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Terminology for Benchmarking Session Initiation Protocol (SIP)

Networking Devices

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Abstract

This document provides a terminology for benchmarking the SIP

performance of networking devices. The term performance in this

context means the capacity of the device- or system-under-test to

process SIP messages. Terms are included for test components, test

setup parameters, and performance benchmark metrics for black-box

benchmarking of SIP networking devices. The performance benchmark

metrics are obtained for the SIP signaling plane only. The terms are

intended for use in a companion methodology document for

characterizing the performance of a SIP networking device under a

variety of conditions. The intent of the two documents is to enable

a comparison of the capacity of SIP networking devices. Test setup

parameters and a methodology document are necessary because SIP

allows a wide range of configuration and operational conditions that

can influence performance benchmark measurements. A standard

terminology and methodology will ensure that benchmarks have

consistent definition and were obtained following the same

procedures.

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1. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",

"SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this

document are to be interpreted as described in BCP 14, RFC2119

[RFC2119]. RFC 2119 defines the use of these key words to help make

the intent of standards track documents as clear as possible. While

this document uses these keywords, this document is not a standards

track document. The term Throughput is defined in RFC2544 [RFC2544].

For the sake of clarity and continuity, this document adopts the

template for definitions set out in Section 2 of RFC 1242 [RFC1242].

The terms Device Under Test (DUT) and System Under Test (SUT) are

defined in the following BMWG documents:

Device Under Test (DUT) (c.f., Section 3.1.1 RFC 2285 [RFC2285]).

System Under Test (SUT) (c.f., Section 3.1.2, RFC 2285 [RFC2285]).

Many commonly used SIP terms in this document are defined in RFC 3261

[RFC3261]. For convenience the most important of these are

reproduced below. Use of these terms in this document is consistent

with their corresponding definition in [RFC3261].

o Call Stateful: A proxy is call stateful if it retains state for a

dialog from the initiating INVITE to the terminating BYE request.

A call stateful proxy is always transaction stateful (should transaction stateful be defined? Seems to be the same as call stateful?), but the

converse is not necessarily true.

o Stateful Proxy: A logical entity that maintains the client and

server transaction state machines defined by this specification

during the processing of a request, also known as a transaction

stateful proxy. The behavior of a stateful proxy is further

defined in Section 16 of RFC 3261 [RFC3261] . A transaction

stateful proxy is not the same as a call stateful proxy (this is to the point above that transaction Stateful should probably be a separate bullet with definition).

o Stateless Proxy: A logical entity that does not maintain the

client or server transaction state machines defined in this

specification when it processes requests. A stateless proxy

forwards every request it receives downstream and every response

it receives upstream.

o Back-to-back User Agent: A back-to-back user agent (B2BUA) is a

logical entity that receives a request and processes it as a user

agent server (UAS). In order to determine how the request should

be answered, it acts as a user agent client (UAC) and generates

requests. Unlike a proxy server, it maintains dialog state and

must participate in all requests sent on the dialogs it has

established. Since it is a concatenation of a UAC and a UAS, no

explicit definitions are needed for its behavior.

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o Loop: A request that arrives at a proxy, is forwarded, and later

arrives back at the same proxy. When it arrives the second time,

its Request-URI is identical to the first time, and other header

fields that affect proxy operation are unchanged, so that the

proxy will make the same processing decision on the request it

made the first time. Looped requests are errors, and the

procedures for detecting them and handling them are described by

the SIP protocol[RFC3261] and also by RFC 5393

2. Introduction

Service Providers and IT Organizations deliver Voice Over IP (VoIP)

and Multimedia network services based on the IETF Session Initiation

Protocol (SIP) [RFC3261]. SIP is a signaling protocol originally

intended to dynamically establish, disconnect and modify

streams of media between end users. As it has evolved, it has been

adopted for use in a growing number of services and applications.

Many of these result in the creation of a media session, but some do

not. Examples of this latter group include text messaging and

subscription services. The set of benchmarking terms provided in

this document is intended for use with any SIP-enabled device

performing SIP functions in the interior of the network, whether or

not these result in the creation of media sessions. The performance

of end-user devices is outside the scope of this document.

A number of networking devices have been developed to support SIP-

based VoIP services. These include SIP Servers, Session Border

Controllers (SBC), Back-to-back User Agents (B2BUA), and SIP-Aware

Stateful Firewalls. These devices contain a mix of voice and IP

functions whose performance may be reported using metrics defined by

the equipment manufacturer or vendor. The Service Provider or IT

Organization seeking to compare the performance of such devices will

not be able to do so using these vendor-specific metrics, whose

conditions of test and algorithms for collection are often

unspecified. SIP functional elements and the devices that include

them can be configured many different ways and can be organized into

various topologies. These configuration and topological choices

impact the value of any chosen signaling benchmark. Unless these

conditions-of-test are defined, a true comparison of performance

metrics will not be possible. Some SIP-enabled network devices

terminate or relay media as well as signaling. The processing of

media by the device impacts the signaling performance. As a result,

the conditions-of-test must include information as to whether or not

the device under test processes media and if the device does process

media, a description of the media handled and the manner in which it

is handled (check to make sure this is described in later sections, by itself it is not clear). This document and its companion methodology document

[I-D.ietf-bmwg-sip-bench-meth] provide a set of black-box benchmarks

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for describing and comparing the performance of devices that

incorporate the SIP User Agent Client and Server functions and that

operate in the network's core.

