Achieving Reliability in Converged MPLS Networks

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Agenda

- Services Are Converging
- The Service Disruption Problem
- The High Availability Solution
- Validating High Availability Mechanisms

Services Are Converging

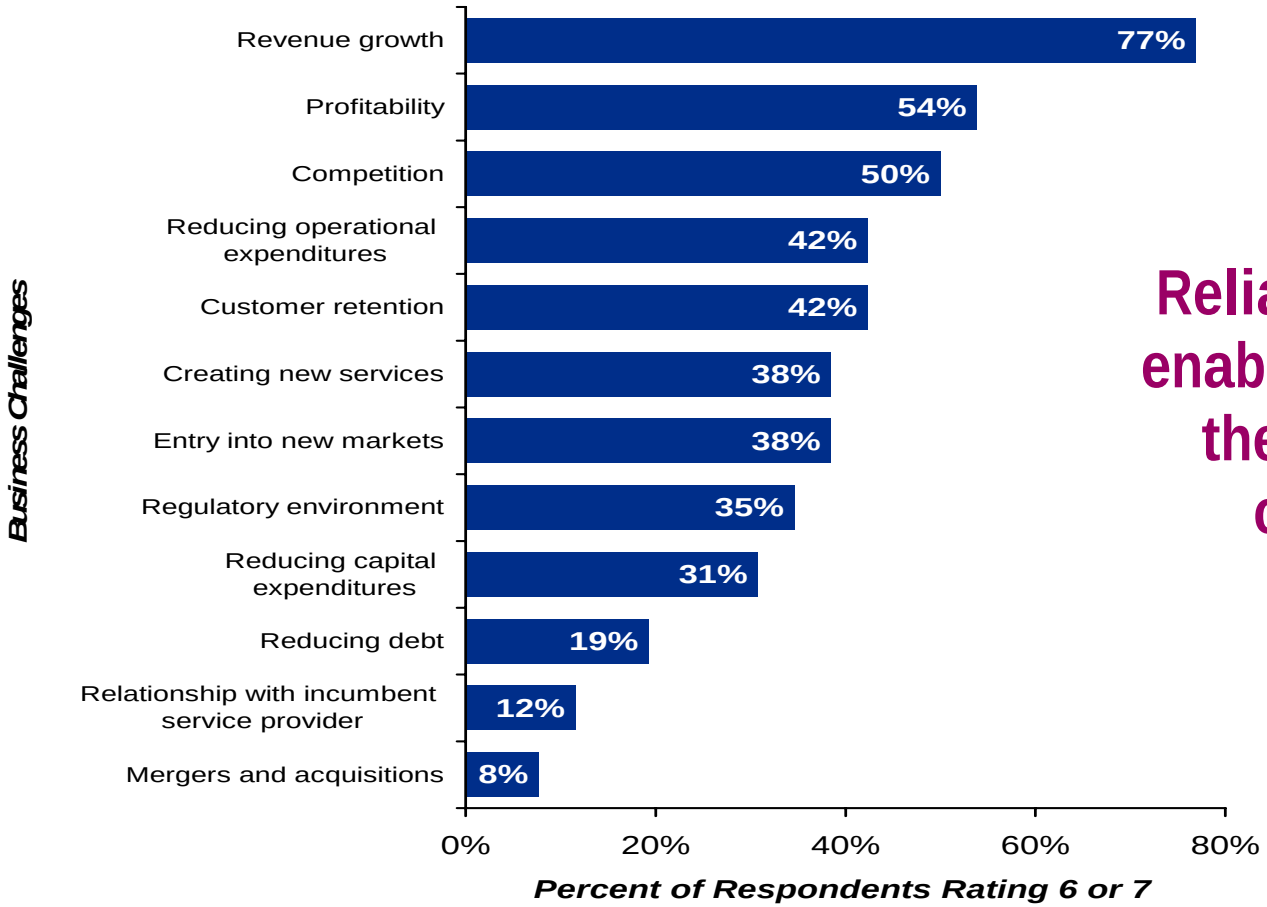
Key Drivers

- Real time triple play services (IPTV, VoIP) will be delivered over a converged IP/MPLS core. These services require stringent QoS mechanisms to guarantee the user experience
- Rationalisation of services onto a single IP/MPLS infrastructure with reduce capital (CAPEX) and operational (OPEX) expenses
- Emerging wireless services will also have an impact on the core IP/MPLS network.

