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**Terminology for Accelerated Stress Benchmarking**  
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ABSTRACT

This document provides the Terminology for performing Stress Benchmarking of networking devices. The three phases of the Stress Test: Startup, Instability and Recovery are defined along with the benchmarks and configuration terms associated with the each phase. Also defined are the Benchmark Planes fundamental to stress testing configuration, setup and measurement. The terminology is to be used with the companion framework and methodology documents.

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## 1. Introduction

Routers in an operational network are simultaneously configured with multiple protocols and security policies while forwarding traffic and being managed. To accurately benchmark a router for deployment it is necessary to test that router in operational conditions by simultaneously configuring and scaling network protocols and security policies, forwarding traffic, and managing the device. It is helpful to accelerate these network operational conditions so that the router under test can be benchmarked with faster test duration. Testing a router in accelerated network conditions is known as Accelerated Stress Testing.

This document provides the Terminology for performing Stress Benchmarking of networking devices. The three phases of the Stress Test: Startup, Instability and Recovery are defined along with the benchmark and configuration terms associated with the each phase. Benchmarks for stress testing are defined using the Aggregate Forwarding Rate and control plane Session Count during each phase of the test. Also defined are the Benchmark Planes fundamental to stress testing configuration, setup and measurement. These are the Control Plane, Data Plane, Management Plane and Security Plane For each plane, the Configuration Set, Startup Conditions, and Instability Conditions are defined. White Box benchmarks are provided in Appendix 1 for additional DUT behavior measurements. The terminology is to be used with the companion methodology document [\[4\]](#). The sequence of phases, actions, and benchmarks are shown in Table 1.

## 2. Existing definitions

[RFC 1242](#) "Benchmarking Terminology for Network Interconnect Devices" and [RFC 2285](#) "Benchmarking Terminology for LAN Switching Devices" should be consulted before attempting to make use of this document. For the sake of clarity and continuity this RFC adopts the template for definitions set out in [Section 2 of RFC 1242](#). Definitions are indexed and grouped together in sections for ease of reference.

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](#), [RFC 2119](#) [Br97]. [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.

Table 1. Phase Sequence and Benchmarks

III. Recovery Phase	II. Instability Phase	I. Startup Phase
<-----<-----<-----<-----<-----<	<-----<-----<-----<-----<-----<	<-----<-----<-----<-----<-----<
Remove Instability Conditions	Achieve Configuration Set	Apply Startup Conditions
Benchmark: Recovered Aggregate Forwarding Rate	Benchmark: Unstable Aggregate Forwarding Rate  Degraded Aggregate Forwarding Rate  Average Degraded Forwarding Rate	Benchmark: Stable Aggregate Forwarding Rate
Recovered Latency	Unstable Latency	Startup Latency
Recovered Uncontrolled Sessions Lost	Recovered Uncontrolled Sessions Lost	Stable Session Count
Recovery Time		

### 3. Term definitions

#### 3.1 General Terms

##### 3.1.1 Benchmark Planes

###### Definition:

The features, conditions, and behavior for the Accelerated Stress Benchmarking.

###### Discussion:

There are four Benchmark Planes: Control Plane, Data Plane, Management Plane, and Security Plane as shown in Figure 1. The Benchmark Planes define the Configuration, Startup Conditions, Instability Conditions, and Failure Conditions used for the test.