The definition of SIP performance benchmarks necessarily includes

definitions of Test Setup Parameters and a test methodology. These

enable the Tester to perform benchmarking tests on different devices

and to achieve comparable results. This document provides a common

set of definitions for Test Components, Test Setup Parameters, and

Benchmarks. All the benchmarks defined are black-box measurements of

the SIP signaling plane. The Test Setup Parameters and Benchmarks

defined in this document are intended for use with the companion

Methodology document. Benchmarks of internal DUT characteristics

(also known as white-box benchmarks) such as Session Attempt Arrival

Rate, which is measured at the DUT, are described in Appendix A to

allow additional characterization of DUT behavior with different

distribution models.

2.1. Scope

The scope of this work item is summarized as follows:

o This terminology document describes SIP signaling performance

benchmarks for black-box measurements of SIP networking devices.

Stress and debug scenarios are not addressed in this work item.

o The DUT must be an RFC 3261 capable network equipment. This may

be a Registrar, Redirect Server, Stateless Proxy or Stateful

Proxy. A DUT MAY also include a B2BUA, SBC functionality. The

DUT MAY be a multi-port SIP-to-switched network gateway

implemented as a SIP UAC or UAS.

o The DUT MAY include an internal SIP Application Level Gateway

(ALG), firewall, and/or a Network Address Translator (NAT). This

is referred to as the "SIP Aware Stateful Firewall."

o The DUT or SUT MUST NOT be end user equipment, such as personal

digital assistant, a computer-based client, or a user terminal.

o The Tester acts as multiple "Emulated Agents" (EA) that initiate

(or respond to) SIP messages as session endpoints and source (or

receive) associated media for established connections.

o SIP Signaling in presence of Media

\* The media performance is not benchmarked in this work item.

\* It is RECOMMENDED that SIP signaling plane benchmarks be

performed with media present, but this is optional.

\* The SIP INVITE requests MUST include the SDP body.

\* The type of DUT dictates whether the associated media streams

traverse the DUT or SUT. Both scenarios are within the scope

of this work item.

\* SIP is frequently used to create media streams; the signaling

plane and media plane are treated as orthogonal to each other

in this document. While many devices support the creation of

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media streams, benchmarks that measure the performance of these

streams are outside the scope of this document and its

companion methodology document [I-D.ietf-bmwg-sip-bench-meth].

Tests may be performed with or without the creation of media

streams. The presence or absence of media streams MUST be

noted as a condition of the test as the performance of SIP

devices may vary accordingly. Even if the media is used during

benchmarking, only the SIP performance will be benchmarked, not

the media performance or quality.

o Both INVITE and non-INVITE scenarios (such as Instant Messages or

IM) are addressed in this document. However, benchmarking SIP

presence is not a part of this work item.

o Different transport mechanisms -- such as UDP, TCP, SCTP, or TLS

-- may be used. The specific transport mechanism MUST be noted as

a condition of the test as the performance of SIP devices may vary

accordingly.

o Looping and forking options are also considered since they impact

processing at SIP proxies.

o REGISTER and INVITE requests may be challenged or remain

unchallenged for authentication purpose. Whether or not the

REGISTER and INVITE requests are challenged is a condition of test

which will be recorded along with other such parameters which may

impact the SIP performance of the device or system under test.

o Re-INVITE requests are not considered in scope of this work item

since the benchmarks for INVITEs are based on the dialog created

by the INVITE and not on the transactions that take place within

that dialog.

o Only session establishment is considered for the performance

benchmarks. Session disconnect is not considered in the scope of

this work item. This is because our goal is to determine the

maximum throughput of the device or system under test, that is the

number of simultaneous SIP sessions that the device or system can

support. It is true that there are BYE requests being created

during the test process. These transactions do contribute to the

load on the device or system under test and thus are accounted for

in the metric we derive. We do not seek a separate metric for the

number of BYE transactions a device or system can support.

o SIP Overload [I-D.ietf-soc-overload-design] is within the scope of

this work item. We test to failure and then can continue to

observe and record the behavior of the system after failures are

recorded. The cause of failure is not within the scope of this

work. (I want to understand this more in the methodology document, seems like a subjective area as far as benchmarking. The recovery time seems more consistent with benchmarking similar to system recovery benchmark in RFC 2544). We note the failure and may continue to test until a

different failure or condition is encountered. Considerations on

how to handle overload are deferred to work progressing in the SOC

working group [I-D.ietf-soc-overload-control]. Vendors are, of

course, free to implement their specific overload control behavior

as the expected test outcome if it is different from the IETF

recommendations. However, such behavior MUST be documented and

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interpreted appropriately across multiple vendor implementations.

This will make it more meaningful to compare the performance of

different SIP overload implementations.

o IMS-specific scenarios are not considered, but test cases can be

applied with 3GPP-specific SIP signaling and the P-CSCF as a DUT.

2.2. Benchmarking Models

This section shows ten models to be used when benchmarking SIP

performance of a networking device. Figure 1 shows the

configuration needed to benchmark the tester itself. This model will

be used to establish the limitations of the test apparatus.

+--------+ Signaling request +--------+

| +----------------------------->| |

| Tester | | Tester |

| EA | Signaling response | EA |

| |<-----------------------------+ |

+--------+ +--------+

/|\ /|\

| Media |

+=========================================+

Figure 1: Baseline performance of the Emulated Agent without a DUT

present

Figure 2 shows the DUT playing the role of a user agent client (UAC),

initiating requests and absorbing responses (thought this work was not going to benchmark UAC?). This model can be used

to baseline the performance of the DUT acting as an UAC without

associated media.