A converged IP / MPLS infrastructure carrying multiple diverse services has to be reliable

Services Are Converging

Carrier/Service Provider Business Challenges

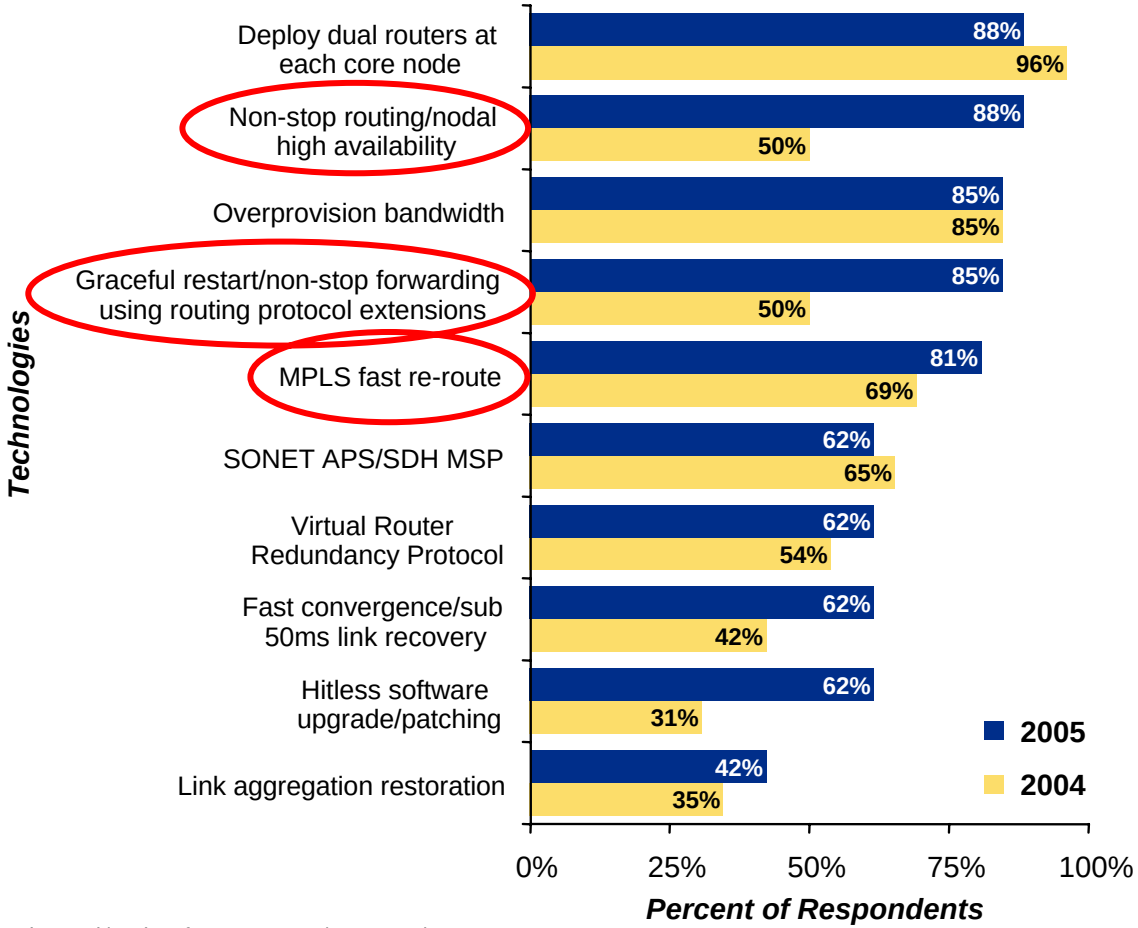


Reliability is a key enabler for meeting these business challenges

Service Provider Plans for IP, MPLS, and ATM: North America & Europe 2004. Infonetics, Dec 2004

Services Are Converging

Network High Availability Use



A mix of High Availability techniques are needed to build reliability into the network

Service Provider Plans for IP, MPLS, and ATM: North America & Europe 2004. Infonetics, Dec 2004