###### Measurement units:

N/A

###### Issues:

None

###### See Also:

Control Plane  
Data Plane  
Management Plane  
Security Plane





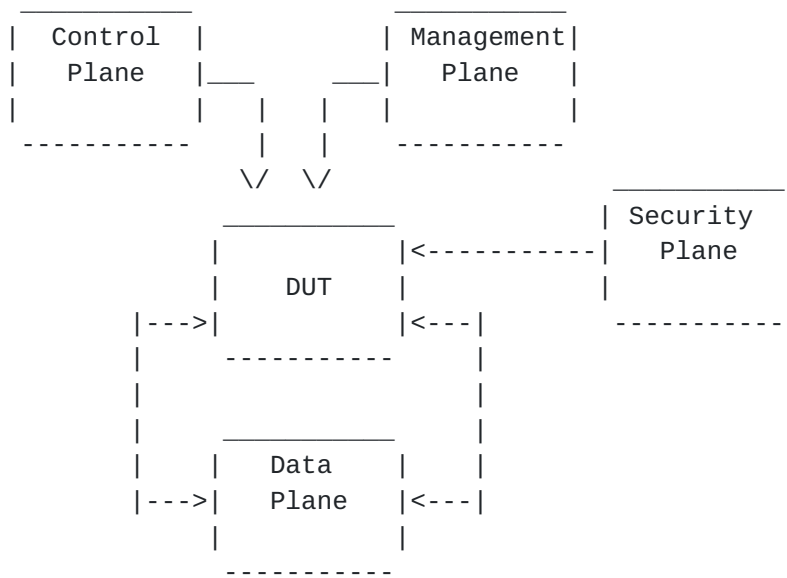


Figure 1. Router Accelerated Stress Benchmarking Planes

### 3.1.2 Configuration Sets

**Definition:**

The features and scaling limits used during the Accelerated Stress Benchmarking.

**Discussion:**

There are four Configuration Sets: Control Plane Configuration Set, Data Plane Configuration Set, Management Plane Configuration Set, and Security Plane Configuration Set.

**Measurement units:**

N/A

**Issues:**

None

**See Also:**

Control Plane Configuration Set  
Data Plane Configuration Set  
Management Plane Configuration Set  
Security Plane Configuration Set

### 3.1.3 Startup Conditions

**Definition:**

Test conditions that occur at the start of the Accelerated Life Benchmark to establish conditions for the remainder of the test.



Discussion:

Startup Conditions may cause stress on the DUT and produce failure. Startup Conditions are defined for the Control Plane and Security Plane.

Measurement units:

N/A

Issues:

None

See Also:

Control Plane Startup Conditions  
Data Plane Startup Conditions  
Management Plane Startup Conditions  
Security Plane Startup Conditions

### 3.1.4 Instability Conditions

Definition:

Test conditions that occur during the Accelerated Stress Benchmark to produce instability and stress the DUT.

Discussion:

Instability Conditions are applied to the DUT after the Startup Conditions have completed. Instability Conditions occur for the Control Plane, Data Plane, Management Plane, and Security Plane.

Measurement units:

N/A

Issues: None

See Also:

Control Plane Instability Conditions  
Data Plane Instability Conditions  
Management Plane Instability Conditions  
Security Plane Instability Conditions

### 3.1.5 Aggregate Forwarding Rate

Definition:

Sum of forwarding rates for all interfaces on the DUT during the Startup Phase.

Discussion:

Each interface of the DUT forwards traffic at some measured rate. The Aggregate Forwarding Rate is the sum of forwarding rates for all interfaces on the DUT.



Measurement units:

pps

Issues:

None

See Also:

Startup Phase

### 3.1.6 Controlled Session Loss

Definition:

Control Plane sessions that are intentionally brought down during the Stress test.

Discussion:

The test equipment is able to control protocol session state with the DUT.

Measurement units:

None

Issues:

None

See Also:

Uncontrolled Session Loss

### 3.1.7 Uncontrolled Session Loss

Definition:

Control Plane sessions that are in the down state but were not intentionally brought down during the Stress test.

Discussion:

The test equipment is able to control protocol session state with the DUT. The test equipment is also to monitor for sessions lost with the DUT which the test equipment itself did not intentionally bring down.

Measurement units:

N/A

Issues:

None

See Also:



## 3.2 Benchmark Planes

### 3.2.1 Control Plane

Definition:

The Description of the control protocols enabled for the Accelerated Stress Benchmarking.

Discussion:

The Control Plane defines the Configuration, Startup Conditions, and Instability Conditions of the control protocols. Control Plane protocols may include routing protocols, multicast protocols, and MPLS protocols. These can be enabled or disabled for a benchmark test.

Measurement units:

N/A

Issues:

None

See Also:

- Benchmark Planes
- Control Plane Configuration Set
- Control Plane Startup Conditions
- Control Plane Instability Conditions

### 3.2.2 Data Plane

Definition:

The data traffic profile used for the Accelerated Stress Benchmarking.

Discussion:

The Data Plane defines the Configuration, Startup Conditions, and Instability Conditions of the data traffic. The Data Plane includes the traffic and interface profile.