+--------+ Signaling request +--------+

| +----------------------------->| |

| DUT | | Tester |

| | Signaling response | EA |

| |<-----------------------------+ |

+--------+ +--------+

Figure 2: Baseline performance for DUT acting as a user agent client

without associated media

Figure 3 shows the DUT playing the role of a user agent server (UAS),

absorbing the requests and sending responses. This model can be used

as a baseline performance for the DUT acting as a UAS without

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associated media.

+--------+ Signaling request +--------+

| +----------------------------->| |

| Tester | | DUT |

| EA | Response | |

| |<-----------------------------+ |

+--------+ +--------+

Figure 3: Baseline performance for DUT acting as a user agent server

without associated media

Figure 4 shows the DUT plays the role of a user agent client (UAC),

initiating requests and absorbing responses (same comments as Figure 2). This model can be used

as a baseline performance for the DUT acting as a UAC with associated

media.

+--------+ Signaling request +--------+

| +----------------------------->| |

| DUT | | Tester |

| | Signaling response | (EA) |

| |<-----------------------------+ |

| |<============ Media =========>| |

+--------+ +--------+

Figure 4: Baseline performance for DUT acting as a user agent client

with associated media

Figure 5 shows the DUT plays the role of a user agent server (UAS),

absorbing the requests and sending responses. This model can be used

as a baseline performance for the DUT acting as a UAS with associated

media.

+--------+ Signaling request +--------+

| +----------------------------->| |

| Tester | | DUT |

| (EA) | Response | |

| |<-----------------------------+ |

| |<============ Media =========>| |

+--------+ +--------+

Figure 5: Baseline performance for DUT acting as a user agent server

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with associated media

Figure 6 shows that the Tester acts as the initiating and responding

EA as the DUT/SUT forwards Session Attempts (and the DUT is acting as Proxy?).

+--------+ Session +--------+ Session +--------+

| | Attempt | | Attempt | |

| |<------------+ |<------------+ |

| | | | | |

| | Response | | Response | |

| Tester +------------>| DUT +------------>| Tester |

| (EA) | | | | (EA) |

| | | | | |

+--------+ +--------+ +--------+

Figure 6: DUT/SUT performance benchmark for session establishment

without media

Figure 7 is used when performing those same benchmarks with

Associated Media traversing the DUT/SUT.

+--------+ Session +--------+ Session +--------+

| | Attempt | | Attempt | |

| |<------------+ |<------------+ |

| | | | | |

| | Response | | Response | |

| Tester +------------>| DUT +------------>| Tester |

| (EA) | | | | (EA) |

| | Media | | Media | |

| |<===========>| |<===========>| |

+--------+ +--------+ +--------+

Figure 7: DUT/SUT performance benchmark for session establishment

with media traversing the DUT

Figure 8 is to be used when performing those same benchmarks with

Associated Media, but the media does not traverse the DUT/SUT.

Again, the benchmarking of the media is not within the scope of this

work item. The SIP control signaling is benchmarked in the presence

of Associated Media to determine if the SDP body of the signaling and

the handling of media impacts the performance of the DUT/SUT. If the media does not flow through the DUT, then I don’t see the value. This will not affect the SIP signaling performance, right?

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+--------+ Session +--------+ Session +--------+

| | Attempt | | Attempt | |

| |<------------+ |<------------+ |

| | | | | |

| | Response | | Response | |

| Tester +------------>| DUT +------------>| Tester |

| (EA) | | | | (EA) |

| | | | | |

+--------+ +--------+ +--------+

/|\ /|\

| Media |

+=============================================+

Figure 8: DUT/SUT performance benchmark for session establishment

with media external to the DUT

Figure 9 is used when performing benchmarks that require one or more

intermediaries to be in the signaling path. The intent is to gather

benchmarking statistics with a series of DUTs in place. In this

topology, the media is delivered end-to-end and does not traverse the

DUT. Are both of the DUTs same vendor / model number ? Seems like it would be complex to isolate the bottleneck unless this was the case. Same comment on media. If the media external can be eliminated, this would simplify the scenarios too which are becoming a little over welming.

SUT

------------------^^^^^^^^-------------

/ \

+------+ Session +---+ Session +---+ Session +------+

| | Attempt | | Attempt | | Attempt | |

| |<---------+ |<---------+ |<---------+ |

| | | | | | | |

| | Response | | Response | | Response | |

|Tester+--------->|DUT+--------->|DUT|--------->|Tester|

| (EA) | | | | | | (EA) |

| | | | | | | |

+------+ +---+ +---+ +------+

/|\ /|\

| Media |

+=============================================+

Figure 9: DUT/SUT performance benchmark for session establishment

with multiple DUTs and end-to-end media

Figure 10 is used when performing benchmarks that require one or more

intermediaries to be in the signaling path. The intent is to gather

benchmarking statistics with a series of DUTs in place. In this

topology, the media is delivered hop-by-hop through each DUT.

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SUT

-----------------^^^^^^^^-------------

/ \

+------+ Session +---+ Session +---+ Session +------+

| | Attempt | | Attempt | | Attempt | |

| |<---------+ |<---------+ |<---------+ |

| | | | | | | |

| | Response | | Response | | Response | |

|Tester+--------->|DUT+--------->|DUT|--------->|Tester|

| (EA) | | | | | | (EA) |

| | | | | | | |

| |<========>| |<========>| |<========>| |

+------+ Media +---+ Media +---+ Media +------+

Figure 10: DUT/SUT performance benchmark for session establishment

with multiple DUTs and hop- by-hop media

Figure 11 illustrates the SIP signaling for an Established Session.