The Service Disruption Problem

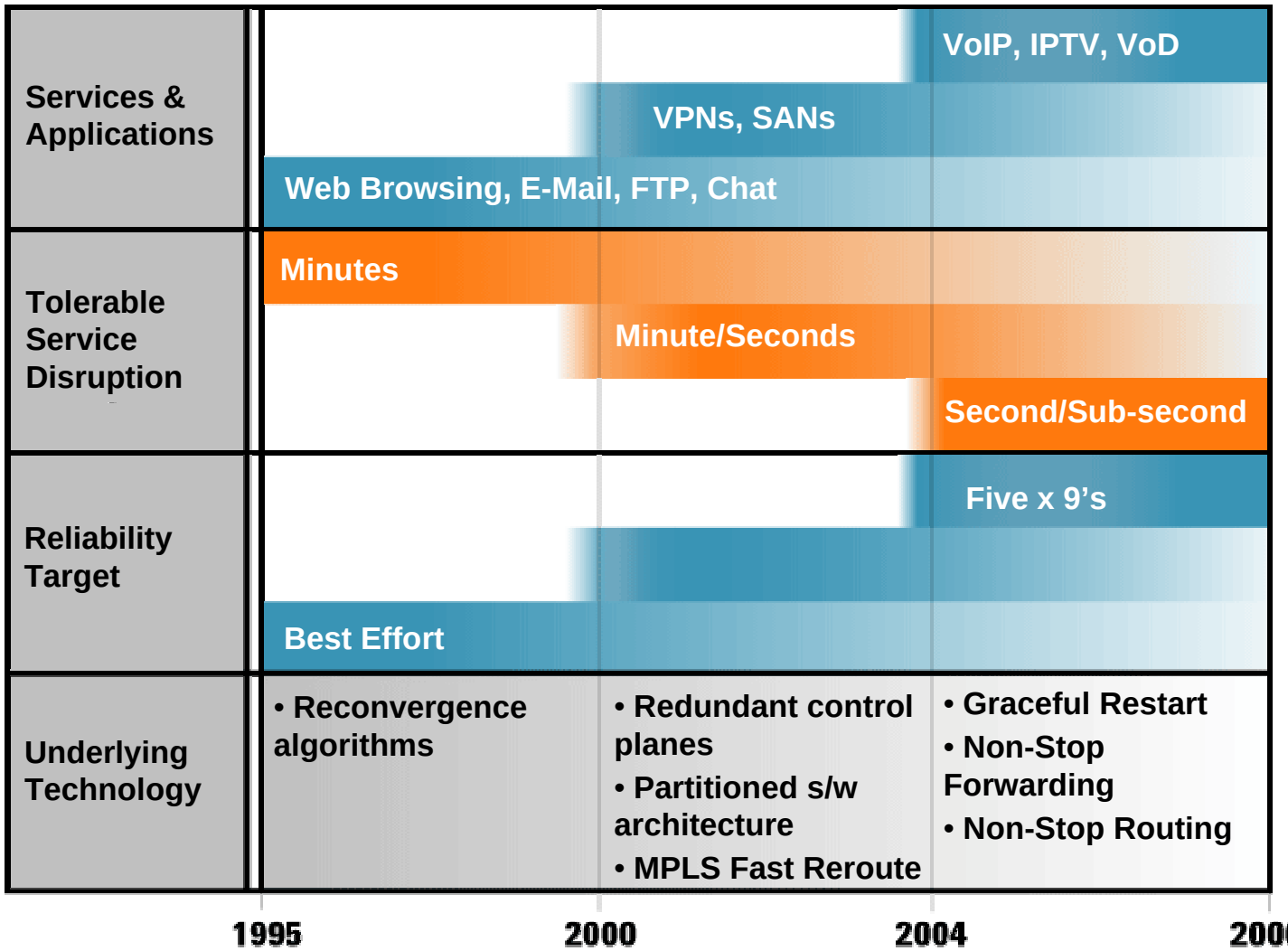
Reliability in Traditional Networks

- Routing protocol instabilities would often disrupt packet forwarding on early Router implementations (e.g. lost or delayed packets)
- Traditional IP & MPLS route convergence algorithms take too long to recover from network topology changes
- Service disruption times are in the order of minutes and performance degradation is likely to be significant

Reducing service disruption is a top priority as it can have a negative impact on revenue and customer satisfaction

The High Availability Solution

Reliability Technology Evolution



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The High Availability Solution

Mechanisms, Principles & Impact

HA Mechanism	Principle of Operation	Network Impact
Redundant Control Plane	Hardware protection - Two independent control planes with mirrored routing tables.	Routing sessions still restart. Forwarding plane exposed and service delivery disrupted.
Graceful Restart (GR)	Forwarding plane preserved as control plane recovers using neighbours as helpers	Service delivery continues; routing protocol recovery time and network ripple minimised.
MPLS Fast Reroute	Pre-established tunnel - cutover. Works in conjunction with GR and NSF	Minimises forwarding plane impact in the event of MPLS link or node failure.
Non Stop Routing	Routing updates continue between RIB and FIB in the event of an outage	Network operation continues as normal.

