TWAMP - RFC-5357

A Two-Way Active Measurement Protocol

1. What is it?

TWAMP means **T**wo **W**ay **A**ctive **M**easurement **P**rotocol.
Based on RFC-5357 standard, TWAMP use the methodology and the architecture of OWAMP (**O**ne **W**ay **A**ctive **M**easurement **P**rotocol based on RFC-4656) foundation, where Round Trip or Two-Way Measurement has been added to have additional tool to isolate Network issue and for Network Performance optimization.
The key TWAMP advantages are the following:

- Easy to set up and use
- Time synchronization is not mandatory, when for OWAMP is required.
- All network equipment manufacturer has already implemented it or in process to do it.

This protocol is used to measure the QoS (Quality of Service) KPIs between any two point of IP (Layer 3) Network.

2. TWAMP KPIs:

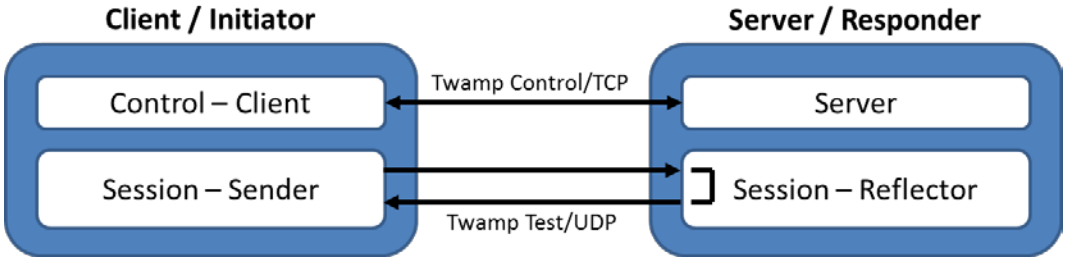
- Lost Packets
- Out of Order Packets
- Duplicate Packets
- Latency/Delay
- Packet Delay Variation – PDV (as defined in the ITU-T Y.1540 standard)
- IP Delay Variation – IPDV (as defined in the RFC-3550 standard)
- Inter Delay - time taken by the TWAMP responder to process the incoming packets and respond.
- TTL

All these metrics are available for One Way or Two Way (Round Trip) Measurements.
Two Way (Round Trip) measurement do not required that both end point are time synchronized, except the One-Way Delay/Latency measurement, for that specific case both end points must be time synchronized.

3. TWAMP architecture

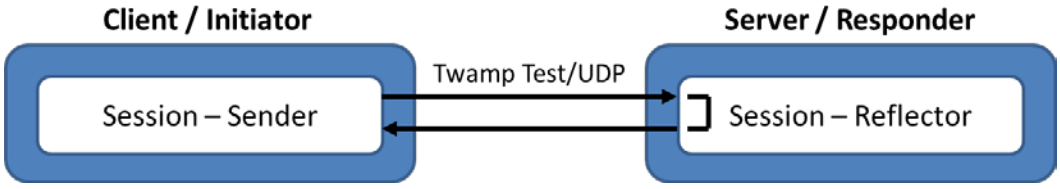
TWAMP is combination of 2 elements

- Client (Initiator)
- Server (Responder)



In the full TWAMP protocol, the Client initiates the TCP-based negotiation by connecting to the TWAMP port on the Server, which is 862 by default. The Server responds with some information about its characteristics, especially its authentication level, and a negotiation of the test follows. If the negotiation is successful, the test itself starts: again the Client initiates the test by generating UDP test traffic towards the port number that was specified by the Server. The Server responds to each UDP packet using a precise test methodology that involves exchanging timestamps.
At the end of the test or at periodic time intervals, the Client computes the measurements which can then be reported.

TWAMP Light
There is a lighter version of TWAMP called TWAMP light. In that reduced version of TWAMP, the test starts without any negotiation: the TWAMP Client generates UDP test packets to the TWAMP port on the Server, also 862 by default, and the Server responds exactly in the same manner as in the full TWAMP protocol. TWAMP light is exactly TWAMP-full without the TCP-based negotiation.