The Tester acts as the EAs and initiates a Session Attempt with the

DUT/SUT. When the EA receives a 200 OK from the

DUT/SUT, that session is considered to be an Established Session. The

illustration indicates three states of the session bring created by

the EA – (1) Attempting, (2) Established, and (3)Disconnecting.

Sessions can be

one of two type: Invite-Initiated Session (IS) or Non-Invite

Initiated Session (NS). Failure for the DUT/SUT to successfully

respond within the Establishment Threshold Time is considered a

Session Attempt Failure. SIP Invite messages MUST include the SDP

body to specify the Associated Media. Use of Associated Media, to be

sourced from the EA, is optional. When Associated Media is used, it

may traverse the DUT/SUT depending upon the type of DUT/SUT. The

Associated Media is shown in Figure 11 as "Media" connected to media

ports M1 and M2 on the EA. After the EA sends a BYE, the session

disconnects. Performance test cases for session disconnects are not

considered in this work item (the BYE request is shown for

completeness.)

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EA DUT/SUT M1 M2

| | | |

| INVITE | | |

---------+-------------->| | |

| | | |

Attempting | | |

| 200 OK | | |

---------+<--------------| | |

| ACK | | |

|-------------->| | |

| | | |

| | | |

| | | Media |

Established | |<=====>|

| | | |

| BYE | | |

--------+--------------> | | |

| | | |

Disconnecting | | |

| 200 OK | | |

--------|<-------------- | | |

| | | |

Figure 11: Invite-initiated Session States

3. Term Definitions

3.1. Protocol Components (should the fact that the signaling can occur over TCP or UDP, TCP being more common? Reverse for media.)

3.1.1. Session

Definition:

The combination of signaling and media messages and processes that

support a SIP-based service.

Discussion:

SIP messages are used to create and manage services for end users.

Often, these services include the creation of media streams that

are defined in the SDP body of a SIP message and carried in RTP

protocol data units. However, SIP messages can also be used to

create Instant Message services and subscription services, and

such services are not associated with media streams. SIP reserves

the term "session" to describe services that are analogous to

telephone calls on a circuit switched network. SIP reserves the

term "dialog" to refer to a signaling-only relationship between

User Agent peers. SIP reserves the term "transaction" to refer to

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the brief communication between a client and a server that lasts

only until the final response to the SIP request. None of these

terms describes the entity whose performance we want to benchmark.

For example, the MESSAGE request does not create a dialog and can

be sent either within or outside of a dialog. It is not

associated with media, but it resembles a phone call in its

dependence on human rather than machine initiated responses. The

SUBSCRIBE method does create a dialog between the originating end-

user and the subscription service. It, too, is not associated

with a media session.

In light of the above observations, we have extended the term

"session" to include SIP-based services that are not initiated by

INVITE requests and that do not have associated media. In this

extended definition, a session always has a signaling component

and may also have a media component (this confusing, the above sentence says that the extended session does not have media). Thus, a session can be

defined as signaling-only or a combination of signaling and media.

We define the term "Associated Media", see Section 3.1.4, to

describe the situation in which media is associated with a SIP

dialog. The terminology "Invite-initiated Session" (IS)

Section 3.1.8 and "Non-invite-Initiated Session" (NS)

Section 3.1.9 are used to distinguish between these two types of

sessions. An Invite-initiated Session is a session as defined in

SIP. The performance of a device or system that supports Invite-

initiated Sessions that do not create media sessions, "Invite-

initiated Sessions without Associated Media", can be measured and

is of interest for comparison and as a limiting case. The

REGISTER request can be considered to be a "Non-invite-initiated

Session without Associated Media." A separate set of benchmarks

is provided for REGISTER requests since most implementations of

SIP-based services require this request and since a registrar may

be a device under test.

A Session in the context of this document, can be considered to be

a vector with three components:

1. A component in the signaling plane (SIP messages), sess.sig;

2. A media component in the media plane (RTP and SRTP streams for

example), sess.med (which may be null);

3. A control component in the media plane (RTCP messages for

example), sess.medc (which may be null).

An IS is expected to have non-null sess.sig and sess.med

components. The use of control protocols in the media component

is media dependent, thus the expected presence or absence of

sess.medc is media dependent and test-case dependent. An NS is

expected to have a non-null sess.sig component, but null sess.med

and sess.medc components. Is this information really important ? If not, it is hard to follow, guess I’ll see as I read through.

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Packets in the Signaling Plane and Media Plane will be handled by

different processes within the DUT. They will take different

paths within a SUT. These different processes and paths may

produce variations in performance. The terminology and benchmarks

defined in this document and the methodology for their use are

designed to enable us to compare performance of the DUT/SUT with

reference to the type of SIP-supported application it is handling.

Note that one or more sessions can simultaneously exist between

any participants. This can be the case, for example, when the EA

sets up both an IM and a voice call through the DUT/SUT. These

sessions are represented as an array session[x].

Sessions will be represented as a vector array with three

components, as follows:

session->

session[x].sig, the signaling component

session[x].medc[y], the media control component (e.g. RTCP)

session[x].med[y], an array of associated media streams (e.g.

RTP, SRTP, RTSP, MSRP). This media component may consist of zero

or more media streams.

Figure 12 models the vectors of the session. Might be my lack of experience in this vector representation, but I wonder if industry lab guy running these tests will get any value out of these representations.

Measurement Units:

N/A.

Issues:

None.

