it has been assigned.

Indication of Interest: AT&T, CenturyLink, Comcast, iconectiv, JSI, Neustar, and Sprint.

5.2 Routing Use Cases

5.2.1 Routing Use Case 1 – Name Server (NS) Records

Description: Demonstrate the ability to enable end to end IP connectivity with the provisioning and distribution of name server (NS) records.

Registry Vendors: Provide industry database for the provisioning and distribution of NS records. Registry provider would need to provide graphical user interface (GUI) for provisioning and standard interface for downloading NS records.

Service Providers: It is anticipated that service providers would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing databases (DBs), route servers, enumerated type (ENUM) servers, ingress and egress session border controllers (SBCs). SPs would also provide an interface to local DB (routing server) for receiving NS records via testbed registry.

Indication of Interest: AT&T, CenturyLink, iconectiv, and Neustar.

5.2.2   Routing Use Case 2 – Uniform Resource Identifiers (URIs)

Description: Demonstrate the ability to enable end-to-end IP connectivity with provisioning and distribution of uniform resource identifiers (URIs).

Registry Vendors: Provide an industry database for the provisioning and distribution of URIs. Registry vendor would need to provide GUI for provisioning and standard interface for downloading URIs. If available the registry vendor could also provide an interface (SIP/ENUM) to enable call-by-call query to retrieve URI.

Service Providers: It is anticipated that SPs would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing DBs, route servers, ENUM servers, ingress and egress SBCs. SPs would also provide interface to local DB (routing server) for receiving URI via testbed registry.

Indication of Interest: AT&T, CenturyLink, iconectiv, and Neustar.

5.2.3   Routing Use Case 3 – Distributed Service Bureau

Description: A distributed service bureau is based on the premise that a per-TN registry of routing references is hosted in a distributed fashion among various entities in the public switched telephone network (PSTN). These can include:
- Telephony service providers/carriers.
- Transit providers.
- Service bureau providers on the behalf of the above.

Service Providers/Transit Providers/Service Bureau Providers: Provide hosting and source code implementation of a distributed registry that can be hosted in a service provider or service bureau provider network.

Service Providers/Vendors: It is anticipated that service providers would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing DBs, route servers, ENUM servers, ingress and egress SBCs. SPs would also provide an interface to local DB (routing server) for receiving URIs via testbed registry.

Indication of Interest: AT&T, CenturyLink, Comcast, Inteliquent, iconectiv, and Neustar.

5.2.4 Routing Use Case 4 – 800

Description: Demonstrate potential evolution of toll-free routing leveraging the capabilities of internet protocols.

800 Data Base Vendors: Enables the existing Toll-Free Number Administration System (SMS/800 Registry) to allow the industry to continue to leverage existing connectivity and provisioning processes while enabling toll-free routing in an IP environment.

Service Providers: SPs would administer IP endpoint and IP network call routing data via the GUI or API to the SMS/800 Registry. It is anticipated that SPs would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing DBs, route servers, ingress and egress SBCs, and toll-free application servers. SPs would also provide an interface to local DB (routing server) for receiving NS records via registry database.

Indication of Interest: AT&T and SMS/800.

5.2.5 Routing Use Case 5 – LERG™ Routing Guide IP Enhancements

Description: This use case would demonstrate proof of concept as well as the ability to enable end-to-end IP connectivity using URIs associated with aggregate TN constructs and fully qualified domain names (FQDNs). These URIs would be associated with an operating company number (OCN), location routing number (LRN), NXX, etc.

Registry Vendors: Would provide LERG™ routing guide files or data for the provisioning and distribution of URI and FQDN records. The registry would need to provide GUI for provisioning and files for downloading.

Service Providers: It is anticipated that SPs would work with vendors to provide IP call routing infrastructure including but not limited to switching, local routing DBs, route servers, ENUM servers, ingress and egress SBCs. SPs would allow acceptance of LERG™ routing guide files or data with IP routing data (URIs and FQDNs) to support routing at the block level.

Indication of Interest: Inteliquent, iconectiv, and Neustar

5.3 Provider to Provider Use Cases

5.3.1 P-to-P Use Case 1 - Exchange of Data Using In-band Mechanisms

Description: Provide test setup and source code implementation that would support provisioning, exchange, and querying of a range of metadata, including an RFC4474bis based data verification service. Common framework should support signed data including:

- Caller-id.

- Caller-id name (CNAM).
- Enhanced CNAM and subscriber metadata.

Distributed Service Bureaus: Certificate provisioning and distribution via distributed service bureau. certificates are provisioned on a per-TN basis by the SP of record, or by a third party authorized by the SP of record, and hosted in a distributed fashion among various entities in the PSTN, for validation by terminating party.

Service Providers/Vendors: The SP manages corresponding private key internally.
The assumption is that each provider has its own secure mechanism for validating the customer is who they say they are, consistent with 4474bis. It is anticipated that SPs would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing DBs, route servers, ENUM Servers, ingress and egress SBCs.

Indication of Interest: AT&T, CenturyLink, Comcast, iconectiv, InCharge Systems, and Neustar.

5.3.2 P-to-P Use Case 2 – Data Verification – Anti-Spoofing

Description: Provide test setup and source code implementation of an RFC4474bis-based data verification service. Although the steps in this use case can be used for anti-spoofing mechanisms, the tests also explicitly include validation of other data such as caller-id, CNAM, enhanced CNAM, and other subscriber metadata.

Distributed Service Bureaus: Certificate provisioning and distribution via distributed service bureau. certificates are provisioned on a per-TN basis by the SP of record and hosted in a distributed fashion among various entities in the PSTN, for validation by terminating party.