4. Time Synchronization

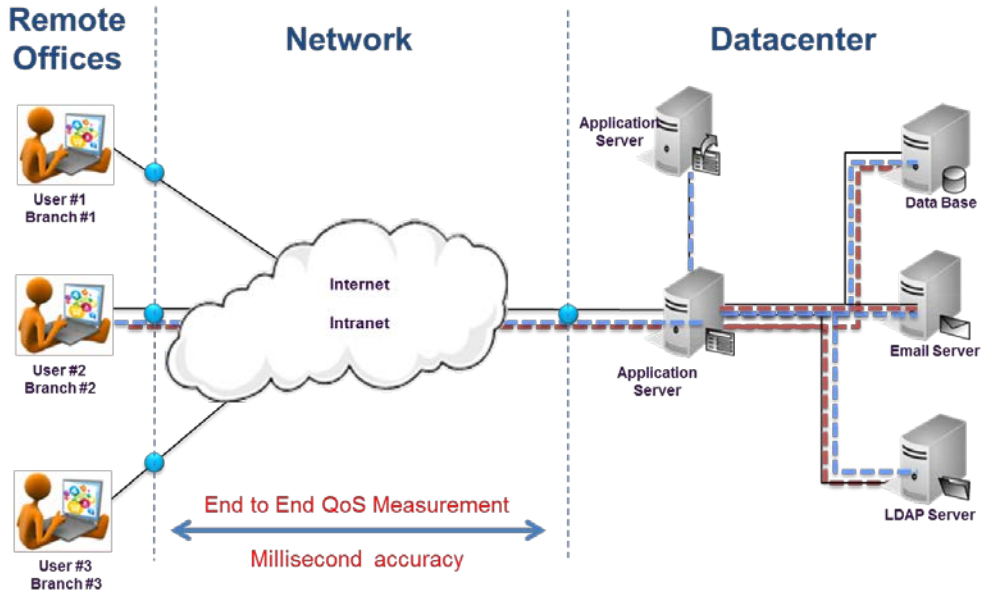
Two Way (Round Trip) measurement do not require that both end point are time synchronized.
All KPIs can be computed in both mode, One Way and Two Way, except Latency/Delay measurement available in Two Way/Round Trip or One Way.
Latency/Delay type of measurement will depend if the Server/Responder is Time Synchronized or not with the Client/Initiator.

To troubleshoot asynchronous network issues, it's highly recommended to have the initiator and the responder time synchronized in order to get One Way Latency/Delay measurements.

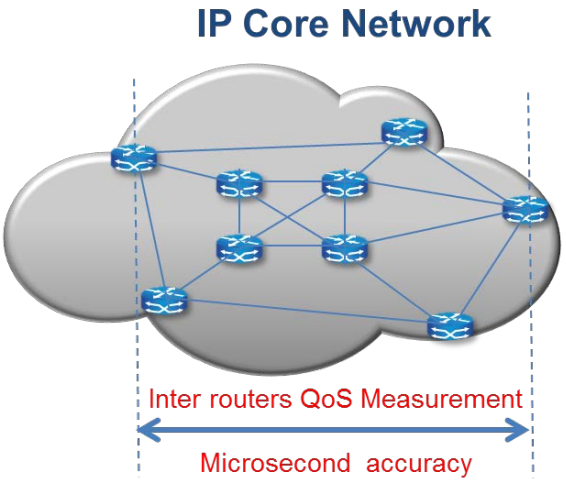
A Probe (Client/Initiator)
B Probe or Network Equipement (Server/Responder)

A Time Synch.	B Time Synch.	KPIs	Type of Measurement
Yes	Yes	Packet Loss	One Way
		Duplicate Packet	One Way
		Out Of Order Packet	One Way
		PDV - Packet delay Variation	One Way
		IPDV - Inter Packet Delay Variation	One Way
		Inter Delay	One Way
		Delay/Latency	One Way
		TTL	One Way
Yes	No	Packet Loss	One Way
		Duplicate Packet	One Way
		Out Of Order Packet	One Way
		PDV - Packet delay Variation	One Way
		IPDV - Inter Packet Delay Variation	One Way
		Inter Delay	One Way
		Delay/Latency	Two Way - Round Trip
		TTL	One Way

The clock accuracy used to synchronize the TWAMP Client and Server, will depend on where the measurements are performed.



The clock accuracy that fits perfectly the accuracy challenge of End to End One Way Latency/Delay measurements is NTP (Network Time Protocol) with his millisecond accuracy.



The clock technology that fits perfectly the accuracy challenge of an IP core or Mobile Backhaul Network is PTPv2 (IEEE 1588 with Telecom Profile) with his µs accuracy. In several cases PTPv2 is already used in Mobile Backhaul Networks.