Achieving 99.999% reliability requires a mix of HA mechanisms

Validating High Availability Mechanisms
The Need to Test

- There will be multiple HA mechanisms utilised. The complex interaction between the individual mechanisms needs to be understood and tested.
- Multi-protocol environments are a necessity but unfortunately it also increases network complexity. Network nodes will be running multiple control and routing protocols (e.g. BGP, OSPF/ISIS, RSVP, LDP)
- Edge nodes (PE) are considered amongst the highest risk devices as these typically have a large number of peering relationships
- The network is only as reliable as its weakest link

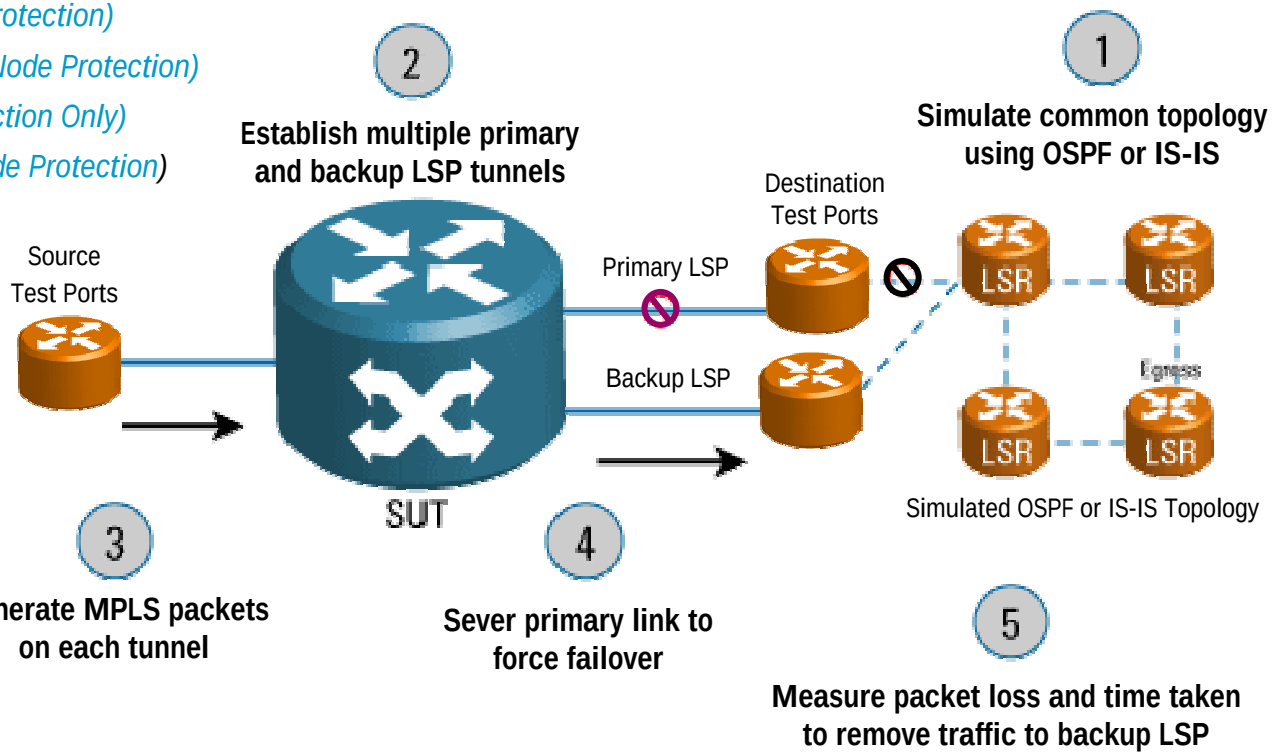
Quantifying the robustness of HA mechanisms in a realistic test environment is essential to minimize service disruption

Validating High Availability Mechanisms

Test Method 1 – Scaled MPLS Fast Reroute

Simulated Failure Modes:

- *Laser Off (Line and Node Protection)*
- *Bring down PPP (Line and Node Protection)*
- *Withdraw LSA (Node Protection Only)*
- *SONET Alarm (Line and Node Protection)*



1) **Measure duration of switchover to backup MPLS LSP**
2) **Measure packet loss, latency and jitter**

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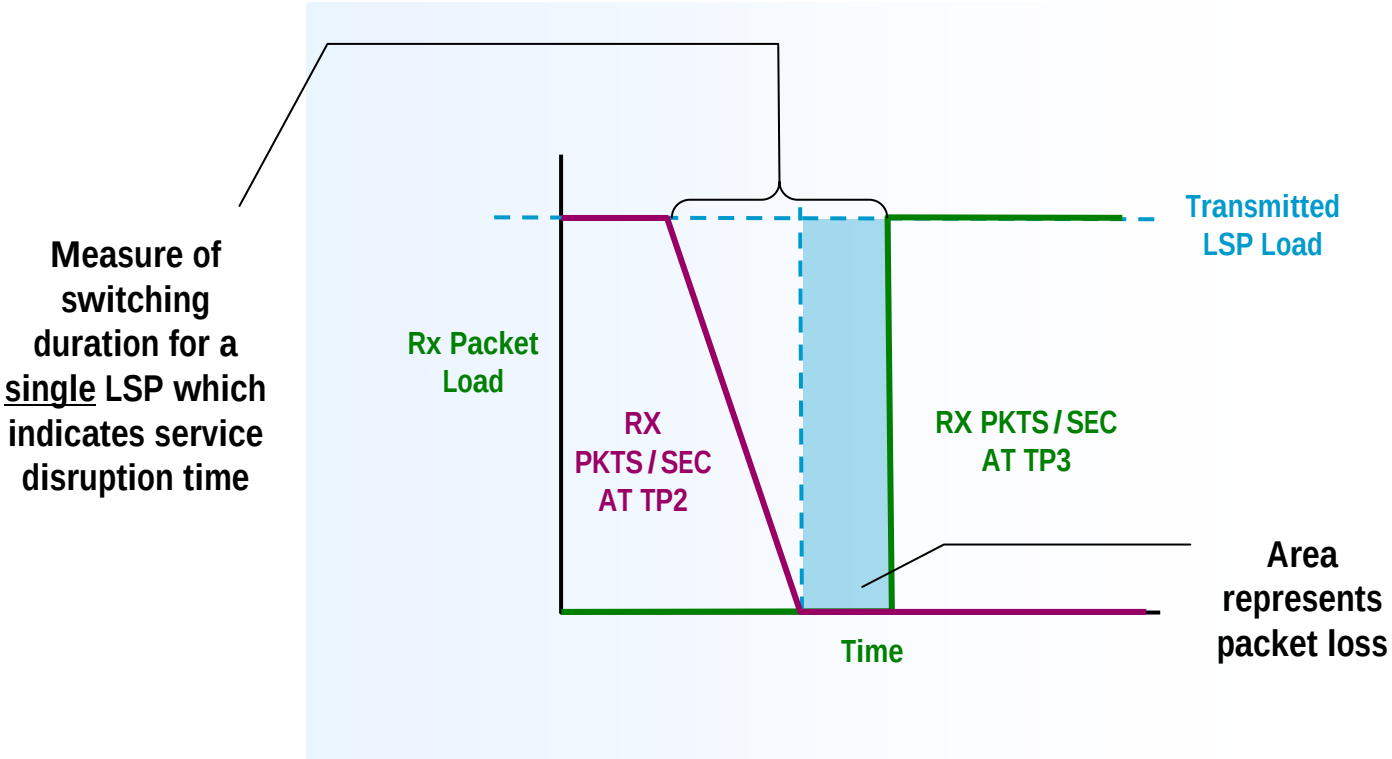
Validating High Availability Mechanisms

MPLS Fast Reroute Measurements



The right measurements are critical to verify that HA mechanisms are operating correctly