See Also:

Media Plane

Signaling Plane

Associated Media

Invite-initiated Session (IS)

Non-invite-initiated Session (NS)

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Figure 12: Session components

3.1.2. Signaling Plane

Definition:

The plane in which SIP messages [RFC3261] are exchanged between

SIP Agents [RFC3261].

Discussion:

SIP messages are used to establish sessions in several ways:

directly between two User Agents [RFC3261], through a Proxy Server

[RFC3261], or through a series of Proxy Servers. The Session

Description Protocol is included in the Signaling Plane. (SDP). This SDP seems dangling.

The Signaling Plane for a single Session is represented by

session.sig.

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Measurement Units:

N/A. Why N/A, wouldn’t these be calls per second, etc?

Issues:

None.

See Also:

Media Plane

EAs

3.1.3. Media Plane

Definition:

The data plane in which one or more media streams and their

associated media control protocols are exchanged between User

Agents after a media connection has been created by the exchange

of signaling messages in the Signaling Plane.

Discussion:

Media may also be known as the "bearer channel". The Media Plane

MUST include the media control protocol, if one is used, and the

media stream(s). Examples of media are audio and video. The

media streams are described in the SDP of the Signaling Plane.

The media for a single Session is represented by session.med. The

media control protocol for a single media description is

represented by session.medc.

Measurement Units:

N/A.

Issues:

None.

See Also:

Signaling Plane

3.1.4. Associated Media

Definition:

Media that corresponds to an 'm' line in the SDP payload of the

Signaling Plane.

Discussion:

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Any media protocol MAY be used.

For any session's signaling component, session.sig, there may be

zero, one, or multiple associated media streams. When there are

multiple media streams, these are represented be a vector array

session.med[y]. When there are multiple media streams there will

be multiple media control protocol descriptions as well. They are

represented by a vector array session.medc[y].

Measurement Units:

N/A.

Issues:

None.

3.1.5. Overload

Definition:

Overload is defined as the state where a SIP server does not have

sufficient resources to process all incoming SIP messages

[I-D.ietf-soc-overload-design].

Discussion:

The distinction between an overload condition and other failure

scenarios is outside the scope of black box testing and of this

document. Under overload conditions, all or a percentage of

Session Attempts will fail due to lack of resources. In black box

testing the cause of the failure is not explored. The fact that a

failure occurred for whatever reason, will trigger the tester to

reduce the offered load, as described in the companion methodology

document, [I-D.ietf-bmwg-sip-bench-meth]. SIP server resources

may include CPU processing capacity, network bandwidth, input/

output queues, or disk resources. Any combination of resources

may be fully utilized when a SIP server (the DUT/SUT) is in the

overload condition. For proxy-only type of devices, it is

expected that the proxy will be driven into overload based on the

delivery rate of signaling requests.

For UA-type of network devices such as gateways, it is expected

that the UA will be driven into overload based on the volume of

media streams it is processing. This ties to earlier comment, should the device be placed into overload and then benchmarked to determine when system functionality is restored?

Measurement Units:

N/A.

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Issues:

The issue of overload in SIP networks is currently a topic of

discussion in the SIPPING WG. The normal response to an overload

stimulus -- sending a 503 response -- is considered inadequate and

new response codes and behaviors may be specified in the future.

From the perspective of this document, all these responses will be

considered to be failures. There is thus no dependency between

this document and the ongoing work on the treatment of overload

failure.

3.1.6. Session Attempt

Definition:

A SIP request sent by the EA that has not received a final

response.

Discussion:

The attempted session may be Invite Initiated or Non-invite

Initiated. When counting the number of session attempts we

include all INVITEs that are rejected for lack of authentication

information. The EA needs to record the total number of session

attempts including those attempts that are routinely rejected by a

proxy that requires the UA to authenticate itself. The EA is

provisioned to deliver a specific number of session attempts per

second. But the EA must also count the actual number of session

attempts per given tie interval. Is there a time limit to declaring a failed attempt?

Measurement Units:

N/A.

Issues:

None.

See Also:

Session

Session Attempt Rate

Invite-initiated Session

Non-Invite initiated Session

3.1.7. Established Session

Definition:

A SIP session for which the EA acting as the UE/UA has received a

200 OK message.

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Discussion:

An Established Session MAY be Invite Initiated or Non-invite

Initiated.

Measurement Units:

N/A.

Issues:

None.

See Also:

Invite-initiated Session

Session Attempting State

Session Disconnecting State

3.1.8. Invite-initiated Session (IS)

Definition:

A Session that is created by an exchange of messages in the

Signaling Plane, the first of which is a SIP INVITE request.

Discussion:

When an IS becomes an Established Session its signaling component

is identified by the SIP dialog parameter values, Call-ID, To-tag,

and From-tag (RFC3261 [RFC3261]). An IS may have zero, one or

multiple Associated Media descriptions in the SDP body. The

inclusion of media is test case dependent. An IS is successfully

established if the following two conditions are met:

1. Sess.sig is established by the end of Establishment Threshold

Time (c.f. Section 3.3.3), and

2. If a media session is described in the SDP body of the

signaling message, then the media session is established by

the end of Establishment Threshold Time (c.f. Section 3.3.3).

An SBC or B2BUA may receive media from a calling or called

party before a signaling dialog is established and certainly

before a confirmed dialog is established. The EA can be built

in such a way that it does not send early media or it needs to

include a parameter that indicates when it will send media.

This parameter must be included in the list of test setup

parameters in Section 5.1 of [I-D.ietf-bmwg-sip-bench-meth]

Measurement Units:

N/A.

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Issues:

None.