Measurement Units:

N/A

See Also:

- Benchmark Planes
- Data Plane Configuration Set
- Data Plane Startup Conditions
- Data Plane Instability Conditions

### 3.2.3 Management Plane

Definition:

The Management features and tools used for the





Discussion:

A key component of the Accelerated Stress Benchmarking is the Management Plane to assess manageability of the router under stress. The Management Plane defines the Configuration, Startup Conditions, and Instability Conditions of the management protocols and features. The Management Plane includes SNMP, Logging/Debug, Statistics Collection, and management configuration sessions such as telnet, SSH, and serial console. SNMP Gets SHOULD be performed continuously. Management configuration sessions should be open simultaneously and be repeatedly open and closed. Open management sessions should have valid and invalid configuration and show commands entered.

Measurement units:

N/A

Issues:

None

See Also:

- Benchmark Planes
- Management Plane Configuration Set
- Management Plane Startup Conditions
- Management Plane Instability Conditions

### 3.2.4 Security Plane

Definition:

The Security features used during the Accelerated Stress Benchmarking.

Discussion:

The Security Plane defines the Configuration, Startup Conditions, and Instability Conditions of the security features and protocols. The Security Plane includes the ACLs, Firewall, Secure Protocols, and User Login. Tunnels for those such as IPsec should be established and flapped. Policies for Firewalls and ACLs should be repeatedly added and removed from the configuration via telnet, SSH, or serial management sessions.

Measurement units:

N/A

Issues: None

See Also:

- Benchmark Planes
- Security Plane Configuration Set

Security Plane Startup Conditions  
Security Plane Instability Conditions

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### 3.3 Startup

#### 3.3.1 Startup Phase

**Definition**

The portion of the benchmarking test in which the Startup Conditions are generated with the DUT. This begins with the attempt to establish the first session and ends when the last Control Plane session is established.

**Discussion:**

The Startup Phase is the first Phase of the benchmarking test preceding the Instability Phase and Recovery Phase. It is specified by the Configuration Sets and Startup Conditions for each Benchmark Plane. The Startup Phase ends and Instability Phase may begin when the Configuration Sets are achieved with the DUT.

**Measurement Units:**

None

**Issues:**

The 'last control plane session is established' may not be a sufficient indicator that steady-state is achieved and Instability Conditions can be applied to begin the Instability Phase.

**See Also:**

Benchmark Plane  
Configuration Sets  
Startup Conditions  
Instability Phase  
Recovery Phase

#### 3.3.2 Benchmarks

##### 3.3.2.1 Stable Aggregate Forwarding Rate

**Definition:**

Average rate of traffic forwarded by the DUT during the Startup Phase.

**Discussion:**

Stable Aggregate Forwarding Rate is the calculated average of the Aggregate Forwarding Rates measured during the Startup Phase.

**Measurement units:**

pps



Issues:

The act of the DUT establishing the Startup Conditions could influence the forwarding rate in certain implementations so that this "baseline" for the remainder of the test is lowered. The alternative is to change the definition of Stable Aggregate Forwarding Rate so that it measured during the Startup Phase, but after Startup Conditions are achieved. The disadvantage of this definition would be that it loses measurement of any impact that establishing Startup Conditions would have on forwarding rate. When comparing the Startup Aggregate Forwarding Rate benchmark of two devices it is preferred to know the impact establishing Startup Conditions has on Forwarding Rate. The definition was therefore selected so that Stable Aggregate Forwarding Rate is calculated from measurement samples throughout the entire Startup Phase.

See Also:

Startup Phase  
Aggregate Forwarding Rate

### 3.3.2.2 Stable Latency

Definition:

Average measured latency of traffic forwarded by the DUT during the Startup Phase.

Discussion:

Stable Latency is the calculated average Latency during the Startup Phase.

Measurement units:

seconds

Issues:

None

See Also:

Startup Phase  
Stable Aggregate Forwarding Rate

### 3.3.2.3 Stable Session Count

Definition:

Total number of control plane sessions/adjacencies established and maintained by the DUT during the Startup Phase and prior to Instability Conditions being initiated.

Discussion:

This measurement should be made after the Control  
Plane Startup Conditions are applied to the DUT.

Measurement units:  
sessions

Issues:  
None

See Also:  
Startup Phase

3.3.3 Control Plane

3.3.3.1 Control Plane Configuration Set

Definition:  
The routing protocols and scaling values used for the Accelerated Life Benchmarking.

Discussion:  
Control Plane Configuration Set is shown in Figure 2 and specifies the Routing Protocols, Multicast, and MPLS configuration. Specific protocols can be enabled or disabled for a benchmark test.