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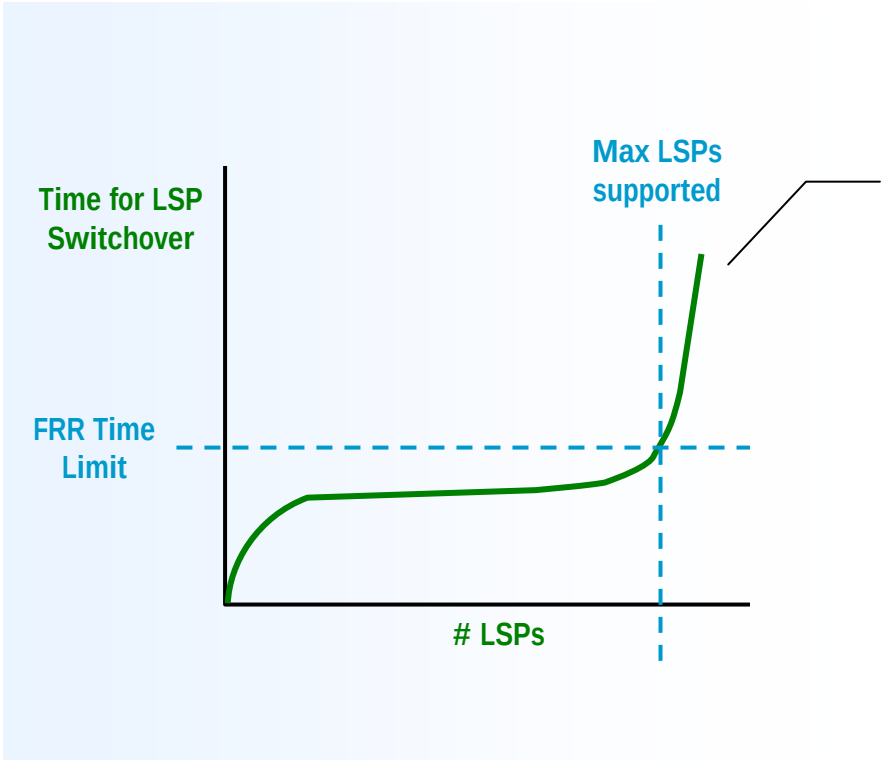
Validating High Availability Mechanisms

MPLS Fast Reroute Measurements



After multiple tests, plot a graph of switchover time versus # LSPs to measure scalability limits

The right measurements are critical to verify that HA mechanisms are operating correctly

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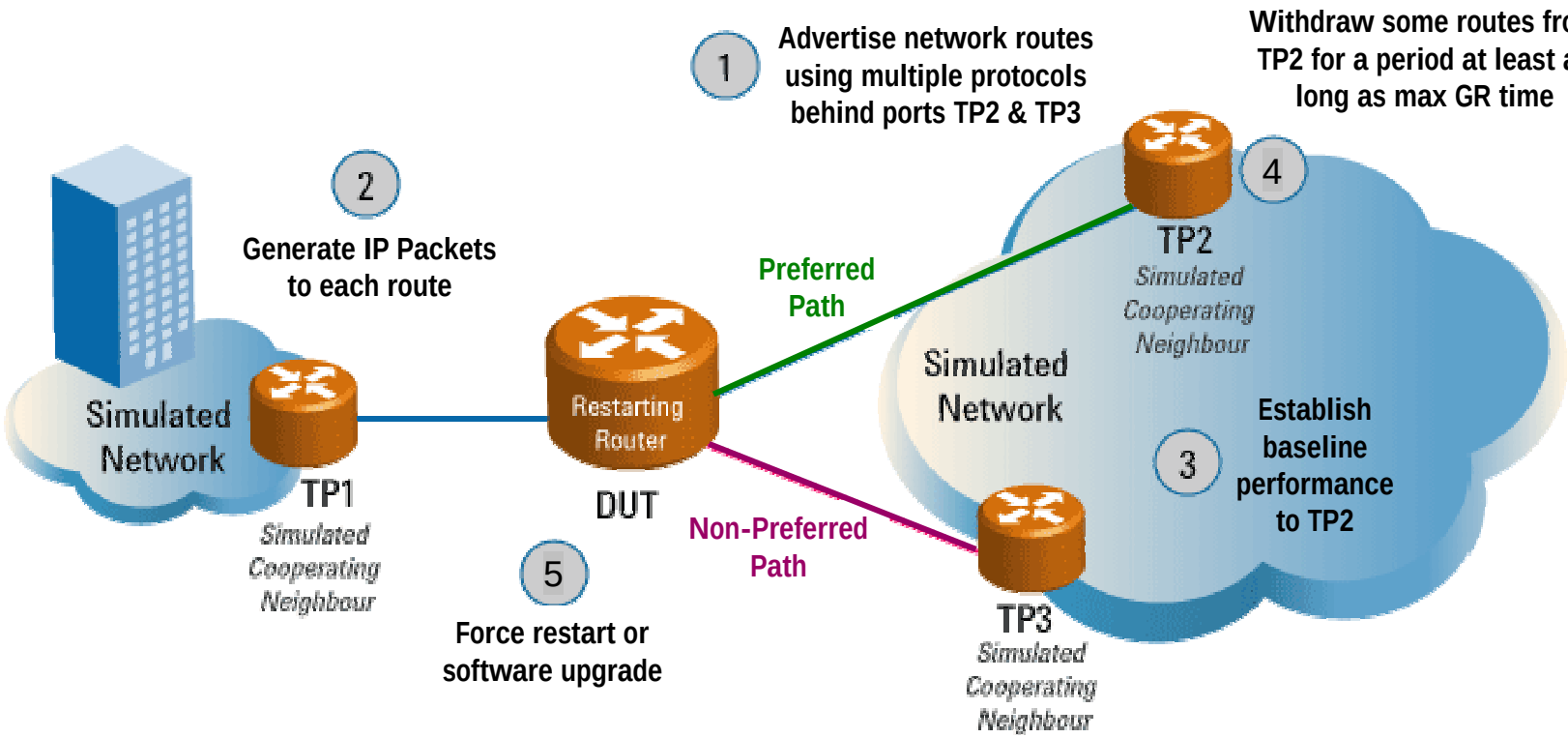
Validating High Availability Mechanisms