See Also:

Session

Non-Invite initiated Session

Associated Media

3.1.9. Non-INVITE-initiated Session (NS)

Definition:

A session that is created by an exchange of SIP messages in the

Signaling Plane the first of which is not a SIP INVITE message.

Discussion:

An NS is successfully established if the Session Attempt via a

non- INVITE request results in the EA receiving a 2xx reply before

the expiration of the Establishment Threshold timer (c.f.,

Section 3.3.3). An example of a NS is a session created by the

SUBSCRIBE request.

Measurement Units:

N/A.

Issues:

None.

See Also:

Session

Invite-initiated Session

3.1.10. Session Attempt Failure (is this the same as Session Attempt?) there was language “routinely rejected by a

proxy that requires the UA to authenticate itself. “

Definition:

A session attempt that does not result in an Established Session.

Discussion:

The session attempt failure may be indicated by the following

observations at the EA:

1. Receipt of a SIP 4xx, 5xx, or 6xx class response to a Session

Attempt.

2. The lack of any received SIP response to a Session Attempt

within the Establishment Threshold Time (c.f. Section 3.3.3).

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Measurement Units:

N/A.

Issues:

None.

See Also:

Session Attempt

3.1.11. Standing Sessions Count

Definition:

The number of Sessions currently established on the DUT/SUT at any

instant.

Discussion:

The number of Standing Sessions is influenced by the Session

Duration and the Session Attempt Rate. Benchmarks MUST be

reported with the maximum and average Standing Sessions for the

DUT/SUT for the duration of the test. In order to determine the

maximum and average Standing Sessions on the DUT/SUT for the

duration of the test it is necessary to make periodic measurements

of the number of Standing Sessions on the DUT/SUT. The

recommended value for the measurement period is 1 second. Since

we cannot directly poll the DUT/SUT, we take the number of

standing sessions on the DUT/SUT to be the number of distinct

calls as measured by the number of distinct Call-IDs that the EA

is processing at the time of measurement. The EA must make that

count available for viewing ad recording.

Measurement Units:

Number of sessions

Issues:

None.

See Also:

Session Duration

Session Attempt Rate

Session Attempt Rate

Emulated Agent

3.2. Test Components

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3.2.1. Emulated Agent

Definition:

A device in the test topology that initiates/responds to SIP

messages as one or more session endpoints and, wherever

applicable, sources/receives Associated Media for Established

Sessions.

Discussion:

The EA functions in the Signaling and Media Planes. The Tester

may act as multiple EAs.

Measurement Units:

N/A

Issues:

None.

See Also:

Media Plane

Signaling Plane

Established Session

Associated Media

3.2.2. Signaling Server

Definition:

Device in the test topology that acts to create sessions between

EAs. This device is either a DUT or a component of a SUT.

Discussion:

The DUT MUST be an RFC 3261 capable network equipment such as a

Registrar, Redirect Server, User Agent Server, Stateless Proxy, or

Stateful Proxy. A DUT MAY also include B2BUA or SBC.

Measurement Units:

NA

Issues:

None.

See Also:

Signaling Plane

3.2.3. SIP-Aware Stateful Firewall

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Definition:

Device in the test topology that provides protection against

various types of security threats to which the Signaling and Media

Planes of the EAs and Signaling Server are vulnerable.

Discussion:

Threats may include Denial-of-Service, theft of service and misuse

of service.he SIP-Aware Stateful Firewall MAY be an internal

component or function of the Session Server. The SIP-Aware

Stateful Firewall MAY be a standalone device. If it is a

standalone device it MUST be paired with a Signaling Server. If

it is a standalone device it MUST be benchmarked as part of a SUT.

SIP-Aware Stateful Firewalls MAY include Network Address

Translation (NAT) functionality. Ideally, the inclusion of the

SIP-Aware Stateful Firewall in the SUT does not lower the measured

values of the performance benchmarks.

Measurement Units:

N/A

Issues:

None.

See Also:

3.2.4. SIP Transport Protocol

Definition:

The protocol used for transport of the Signaling Plane messages.

Discussion:

Performance benchmarks may vary for the same SIP networking device

depending upon whether TCP, UDP, TLS, SCTP, or another transport

layer protocol is used. For this reason it MAY be necessary to

measure the SIP Performance Benchmarks using these various

transport protocols. Performance Benchmarks MUST report the SIP

Transport Protocol used to obtain the benchmark results.

Measurement Units:

TCP,UDP, SCTP, TLS over TCP, TLS over UDP, or TLS over SCTP

Issues:

None.

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See Also:

3.3. Test Setup Parameters

3.3.1. Session Attempt Rate

Definition:

Configuration of the EA for the number of sessions per second that

the EA attempts to establish using the services of the DUT/SUT.

Discussion:

The Session Attempt Rate is the number of sessions per second that

the EA sends toward the DUT/SUT. Some of the sessions attempted

may not result in a session being established. A session in this

case may be either an IS or an NS.

Measurement Units:

Session attempts per second

Issues:

None.

See Also:

Session

Session Attempt

**3.3.2. IS Media Attempt Rate**

Definition:

Configuration on the EA for the rate, measured in sessions per

second, at which the EA attempts to establish INVITE-initiated

sessions with Associated Media, using the services of the DUT/SUT.

Discussion:

An IS is not required to include a media description. The IS

Media Attempt Rate defines the number of media sessions we are

trying to create, not the number of media sessions that are

actually created. Some attempts might not result in successful

sessions established on the DUT.

Measurement Units:

session attempts per second (saps)

Issues:

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None.