There are some proprietary solutions on the market that can provide µs clock accuracy but usually they are based on specific and proprietary hardware design.

There is one key point to consider when you deploy Network Performance Monitoring Solution is to have a future proof solution, it means a software based solution that can be use in legacy Network infrastructure, in NFV/SDN or Hybrid environment.

5. TWAMP positioning

There is some confusion as to the positioning of TWAMP against two other well-known Layer 3 Performance Monitoring technologies.

- IP SLA
- Ping – ICMP

Features		TWAMP	Ping - ICMP Echo	IP SLA	Advisor SLA's TWAMP Solution
Standard based		Yes - RFC-5357	Yes, RFC-792	Yes and No	Yes
Full TWAMP		Yes	N/A	No	Yes
TWAMP Light		Yes	N/A	Yes	Yes
IP Network		Yes	No	Yes	Yes
IP Connectivity Check		No	Yes	No	Yes
Robust and reliable Test Methodology		Yes	No	No, issue during high traffic load conditions the same processor is used for Routing capability and IP SLA monitoring	Yes
Two Way Round Trip KPIs	Packet Loss	Yes	Yes but not accurate and not reliable sometime routers can limit or block ICMP messages	Yes	Yes
	Duplicate Packet	Yes	No	No	Yes
	Out Of Order Packet	Yes	No	No	Yes
	PDV - Packet delay Variation	Yes	No	Yes	Yes
	IPDV - Inter Packet Delay Variation	Yes	No	No	Yes
	Inter Delay	Yes	No	No	Yes
	Delay/Latency	Yes	Yes but not accurate and not reliable sometime routers can limit or block ICMP messages	Yes	Yes
	TTL	Yes	Yes	No	Yes
One Way KPIs	Packet Loss	Yes	No	Yes	Yes
	Duplicate Packet	Yes	No	No	Yes
	Out Of Order Packet	Yes	No	No	Yes
	PDV - Packet delay Variation	Yes	No	Yes	Yes
	IPDV - Inter Packet Delay Variation	Yes	No	No	Yes
	Inter Delay	Yes	No	No	Yes
	Delay/Latency	Yes	No	No	Yes
	TTL	Yes	No	No	Yes
Time Accuracy for		N/A	ms	ms	µs
Software standalone solution		N/A	Yes	No Hardware proprietary	Yes and NFV ready
Hardware solution		N/A	Yes available in most of Network Equipment	Yes Hardware proprietary	Yes based on COTS (Commercial Off the Shelf) Servers
Network Equipment implementation		Yes, All new Network Equipement come with at least TWAMP Light and in the best case with TWAMP Full capability	Yes but Network Equipement can limit or block ICMP availibility and performance	Yes, but only on Cisco devices	Yes Advisor SLA software probe is NFV ready and can interact with all Network Equipment with TWAMP (Light or Full) capability
Performances		Will depend on how TWAMP has been implemented	Limited performance, only few frames per secondes	limitation due to the shared processor	Advisor SLA Probe can generate up to 12.000 Test sessions

To summarize
Ping is a good enough to have some indication regarding IP Connectivity of one network equipment and get a rough value of Latency Round Trip measurement, but this tool cannot be used as a reference.

IP SLA is a comprehensive monitoring suite however it has some limitations such as poor accuracy and performance issues that may require additional hardware.

6. TWAMP implementation in Advisor SLA

TWAMP is the latest technology implemented in Advisor SLA to give to Carriers/Service Providers a complete visibility on the performance of their IP based Network infrastructure.

With real time accurate measurement (µs accuracy), scalable Hardware & Software, and most importantly, with its open architecture capabilities, Advisor SLA minimizes operational costs, reduces MTTR and increases the quality perceived by customers.