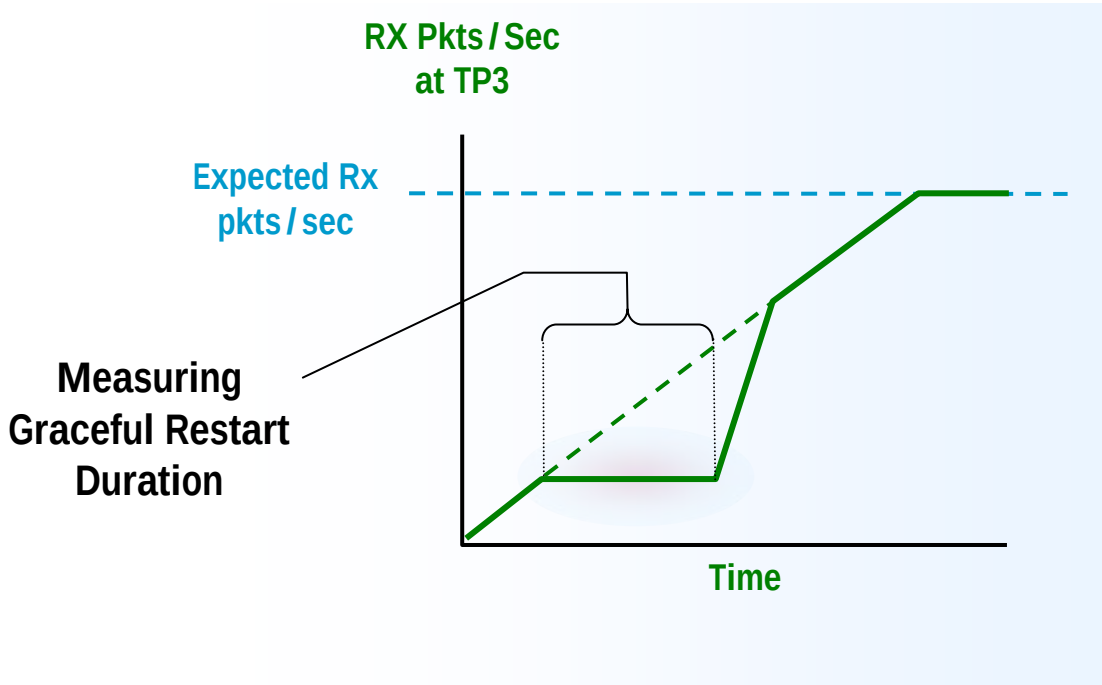
Test Method 2 – Multi-protocol Graceful Restart