Measurement units:  
N/A

Issues:  
None

See Also:  
Data Plane Configuration Set  
Management Configuration Set  
Security Configuration Set

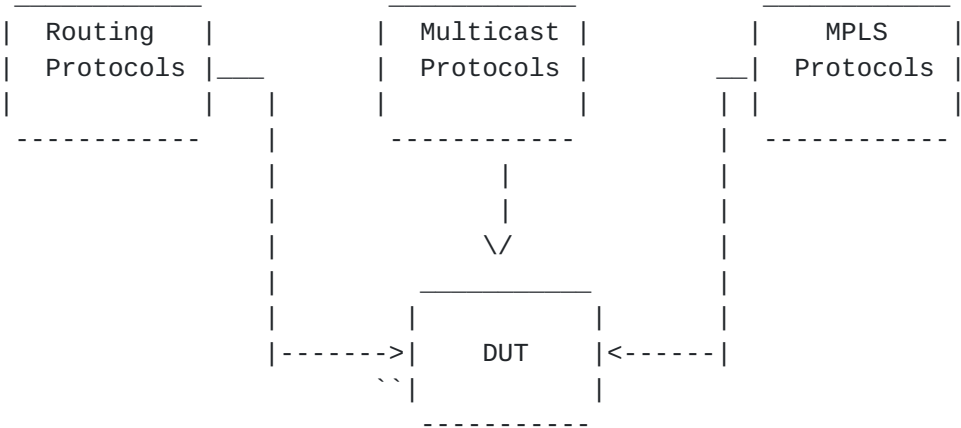


Figure 2. Control Plane Configuration Module





### 3.3.3.2 Control Plane Startup Conditions

Definition:

Control Plane conditions that occur at the start of the Accelerated Stress Benchmarking to establish conditions for the remainder of the test.

Discussion:

Startup Conditions may cause stress on the DUT and produce failure. Startup Conditions for the Control Plane include session establishment rate, number of sessions established and number of routes learned.

Measurement units:

N/A

Issues:

None

See Also:

Startup Conditions  
Security Plane Startup Conditions  
Control Plane Configuration Set

### 3.3.4 Data Plane

#### 3.3.4.1 Data Plane Configuration Set

Definition:

The data traffic profile enabled for the Accelerated Stress Benchmarking.

Discussion:

Data Plane Configuration Set includes the Traffic Profile and interfaces used for the Accelerated Stress Benchmarking.

Measurement Units:

N/A

Issues: None

See Also:

Traffic Profile

#### 3.3.4.2 Traffic Profile

Definition

The characteristics of the Offered Load to the DUT used for the Accelerated Stress Benchmarking.

Discussion

The Traffic Profile specifies the number of packet size(s), packet

rate per interface, number of flows, and encapsulation used for the offered load to the DUT.

Measurement Units:

Traffic Profile is reported as follows:

Parameter	Units
-----	-----
Packet Size(s)	bytes
Packet Rate(interface)	array of packets per second
Number of Flows	number
Encapsulation(flow)	array of encapsulation type

Issues:

None

See Also:

Data Plane Configuration Set

### 3.3.5 Management Plane

#### 3.3.5.1 Management Plane Configuration Set

Definition:

The router management features enabled for the Accelerated Stress Test.

Discussion:

A key component of the Accelerated Stress Test is the Management Configuration Set to assess manageability of the router under stress. The Management Configuration Set defines the management configuration of the DUT. Features that are part of the Management Configuration Set include Telnet access, SNMP, Logging/Debug, and Statistics Collection, and services such as FTP, as shown in Figure 3. These features should be enabled throughout the Stress test. SNMP Gets should be made continuously with multiple FTP and Telnet sessions operating simultaneously. FTP sessions should be opened and closed at varying intervals and get and put files while open. Telnet sessions should be opened and closed at varying intervals and enter valid and invalid show and configuration commands while open.

