APPLICATION NOTE

CSCF and HSS Testing

HAMMER ADVANTAGE

- Fully emulate one or more devices with a single test tool and one UI
- Quickly make low-level protocol adjustments to fully simulate your protocol implementation
- Switch between numerous test scenarios on the fly to speed testing and expand test cases
- Generate 3GPP IMS, RFC3261, and non-standard SIP calls, sessions and registrations
- Test harnesses scale from a few calls to hundreds of thousands with unique IP and MAC addresses
- Comprehensive test and error reporting
- IMS diagnostics and troubleshooting tools include packet capture, full protocol decode, multi-protocol call-correlation, and call/session ladder visualization

TARGET ENVIRONMENTS

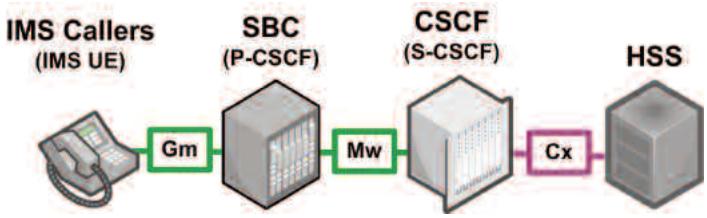
- Development environments: complete harness for early stage isolation testing
- Quality assurance: feature, functional, load, and regression testing with comprehensive reporting and labor-saving automation
- Proof of concept: simulate end-users and emulate missing components for a complete test
- Interoperability: analyze signaling and protocol structure while emulating missing network components
- Vendor verification: perform advanced functional testing, load to tens of thousands of calls, probe for errors, and emulate multiple IMS infrastructure components all in a few units of rack space

Introduction

Call/Session Control Functions (CSCFs) and the Home Subscriber Servers (HSS) are among the most essential elements in the IMS architecture. These devices are among the most complex IMS functions and are commonly based on new architectures, making thorough testing extremely critical. This application note reviews the challenges associated with testing these devices, outlines several typical test scenarios, and describes how Hammer testing equipment from Empirix can be used to ensure the quality of your IMS development.

IMS Architecture Overview

IMS networks are comprised of many elements. Some of the most important include Call/Session Control Functions (CSCFs), Home Subscriber Servers (HSS), and IMS User Equipment. CSCFs form the heart of IMS's core and are involved in nearly all IMS call flow scenarios. P-CSCF's are commonly integrated with Session Border Controllers (SBC) while S-CSCF's are often stand-alone devices that may encompass other IMS elements such as the I-CSCF. The HSS serves as the master database of the IMS network, storing all registration and application data. Users access the network as well as make and receive calls via IMS UE – IMS end points that support the IMS SIP extensions.



Typical Challenges

Implementers of these IMS elements face several challenges, including new protocol development, complex call flow scenarios, and interoperability issues. For example, IMS may be based on SIP, but it also adds several new headers to standard SIP known as the Private Header Extensions to SIP, or P-headers. These additional headers enable IMS features such as roaming, security, multiple user profiles, network identity sharing among multiple user devices, and advanced charging capabilities. IMS also incorporates Diameter for Authentication, Authorization and Accounting (AAA). IMS functions like the HSS use Diameter exclusively for transmitting and receiving various user profile information.

Each of these new protocol implementations must be tested, not only in isolation, but in conjunction with each other. A simple IMS call flow may traverse four or more hops for a single call, creating many points of failure. The situation becomes more complex when multiple vendors are involved and interoperability issues arise from varying standards interpretations.

Hammer for IMS Test Solutions

Empirix's Hammer for IMS test solutions can be used by vendors testing combined CSCF devices or independent S-CSCF, I-CSCF's, and P-CSCF functionality. In addition, Hammer is useful for testing HSS devices and S-CSCF to HSS interaction. Service providers may also conduct similar tests for vendor qualification, interoperability and network interworking tests.

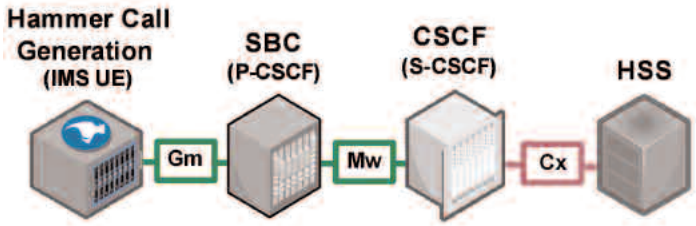
The Hammer for IMS solution for testing CSCFs and HSS's consists of:

- Call generation simulating IMS UEs (Gm interface) or P/I-CSCF's (Mw interface) using the IMS P-headers
- Device emulation of:
  - the HSS over the Cx interface
  - the S-CSCF over the Cx Interface
  - CSCFs over the Mw interface with integrated emulation of the HSS
- Diagnostics and analysis of IMS call flows including full IMS protocol decodes and call correlation across SIP and Diameter enabling easy tracing of calls/sessions through the network

Common Test Scenarios

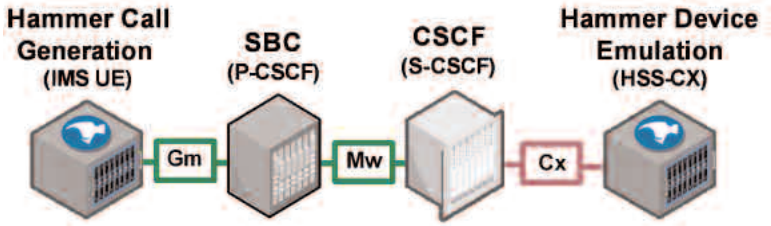
End-to-End System Test

One of the most basic scenarios used in proof of concept, load testing, and interoperability labs is an end-to-end system test. In this case one or more vendor's infrastructure products are used and Hammer Call Generation is used to simulate IMS callers initiating and terminating sessions.