1) Verify continuity of forwarding for the duration of graceful restart
2) Verify that restart duration is within the specified time interval
3) Confirm database re-sync after removal of routes marked as ‘stale’ during restart
4) Verify impact of restart on other protocol functions; software architecture demarcation

Validating High Availability Mechanisms

Graceful Restart Measurements



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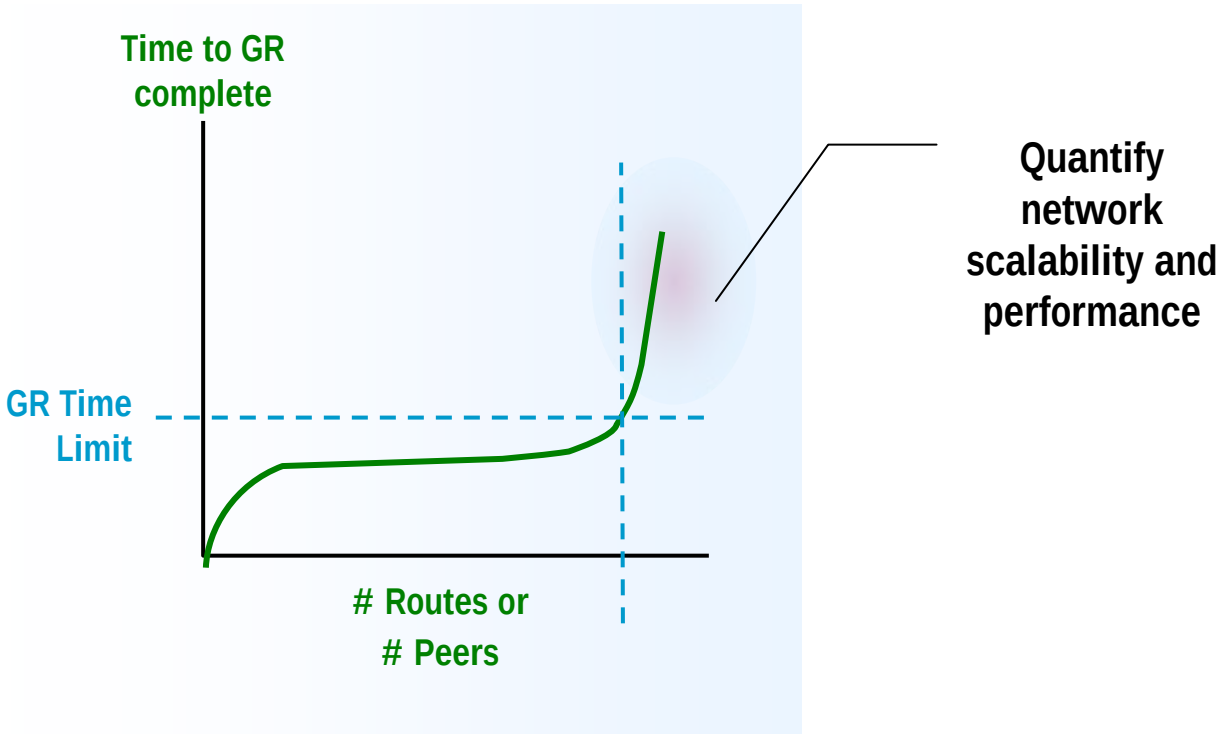
Validating High Availability Mechanisms

Graceful Restart Measurements



The right measurements are critical to verify that HA mechanisms are operating correctly

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Validating High Availability Mechanisms
Test Capabilities

Test Capability	Primary Benefit
Comprehensive HA protocol coverage	Allows all the key HA mechanisms to be tested individually or concurrently
Concurrent multi-protocol emulation	Provide a more realistic environment for improved test accuracy
Ability to scale the test	Verify that the HA mechanisms continue to operate correctly in large & complex network topologies
Real Time Measurements & Graphs	Provide real time instant feedback on the performance of the HA mechanisms under test – reduce the “time-to-insight” factor

Summary

Trends	A converged IP/MPLS infrastructure will carry multiple services and applications – reliability will be a key requirement
Risks	Service disruption has a negative impact on revenue and customer satisfaction
Solutions	Designing IP/MPLS networks using High Availability mechanisms and techniques is critical for ensuring reliability
Validation	Network conditions change over time. HA mechanisms must be continually validated to ensure that they remain effective
Tools	HA test tools can be used to verify that HA mechanisms are performing correctly in highly-scaled multi-protocol networks