Measurement units:

N/A

Issues:

None

See Also:

Control Plane Configuration Set

Data Plane Configuration Set

Security Plane Configuration Set



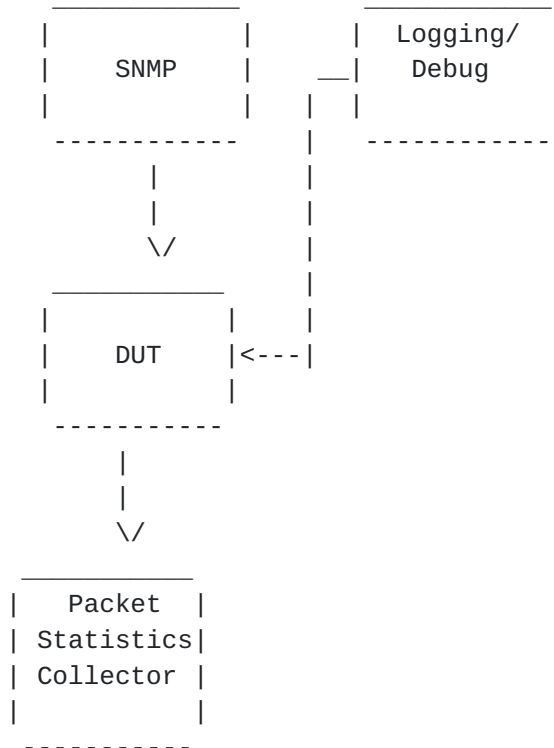


Figure 3. Management Plane Configuration Set

### 3.3.6 Security Plane

#### 3.3.6.1 Security Plane Configuration Set

##### Definition:

Security features and scaling enabled for the Accelerated Stress Test.

##### Discussion:

The Security Plane Configuration Set includes the configuration and scaling of ACLs, Firewall, IPsec, and User Access, as shown in Figure 4. Tunnels should be established and policies configured. Instability is introduced by flapping tunnels and configuring and removing policies.

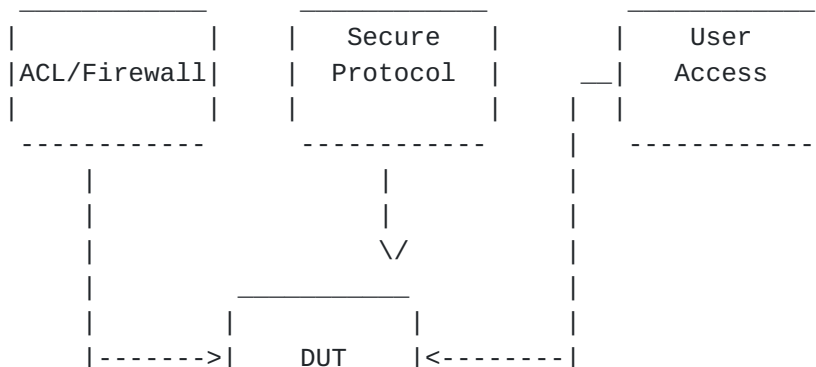




Figure 4. Security Configuration Module

Measurement units:

N/A

Issues:

None

See Also:

ACL Configuration Set

Secure Protocol Configuration Set

Password Login Configuration Set

### 3.3.6.2 Security Plane Startup Conditions

Definition:

Security Plane conditions that occur at the start of the Accelerated Stress Benchmarking to establish conditions for the remainder of the test.

Discussion:

Startup Conditions may cause stress on the DUT and produce failure. Startup Conditions for the Security Plane include session establishment rate, number of sessions established and number of policies learned, and number of user access sessions opened.

Measurement units:

N/A

Issues:

None

See Also:

Startup Conditions

Data Plane Startup Conditions

Management Plane Startup Conditions

Security Plane Startup Conditions

## 3.4 Instability

### 3.4.1 Instability Phase

Definition:

The portion of the benchmarking test in which the Instability Conditions are offered to the DUT.

Discussion:

The Instability Phase is the middle Phase of of the benchmarking test following the Startup Phase and preceding the Recovery Phase.

Measurement Units:

None

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Issues:

None

See Also:

Instability Conditions

Startup Phase

Recovery Phase

3.4.2 Benchmarks

3.4.2.1 Unstable Aggregate Forwarding Rate

Definition:

Rate of traffic forwarded by the DUT during the Instability Phase.

Discussion:

Unstable Aggregated Forwarding Rate is an instantaneous measurement of the Aggregate Forwarding Rate during the Instability Phase.

Measurement units:

pps

Issues:

None

See Also:

Instability Conditions

Aggregate Forwarding Rate

3.4.2.2 Degraded Aggregate Forwarding Rate

Definition:

The reduction in Aggregate Forwarding Rate during the Instability Phase.

