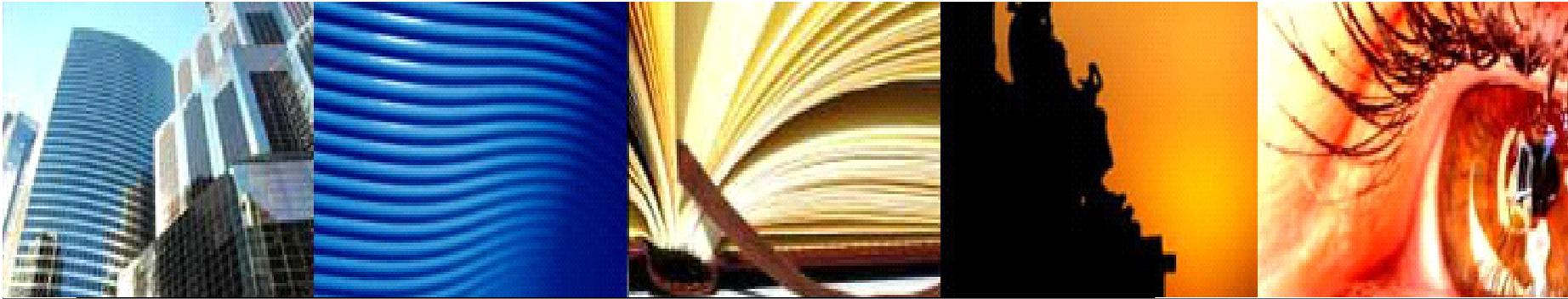


# Carrier Ethernet Installation



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There are a number of testing activities to be performed at the laboratory

1. **Evaluation of New Solutions**, often it is necessary to choose the technology and the equipment that best meet your infrastructure needs and business goals.
2. **Interoperability Testing**,
  - Interoperability: devices must be able to connect each other independently of the vendor
  - Interworking: with legacy technologies as well as core networks.
3. **MEF Certification**, consists of a set of tests that provide evidence for end-users, service providers and manufacturers alike, that products and services are compliant with MEF specifications
4. **RFC 2544 Performance Test**, RFC performance tests include Throughput, Latency, Frame Loss, Burstability or Back-to-Back, Recovery and Reset measurements

# Remote Monitoring



Even the most challenging network problems may often be solved without an on-site visit. Remote auditing can be performed directly by means of:

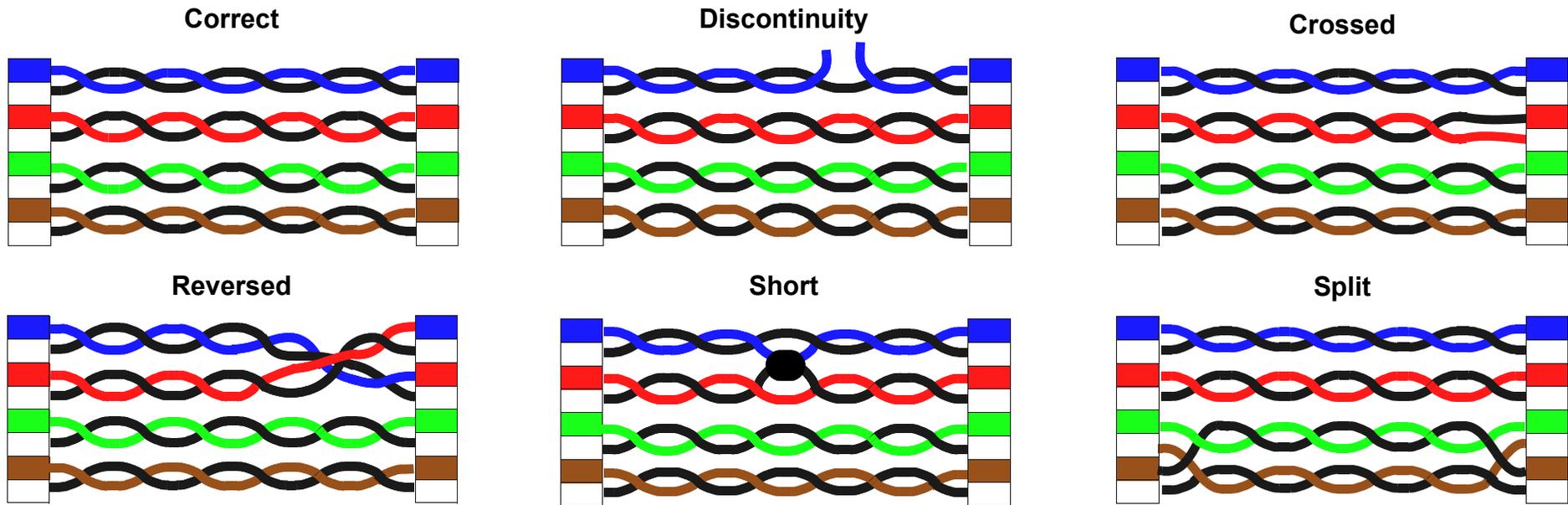
- Monitoring probes,
- Software analysis,
- Network Management System,
- Events reporting,
- Analyser connected through a remote analysis.