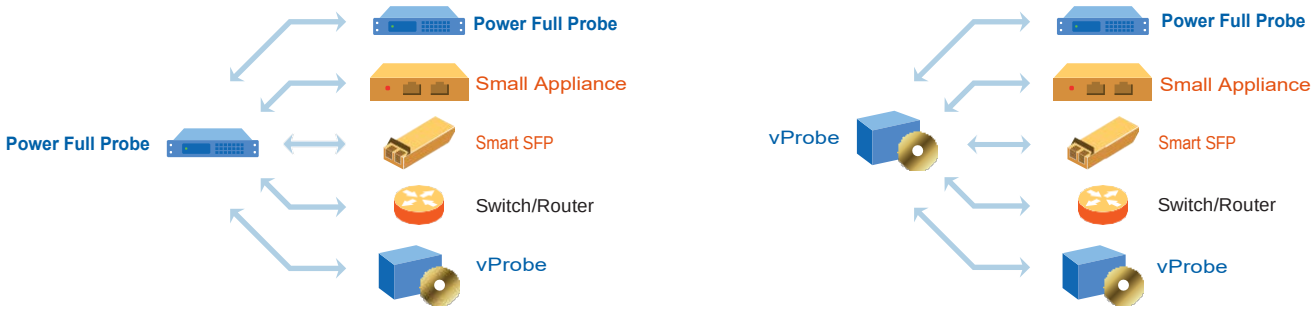
This next IP SLA generation solution is fully independent from the network topology, equipment, and interoperates with most of Network Equipment's available on the market.

Our device-agnostic approach is also critical for supporting a multivendor network and the various services being delivered.

Advisor SLA helps Carriers & Service Providers to proactively manage SLA, check the compliance of the Service Level Agreement contracts, and Network efficiency.

H-Probe (Hardware Probe) & V-Probe (Virtual Probe) from Advisor SLA interoperate with various elements to perform different types of Tests:

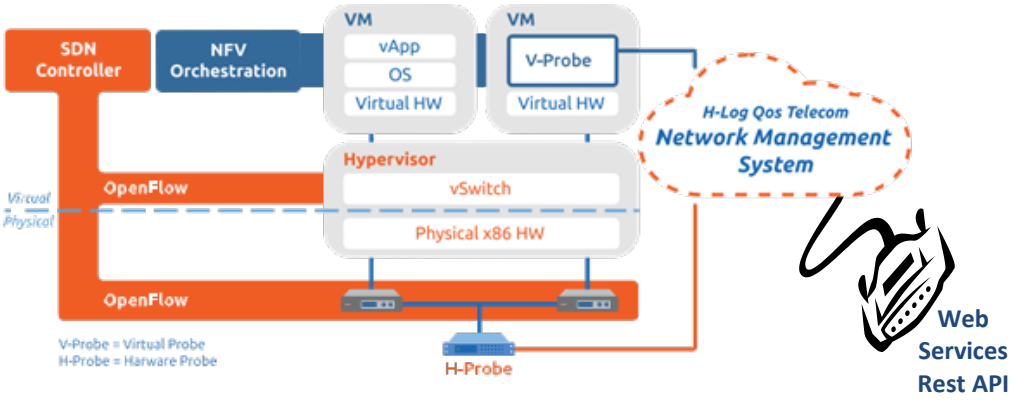
- Full Mesh Test – usually used in IP Core/Backbone Network
- Point to Multi Point Test – Useful for Mobile Backhaul Network Infrastructure
- Point to Point



All types of Probes (Hardware or Software) acts as TWAMP Initiator & Reflector.
Only Smat SFP act as Reflector Only with TWAMP light.

These 3 types of Probes can perform test between themselves but as well with Network Equipment supporting TWAMP Standard (RFC-5357), Full TWAMP stack or TWAMP Light.

V-Probe (Virtual Probe) – Software solution NFV/SDN ready
V-Probe can be easily deployed at any remote location through NFV orchestration.



Advisor SLA keyfeatures

- **Agnostic** - Network Equipment independent Solution.
- **Accurate** - KPIs (Key Performance Indicator) with the best accuracy on the market with µs resolution. Key feature to detect specific Network behavior like Fast Reroute,
- **Probe Family** - Combination of Hardware (H-Probe) & Software Probe (V-Probe) associated with a flexible licensing model, provide the right answer to customer needs in terms of Features, Performances and Price.
- **Open Platform**
    - Test Transaction based on standard, TWAMP - RFC-5357, ...
    - Integration into existing OSS by using Standard Web Services REST Full API.
- **Scalable** - Simple design configuration (1 server) up to Multiple servers architecture (RDBMS)
- **User Friendly** Web Based GUI.
- **Reliable / Trusted** solution – Already deployed at key Carriers & Service Providers: Orange, Telecom Italia, MGTS, Telmex, Renater, FCCN,....
- **Future proof -** NFV/SDN Ready

For more information, please contact us at http://advisorsla.com/contact-us.html