See Also:

IS

3.3.3. Establishment Threshold Time

Definition:

Configuration of the EA for representing the amount of time that

an EA will wait before declaring a Session Attempt Failure.

Discussion:

This time duration is test dependent.

It is RECOMMENDED that the Establishment Threshold Time value be

set to Timer B (for ISs) or Timer F (for NSs) as specified in RFC

3261, Table 4 [RFC3261]. Following the default value of T1

(500ms) specified in the table and a constant multiplier of 64

gives a value of 32 seconds for this timer (i.e., 500ms \* 64 =

32s).

Measurement Units:

seconds

Issues:

None.

See Also:

session establishment failure

3.3.4. Session Duration

Definition:

Configuration of the EA that represents the amount of time that

the SIP dialog is intended to exist between the two EAs associated

with the test.

Discussion:

The time at which the BYE is sent will control the Session

Duration

Normally the Session Duration will be the same as the Media

Session Hold Time. However, it is possible that the dialog

established between the two EAs can support different media

sessions at different points in time. Providing both parameters

allows the testing agency to explore this possibility.

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Measurement Units:

seconds

Issues:

None.

See Also:

Media Session Hold Time

3.3.5. Media Packet Size

Definition:

Configuration on the EA for a fixed size of packets used for media

streams.

Discussion:

For a single benchmark test, all sessions use the same size packet

for media streams. The size of packets can cause variation in

performance benchmark measurements. Know that media is not being measured here, but would it be reasonable to have media fixed sizes for voice and video?

Measurement Units:

bytes

Issues:

None.

See Also:

3.3.6. Media Offered Load

Definition:

Configuration of the EA for the constant rate of Associated Media

traffic offered by the EA to the DUT/SUT for one or more

Established Sessions of type IS.

Discussion:

The Media Offered Load to be used for a test MUST be reported with

three components:

1. per Associated Media stream;

2. per IS;

3. aggregate.

For a single benchmark test, all sessions use the same Media

Offered Load per Media Stream. There may be multiple Associated

Media streams per IS. The aggregate is the sum of all Associated

Media for all IS.

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Measurement Units:

packets per second (pps)

Issues:

None.

See Also:

Established Session

Invite Initiated Session

Associated Media

3.3.7. Media Session Hold Time

Definition:

Parameter configured at the EA, that represents the amount of time

that the Associated Media for an Established Session of type IS

will last.

Discussion:

The Associated Media streams may be bi-directional or uni-

directional as indicated in the test methodology.

Normally the Media Session Hold Time will be the same as the

Session Duration. However, it is possible that the dialog

established between the two EAs can support different media

sessions at different points in time. Providing both parameters

allows the testing agency to explore this possibility.

Measurement Units:

seconds

Issues:

None.

See Also:

Associated Media

Established Session

Invite-initiated Session (IS)

3.3.8. Loop Detection Option

Definition:

An option that causes a Proxy to check for loops in the routing of

a SIP request before forwarding the request.

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Discussion:

This is an optional process that a SIP proxy may employ; the

process is described under Proxy Behavior in RFC 3261 [RFC3261] in

Section 16.3 Request Validation and that section also contains

suggestions as to how the option could be implemented. Any

procedure to detect loops will use processor cycles and hence

could impact the performance of a proxy.

Measurement Units:

NA

Issues:

None.

See Also:

3.3.9. Forking Option

Definition:

An option that enables a Proxy to fork requests to more than one

destination.

Discussion:

This is a process that a SIP proxy may employ to find the UAS.

The option is described under Proxy Behavior in RFC 3261 in

Section 16.1. A proxy that uses forking must maintain state

information and this will use processor cycles and memory. Thus

the use of this option could impact the performance of a proxy and

different implementations could produce different levels of impact.

SIP supports serial or parallel forking. When performing a test,

the type of forking mode MUST be indicated.

Measurement Units:

The number of endpoints that will receive the forked invitation.

A value of 1 indicates that the request is destined to only one

endpoint, a value of 2 indicates that the request is forked to two

endpoints, and so on. This is an integer value ranging between 1

and N inclusive, where N is the maximum number of endpoints to

which the invitation is sent.

Type of forking used, namely parallel or serial.

Issues:

None.

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See Also:

3.4. Benchmarks

3.4.1. Registration Rate

Definition:

The maximum number of registrations that can be successfully

completed by the DUT/SUT in a given time period without

registration failures in that time period.

Discussion:

This benchmark is obtained with zero failure in which 100% of the

registrations attempted by the EA are successfully completed by

the DUT/SUT. The registration rate provisioned on the Emulated

Agent is raised and lowered as described in the algorithm in the

companion methodology draft [I-D.ietf-bmwg-sip-bench-meth] until a

traffic load consisting of registrations at the given attempt rate

over the sustained period of time identified by T in the algorithm

completes without failure.

Measurement Units:

registrations per second (rps)

Issues:

None.

See Also:

3.4.2. Session Establishment Rate

Definition:

The maximum number of sessions that can be successfully completed

by the DUT/SUT in a given time period without session

establishment failures in that time period.

Discussion:

This benchmark is obtained with zero failure in which 100% of the

sessions attempted by the Emulated Agent are successfully

completed by the DUT/SUT. The session attempt rate provisioned on

the EA is raised and lowered as described in the algorithm in the

accompanying methodology document, until a traffic load at the

given attempt rate over the sustained period of time identified by

T in the algorithm completes without any failed session attempts.

Sessions may be IS or NS or a mix of both and will be defined in

the particular test.

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Measurement Units:

sessions per second (sps)

Issues:

None.