These tests help operators to compare devices from different vendors, with a view to choosing one, and to confirm that they work properly before purchasing them. Tests can include:

- Physical-Layer Inter operability testing
- Auto-Negotiation testing
- Flow Control and Pause protocol testing
- PCS and PMA testing, including synchronization
- MAC layer testing, including error management and full-duplex verification
- Physical interfaces: Optical and/or electrical interfaces and frequency tests
- Cabling test: Fibre Optic, UTP, Pair Bonding

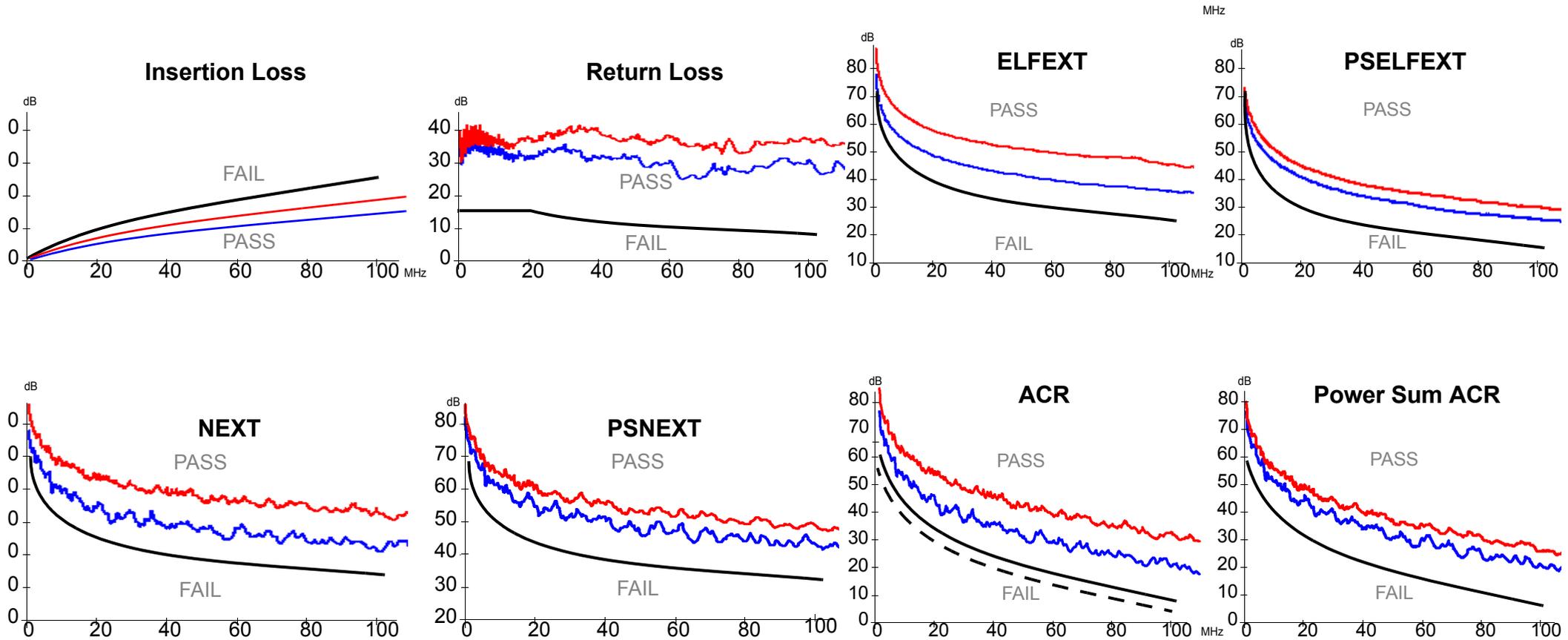
# Wiremap verification for 1000BASE-T



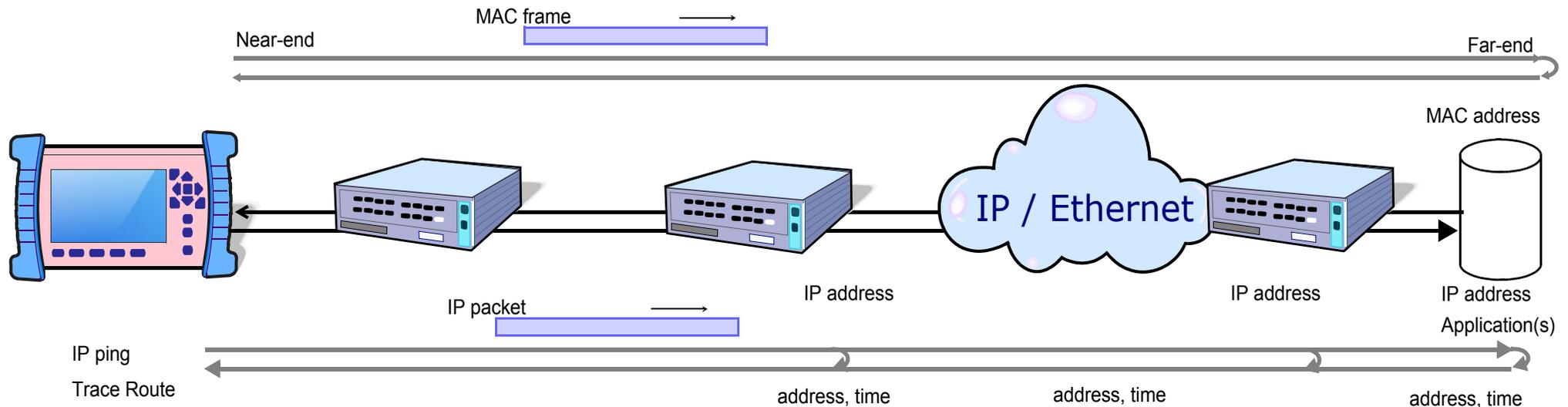