Discussion:

The Degraded Aggregate Forwarding Rate is calculated for each measurement of the Unstable Aggregate Forwarding Rate. The Degraded Aggregate Forwarding Rate is calculated by subtracting each measurement of the Unstable Aggregate Forwarding Rate from the Stable Aggregate Forwarding Rate, such that

Degraded Forwarding Rate =  
Stable Aggregate Forwarding Rate -  
Unstable Aggregate Forwarding Rate

Ideally, the Degraded Aggregate Forwarding Rate is zero.

Measurement Units:

pps

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Issues:

None

See Also:

Instability Phase

Unstable Aggregate Forwarding Rate

### 3.4.2.3 Average Degraded Aggregate Forwarding Rate

Definition

DUT Benchmark that is the calculated average of the obtained Degraded Forwarding Rates.

Discussion:

Measurement Units:

pps

Issues:

None

See Also:

Degraded Aggregate Forwarding Rate

### 3.4.2.4 Unstable Latency

Definition:

The average increase in measured packet latency during the Instability Phase compared to the Startup Phase.

Discussion:

Latency SHOULD be measured at a fixed interval during the Instability Phase. Unstable Latency is the difference between Stable Latency and the average Latency measured during the Instability Phase. It is expected that there be an increase in average latency from the Startup Phase to the Instability phase, but it is possible that the difference be zero. The Unstable Latency cannot be a negative number.

Measurement units:

seconds

Issues:

None

See Also:

Instability Phase

Stable Latency



#### 3.4.2.5 Unstable Uncontrolled Sessions Lost

Definition:

Control Plane sessions that are in the down state but were not intentionally brought down during the Instability Phase.

Discussion:

The test equipment is able to control protocol session state with the DUT. The test equipment is also to monitor for sessions lost with the DUT which the test equipment itself did not intentionally bring down.

Measurement units:

sessions

Issues:

None

See Also:

Controlled Session Loss  
Uncontrolled Session Loss

#### 3.4.3 Instability Conditions

##### 3.4.3.1 Control Plane Instability Conditions

Definition:

Control Plane conditions that occur during the Accelerated Stress Benchmark to produce instability and stress the DUT.

Discussion:

Control Plane Instability Conditions are experienced by the DUT after the Startup Conditions have completed. Control Plane Instability Conditions experienced by the DUT include session loss, route withdrawal, and route cost changes.

Measurement units:

N/A

Issues:

None

See Also:

Instability Conditions  
Data Plane Instability Conditions  
Management Plane Instability Conditions  
Security Plane Instability Conditions



#### 3.4.3.2 Data Plane Instability Conditions

Definition:

Data Plane conditions that occur during the Accelerated Stress Benchmark to produce instability and stress the DUT.

Discussion:

Data Plane Instability Conditions are experienced by the DUT after the Startup Conditions have completed. Data Plane Instability Conditions experienced by the DUT include interface shutdown, link loss, and overloaded links.

Measurement units:

N/A

Issues:

None

See Also:

Instability Conditions  
Control Plane Instability Conditions  
Management Plane Instability Conditions  
Security Plane Instability Conditions

#### 3.4.3.3 Management Plane Instability Conditions

Definition:

Management Plane conditions that occur during the Accelerated Life Benchmark to produce instability and stress the DUT.

Discussion:

Management Plane Instability Conditions are experienced by the DUT after the Startup Conditions have completed. Management Plane Instability Conditions experienced by the DUT include repeated FTP of large files.

Measurement units:

N/A

Issues:

None

See Also:

Instability Conditions  
Control Plane Instability Conditions  
Data Plane Instability Conditions  
Security Plane Instability Conditions

#### 3.4.3.4 Security Plane Instability Conditions

Definition:

Security Plane conditions that occur during the Accelerated

Life Benchmark to produce instability and stress the DUT.



Discussion:

Security Plane Instability Conditions are experienced by the DUT after the Startup Conditions have completed. Security Plane Instability Conditions experienced by the DUT include session loss and uninitiated policy changes.

Measurement units:

N/A

Issues:

None

See Also:

Instability Conditions  
Control Plane Instability Conditions  
Data Plane Instability Conditions  
Management Plane Instability Conditions

### 3.5 Recovery

#### 3.5.1 Recovery Phase

Definition:

The portion of the benchmarking test in which the Startup Conditions are generated with the DUT, but the Instability Conditions are no longer offered to the DUT.