See Also:

Invite-initiated Sessions

Non-INVITE initiated Sessions

Session Attempt Rate

3.4.3. Session Capacity

Definition:

The maximum value of Standing Sessions Count achieved by the DUT/

SUT during a time period T in which the EA is sending session

establishment messages at the Session Establishment Rate.

Discussion:

Sessions may be IS or NS. If they are IS they can be with or

without media. When benchmarking Session Capacity for sessions

with media it is required that these sessions be permanently

established (i.e., they remain active for the duration of the

test.) This can be achieved by causing the EA not to send a BYE

for the duration of the testing (this is confusing, why would the EA send a BYE if test is running? I figured that a session is set-up, then media flows with that session; next sessionis set-up, then media flows, etc). In the signaling plane, this

requirement means that the dialog lasts as long as the test lasts.

When media is present, the Media Session Hold Time MUST be set to

infinity so that sessions remain established for the duration of

the test. If the DUT/SUT is dialog-stateful, then we expect its

performance will be impacted by setting Media Session Hold Time to

infinity, since the DUT/SUT will need to allocate resources to

process and store the state information. The report of the

Session Capacity must include the Session Establishment Rate at

which it was measured.

Measurement Units:

sessions

Issues:

None.

See Also:

Established Session

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Session Attempt Rate

Session Attempt Failure

3.4.4. Session Overload Capacity

Definition:

The maximum number of Established Sessions that can exist

simultaneously on the DUT/SUT until it stops responding to Session

Attempts.

Discussion:

Session Overload Capacity is measured after the Session Capacity

is measured. The Session Overload Capacity is greater than or

equal to the Session Capacity. When benchmarking Session Overload

Capacity, continue to offer Session Attempts to the DUT/SUT after

the first Session Attempt Failure occurs and measure Established

Sessions until there is no SIP message response for the

duration of the Establishment Threshold. Note that the Session

Establishment Performance is expected to decrease after the first

Session Attempt Failure occurs (again, I think system recovery is important benchmark).

Units:

Sessions

Issues:

None.

See Also:

Overload

Session Capacity

Session Attempt Failure

3.4.5. Session Establishment Performance

Definition:

The percent of Session Attempts that become Established Sessions

over the duration of a benchmarking test.

Discussion:

Session Establishment Performance is a benchmark to indicate

session establishment success for the duration of a test. The

duration for measuring this benchmark is to be specified in the

Methodology. The Session Duration SHOULD be configured to

infinity so that sessions remain established for the entire test

duration.

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Session Establishment Performance is calculated as shown in the

following equation:

Session Establishment = Total Established Sessions

Performance --------------------------

Total Session Attempts

Session Establishment Performance may be monitored real-time

during a benchmarking test. However, the reporting benchmark MUST

be based on the total measurements for the test duration.

Measurement Units:

Percent (%)

Issues:

None.

See Also:

Established Session

Session Attempt

3.4.6. Session Attempt Delay

Definition:

The average time measured at the EA for a Session Attempt to

result in an Established Session.

Discussion:

Time is measured from when the EA sends the first INVITE for the

call-ID in the case of an IS. Time is measured from when the EA

sends the first non-INVITE message in the case of an NS. Session

Attempt Delay MUST be measured for every established session to

calculate the average. Session Attempt Delay MUST be measured at

the Session Establishment Rate (max?).

Measurement Units:

Seconds

Issues:

None.

See Also:

Session Establishment Rate

3.4.7. IM Rate

Davids, et al. Expires May 12, 2013 [Page 34]

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Definition:

Maximum number of IM messages completed by the DUT/SUT.

Discussion:

For a UAS, the definition of success is the receipt of an IM

request and the subsequent sending of a final response (should a more technical definition of the request / response be given? I am not IM/SIP expert, but figure there must be a message name for each).

For a UAC, the definition of success is the sending of an IM

request and the receipt of a final response to it. For a proxy,

the definition of success is as follows:

A. the number of IM requests it receives from the upstream client

MUST be equal to the number of IM requests it sent to the

downstream server; and

B. the number of IM responses it receives from the downstream

server MUST be equal to the number of IM requests sent to the

downstream server; and

C. the number of IM responses it sends to the upstream client

MUST be equal to the number of IM requests it received from

the upstream client.

Measurement Units:

IM messages per second

Issues:

None.

See Also:

4. IANA Considerations

This document requires no IANA considerations.

5. Security Considerations

Documents of this type do not directly affect the security of

Internet or corporate networks as long as benchmarking is not

performed on devices or systems connected to production networks.

Security threats and how to counter these in SIP and the media layer

is discussed in RFC3261 [RFC3261], RFC 3550 [RFC3550], RFC3711

[RFC3711] and various other drafts. This document attempts to

formalize a set of common terminology for benchmarking SIP networks.

Packets with unintended and/or unauthorized DSCP or IP precedence

values may present security issues. Determining the security

consequences of such packets is out of scope for this document.

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Appendix A. White Box Benchmarking Terminology

Session Attempt Arrival Rate

Definition:

The number of Session Attempts received at the DUT/SUT over a

specified time period.

Discussion:

Sessions Attempts are indicated by the arrival of SIP INVITES OR

SUBSCRIBE NOTIFY messages. Session Attempts Arrival Rate

distribution can be any model selected by the user of this

document. It is important when comparing benchmarks of different

devices that same distribution model was used. Common

distributions are expected to be Uniform and Poisson.

Measurement Units:

Session attempts/sec

Issues:

None.

See Also:

Session Attempt

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