Wiremap is used to identify installation wiring errors, and it should indicate:

- proper pin termination at each end
- continuity to the remote end
- shorts between any two or more conductors
- crossed pairs or polarity swap, split pairs, reversed pairs or pair swap
- shorted pairs and any other miswiring

# UTP Cat. 5e Certification

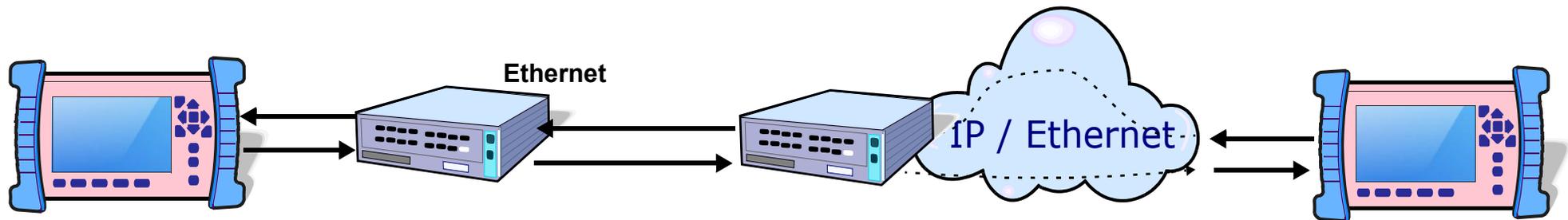


Migration from 10/100BASE-T requires a new certification of the UTP cabling for the new 1000BASE-T applying the new Cat.5e masks



The operations involved are configuration of nodes, continuity and interconnections:

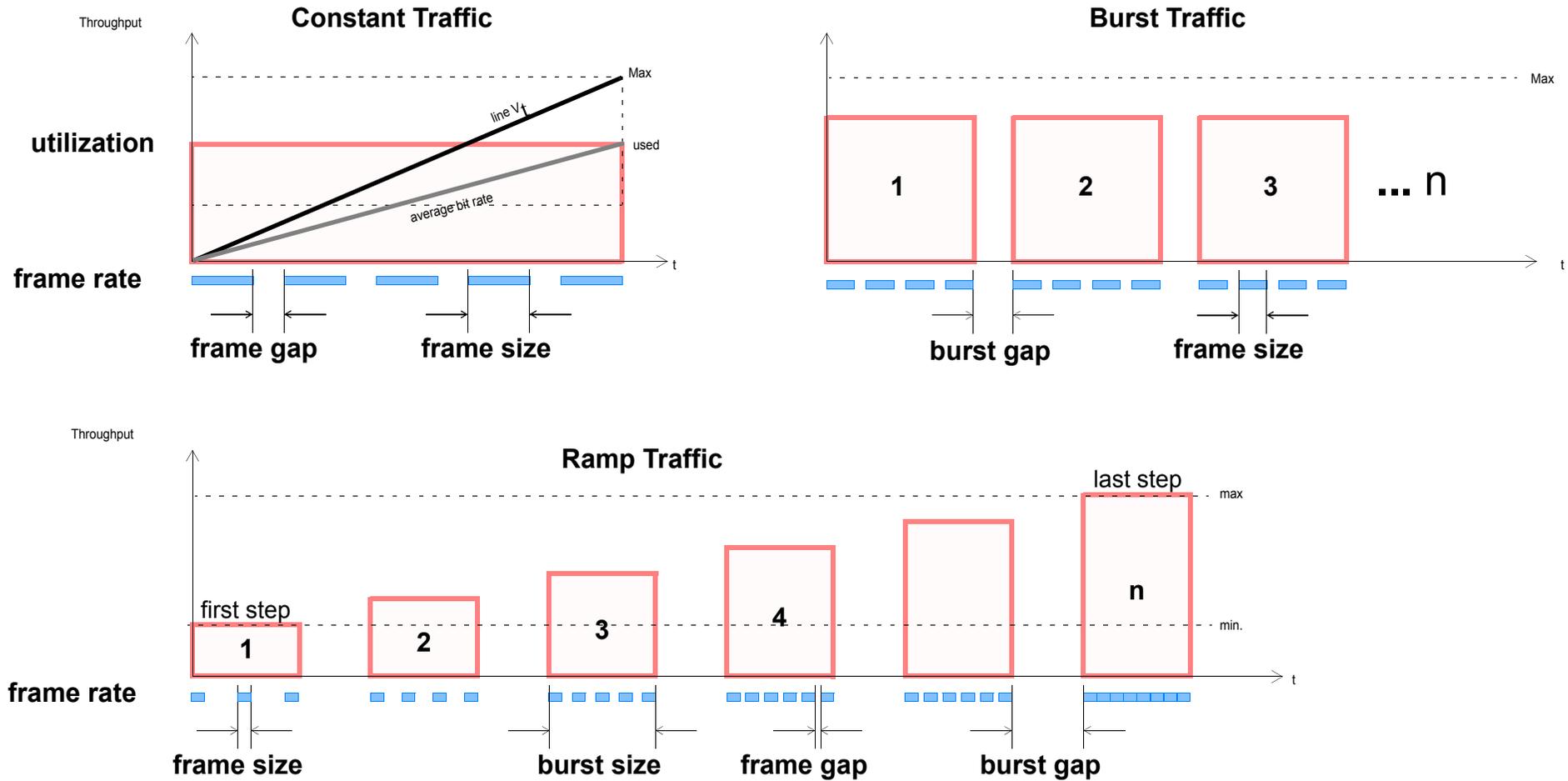
1. Configuration, includes protocol set-up, IP addresses, networks and subnetworks, masks, routing tables, mappings, and encapsulations.
2. Continuity test at:
  - Physical layer, by means of a BER test
  - MAC layer, by means of MAC frame generation/analysis
  - IP layers, by means of Ping and Trace Route



The RFC-2544, designed to verify the performance of LAN devices, has been adopted to verify network performance by means of the following parameters:

- **Throughput:** the number of bits transmitted per second without losing frames
- **Latency:** the average time that elapses between sending traffic and receiving it
- **Frame loss:** the percentage of the maximum rate at which no frames are lost
- **Burstability or back-to-back:** the maximum number of frames that can be sent in a fixed period of time without frames being dropped
- **Recovery:** characterizes how quickly the network recovers from an overload condition
- **Reset:** the time in which a network or station recovers from a reset

# Customer Interfaces Commissioning



A number of tests that allow for the verification of carrier-class services, SLA, and troubleshooting of faults once the network is in service

# QoS Requirements of Multimedia Services



	VoIP	Streamed audio (MP3)
Bandwidth	<b>12 ~ 106 kbit/s</b>	<b>32 ~ 320 kbit/s</b>
Loss	<b>1%</b>	<b>2%</b>
Delay	<b>150 ms</b>	<b>5000 ms</b>
Jitter	<b>30 ms</b>	<b>Insensitive</b>