Discussion:

The Recovery Phase is the final Phase of the benchmarking test following the Startup Phase and Instability Phase. Startup Conditions must not be Restarted.

Measurement Units:

None

Issues:

None

See Also:

Startup Conditions  
Startup Phase  
Instability Conditions  
Instability Phase

#### 3.5.2 Benchmarks

##### 3.5.2.1 Recovered Aggregate Forwarding Rate

Definition

Rate of traffic forwarded by the DUT during the Recovery  
Phase.

Discussion:

Recovered Aggregate Forwarding Rate is an instantaneous measurement of the Aggregate Forwarding Rate during the Recovery Phase. Ideally, each measurement of the Recovered Aggregate Forwarding Rate equals the Stable Aggregate Forwarding Rate because the Instability Conditions do not exist in both the Startup and Recovery Phases.

Measurement Units:

pps

Issues:

None

See Also:

Aggregate Forwarding Rate  
Recovery Phase  
Recovered Aggregate Forwarding Rate  
Startup Phase  
Stable Aggregate Forwarding Rate

### 3.5.2.2 Recovered Latency

Definition:

The average increase in measured packet latency during the Recovery Phase compared to the Startup Phase.

Discussion:

Latency SHOULD be measured at a fixed interval during the Recovery Phase. Unstable Latency is the difference between Stable Latency and the average Latency measured during the Recovery Phase. It is expected that there be no increase in average latency from the Startup Phase to the Recovery Phase. The Recovered Latency cannot be a negative number.

Measurement units:

seconds

Issues: None

See Also:

Recovery Phase  
Stable Latency

### 3.5.2.3 Recovery Time

Definition

The amount of time for the Recovered Aggregate Forwarding Rate to become equal to the Stable Aggregate Forwarding Rate.



Discussion

Recovery Time is measured beginning at the instant the Instability Phase ends until the Recovered Aggregate Forwarding Rate equals the Stable Aggregate Forwarding Rate for a minimum duration of 180 consecutive seconds.

Measurement Units:

seconds

Issues:

None

See Also:

Recovered Aggregate Forwarding Rate  
Stable Aggregate Forwarding Rate

#### 3.5.2.4 Recovered Uncontrolled Control Plane Sessions Lost

Definition:

Control Plane sessions that are in the down state but were not intentionally brought down during the Recovery Phase.

Discussion:

The test equipment is able to control protocol session state with the DUT. The test equipment is also to monitor for sessions lost with the DUT which the test equipment itself did not intentionally bring down.

Measurement units:

sessions

Issues:

None

See Also:

Controlled Session Loss  
Uncontrolled Session Loss

#### 3.5.2.5 Variability Benchmarks

Definition:

The difference between the measured Benchmarks of the same DUT over multiple iterations.

Discussion:

Ideally, the benchmarks measured should be the same for multiple iterations with the same DUT. Configuration Sets Instability conditions SHOULD be held constant for

this benchmark. Whether the DUT can exhibit such predictable and repeatable behavior is an important benchmark in itself.

Measurement units:

As applicable to each Benchmark. The results are to be presented in a table format for successive Iterations. Ideally, the differences should be zero.

Issues:

None

See Also:

Startup Period  
Instability Period  
Recovery Period

4. Security Considerations

Documents of this type do not directly effect the security of the Internet or of corporate networks as long as benchmarking is not performed on devices or systems connected to operating networks.

5. Normative References

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6. Informative References

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- [CONVMETH] Poretsky, S., "Benchmarking Methodology for IGP Data Plane Route Convergence", [draft-ietf-bmwg-igp-dataplane-conv-meth-05](#), work in progress, February 2005.
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## Appendix 1. White Box Benchmarking Terminology

### Minimum Available Memory

#### Definition:

Minimum DUT Available Memory during the duration of the Accelerated Stress Test.

#### Discussion:

It is necessary to monitor DUT memory to measure this benchmark.

#### Measurement units:

bytes

#### Issues: None

#### See Also:

Maximum CPU Utilization

### Maximum CPU Utilization

#### Definition:

Maximum DUT CPU utilization during the duration of the Accelerated Stress Test.

#### Discussion:

It is necessary to monitor DUT CPU Utilization to measure this benchmark.

#### Measurement units: %

#### Issues: None

#### See Also:



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