Service Providers/Vendors: The SP manages corresponding private keys internally.
The assumption is that each provider has its own secure mechanism for validating the customer is who they say they are, consistent with 4474bis. It is anticipated that SPs would work with vendors to provide IP call routing infrastructure including, but not limited to, switching, local routing DBs, route servers, ENUM servers,ingress and egress SBCs.

Indication of Interest: AT&T, CenturyLink Comcast, iconectiv, InCharge Systems, and Neustar.

5.3.3 P-to-P Use Case 3 – Use of TN Certificates – Anti-Spoofing

Description: This use case would demonstrate the use of TN certificates to verify a SIP caller's use of a telephone number identity following the steps mentioned in RFC 4474 (also noting draft-ietf-stir-rfc4474bis) and would demonstrate the functions of a telephone number certificate authority (TN-CA) during verification.

TN-CA: Publish TN certificates, provide the certificates for the certificate chain, and support certificate revocation lists (CRLs) and online certificate status protocol (OCSP) for checking the status of the TN certificate.

Verifier: Be able to fetch a certificate from the TN-CA, validate the certificate, and then use it to verify the INVITE for a SIP call using a TN identity.

Indication of Interest: AT&T, CenturyLink, iconectiv, InCharge Systems, and Neustar.

5.3.4 P-to-P Use Case 4 – Alternative Approach for Acquiring TN Certificates – Anti Spoofing

Description: Demonstrate an alternative approach for acquiring TN certificates to verify a SIP caller's use of a telephone number identity. In this use case, a reference plane would contain URIs for TN certificates.

TN-CAs: TN reference plane would be a database of URIs indexed by TNs, where the stored URI for a TN points to the TN certificate for that number, and where the TN certificate is held by a TN-CA. In the basic case, there could be multiple TN-CAs, but each TN has only one certificate (hosted by one TN-CA).

Verifier: Able to fetch a certificate using the reference plane's URI for a given TN, validate the certificate, and then use it to verify the INVITE for a SIP call using a TN identity. For this use case, the reference plane could contain URIs for TN certificates when there are one or more TN-CAs.

Indication of Interest: AT&T, CenturyLink, iconectiv, InCharge Systems, and Neustar.

5.3.5 P-to-P Use Case 5 – Caller-id Spoofing Mitigation using Verified Tokens

Description: Use of the verified token is a mechanism currently being developed in the ATIS/SIP Forum IP-NNI Task Force for validating origination information associated with the telephone number being used for caller-id as well as the originating SP that is authorized to route calls on the PSTN.

Trust Anchor: Generation of the private key and public key certificate chain involves two actors, the trust anchor and the authorized SP. The trust anchor is the commonly trusted entity that represents the authority to sign certificates through a certificate chain. This signature represents the authority to route telephone calls on the PSTN using telephone numbers as identities.

Authorized Service Provider: The authorized SP first generates a key pair and keeps the private key secret. It then generates a standard certificate signing request (CSR) with the distinguished name (DN) as the unique domain representative of that provider or OCN of the provider, e.g., pstn.example.com using the public key. The trust anchor will provide an identity certificate that has been signed using the private key of the trust anchor.

Indication of Interest: AT&T, CenturyLink, Comcast, Cox, iconectiv, Inteliquent, and Sprint.

6   Mapping of the Use Cases to the Test Plans

Use Case	Sub-Team	Description	Test Plan*	Indication of Interest
5.1.1	Numbering	ITN Number Assignment for individual TN & block allocation	Completed.	AT&T, CenturyLink, Comcast, iconectiv, JSI, Neustar, and Sprint
5.2.1 5.2.2	Routing	Resource Records	Completed.	AT&T, CenturyLink, iconectiv, and Neustar
5.2.3	Routing	Distributed Service Bureau	Completed.	AT&T, CenturyLink, Comcast, iconectiv, Inteliquent, and Neustar
5.2.4	Routing	800	Completed.	AT&T and SMS/800
5.2.5	Routing	LERG™ Routing Guide - IP	Completed.	iconectiv, Inteliquent and Neustar
5.3.1 5.3.2 5.3.3 5.3.4	P-to-P	Secure Telephone Identity	Completed.	AT&T, CenturyLink, Comcast, iconectiv, InCharge Systems, and Neustar,
5.3.5	P-to-P	Verified Token	Completed.	AT&T, CenturyLink, Comcast, Cox, iconectiv, Inteliquent, and Sprint

NOTE: Each of the completed Phase 1 Test Plans is contained in a separate document.

7   Recommendations for Next Steps

This report summarizes the use cases and the level of interest in providing personnel and/or equipment to potentially participate in the testing. The next step will be to develop a recommendation for an ATIS action plan to analyze: 1) the use cases with consideration for potential synergies and interest in participating in testing; and 2) more detail on the availability of equipment and personnel for testing. As part of the next steps, ATIS should liaise with other standards development organizations (SDOs) to notify them of this testbed activity, provide information about the use cases, and solicit feedback and interest in broader participation in the trials/testbed.

The recommendations would include:

- Prioritization of use cases to identify which use cases should be tested first. This will be based on level of interest and availability of equipment and systems to do the testing. The recommendations would include a proposed timeline for the testing, with a focus on the initial tests.
- Proposed strategy to develop the detailed test objectives, configurations, and plans for each use case. The role of existing ATIS committees in developing test plans will be identified, as well as the potential need for new committees or forums, if required.
- Proposed timeline for testing and developing the supporting material (e.g., test plans) with a focus on the initial tests.
- Identified responsibilities for key deliverables, both in terms of technical primes and project management.