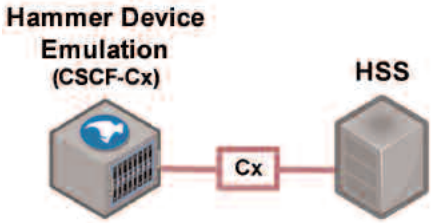
HSS Emulation

HSS devices are critical components of the IMS call flow, but are often difficult to obtain and hard to manage in a lab test environment. Hammer Device Emulation can be used to emulate the HSS, allowing a complete IMS call flow. In addition, the Hammer HSS emulation is easy to configure, manage, incorporate into a test harness, and automate.



HSS Isolation Test

HSS vendors and service providers often test the HSS in isolation for feature and stress testing as well as product verification purposes. In these environments Hammer Device Emulation can be used to emulate a CSCF generating sessions into the HSS over the Cx interface for feature and/or load testing.

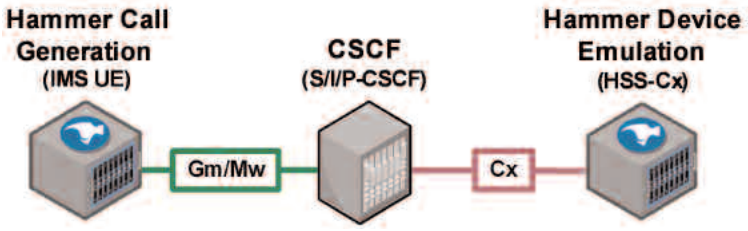


SBC (P-CSCF) Isolation Test

SBCs are commonly configured and isolated load and negative testing as well as product verification. When a P-CSCF is bundled in with the SBC, Hammer Call Generation and Hammer Device Emulation can be used to test the P-CSCF function in addition to SBC capabilities. Hammer Call Generation is used to simulate active callers while the Hammer Device Emulation emulates the CSCF and core network.

CSCF Isolation Test

CSCF devices can also be tested in isolation using Hammer Call Generation and Hammer Device Emulation. The Hammer Call Generation can simulate IMS calls/session signaling as it would look directly from IMS users or from the perspective of another CSCF. Hammer Device Emulation can be use to emulate the Diameter portion of the call flow between the CSCF and HSS.



Features and Specifications

HSS Emulation (Cx, Sh Interfaces)
- Stores Serving S-CSCF, User profiles, User data
- Cx and Sh interface emulation
- User identification, numbering and addressing information
- AS subscriptions to user data
- Access and service authorization
- AKA and MD5 hash support
- TCP and SCTP support

Diameter messages supported:

CER/CEA	PPR/PPA
UAR/UAA	UDR/UDA
MAR/MAA	PUR/PUA
SAR/SAA	SNR/SNA
DWR/DWA	PNR/PNA
RTR/RTA	

P-CSCF Emulation (Gm, Mw Interfaces)
Inbound/outbound SIP Proxy for IMS Core
Message flow support:
- Registration
  - Initial registration
  - Re-registration
  - De-registration
- Subscription and notification
  - General subscription and notification
  - Subscription and notification of the registration status
- General transactions
  - Request routing
  - Response forwarding
  - Privacy handling
- General call
  - Call setup
  - Call teardown
  - Session refreshment

SIP methods supported:

SUBSCRIBE	CANCEL
NOTIFY	UPDATE
INVITE	REFER
ACK	MESSAGE
BYE	REGISTER
PRACK	

S-CSCF Emulation (Cx Interface)
- Used to send Diameter requests to HSS and verify responses
- Establish S-CSCF assignment
- Authorization
- Authentication

Diameter messages supported:

CER/CEA	DWR/DWA
UAR/UAA	RTR/RTA
MAR/MAA	PPR/PPA
SAR/SAA	

IMS UE Emulation (Gm Interface)
Used to emulate IMS end points and simulate end-user behaviour
Message flow support:
- UE-Initiated registration, re-registration, de-registration
- Network-initiated re-registration, de-registration
- Subscribes to registration state
- Call set-up using precondition release
- Call hold and resume
- Call modification
- Blind call transfer

SIP methods supported:

REGISTER	UPDATE
INVITE	REFER
BYE	SUBSCRIBE
PRACK	NOTIFY
CANCEL	MESSAGE

S-CSCF Emulation (Mw Interface)
- Performs the session control services for the subscriber
- Acts as a SIP registrar processing user registrations and maintaining an active registration table
- Handles routing services
- Encapsulates HSS user database in the same emulation

Message flow support:
- Registration
  - Initial registration
  - Re-registration
  - De-registration
- Subscription and notification
  - General subscription and notification
  - Subscription and notification of the registration status
- General transactions
  - Request routing
  - Response forwarding
  - Privacy handling
- General call
  - Call setup
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SIP methods supported:

SUBSCRIBE	CANCEL
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