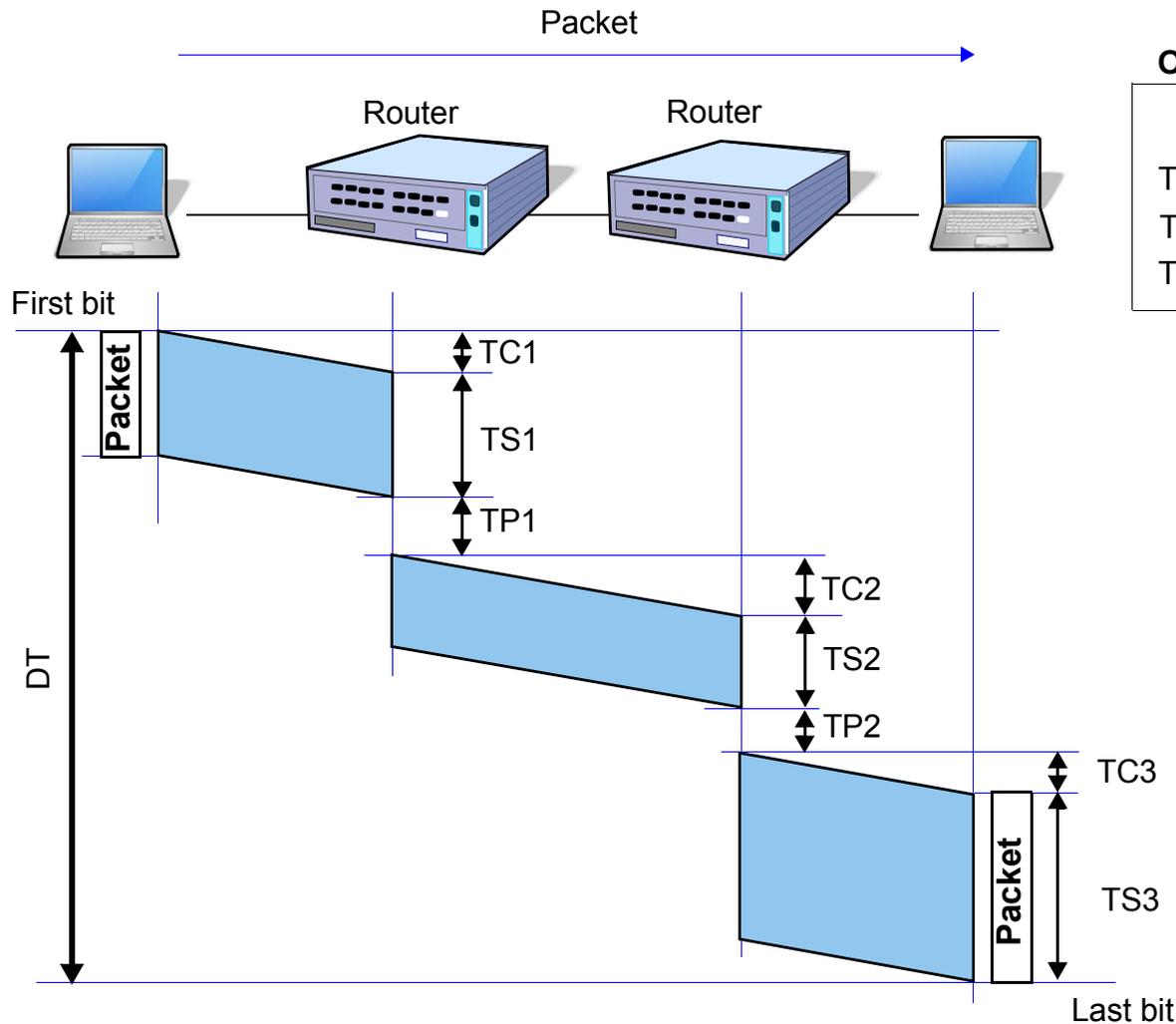


	Streamed video (MPEG-4)
Bandwidth	<b>0.005 ~ 10 Mbit/s</b>
Loss	<b>2%</b>
Delay	<b>5000 ms</b>
Jitter	<b>Insensitive</b>



	Data
Bandwidth	<b>Variable</b>
Loss	<b>Sensitive</b>
Delay	<b>Insensitive</b>
Jitter	<b>Insensitive</b>

# One-way Delay



## One-way Delay

$$DT = STC_i + STS_i + STP_i$$

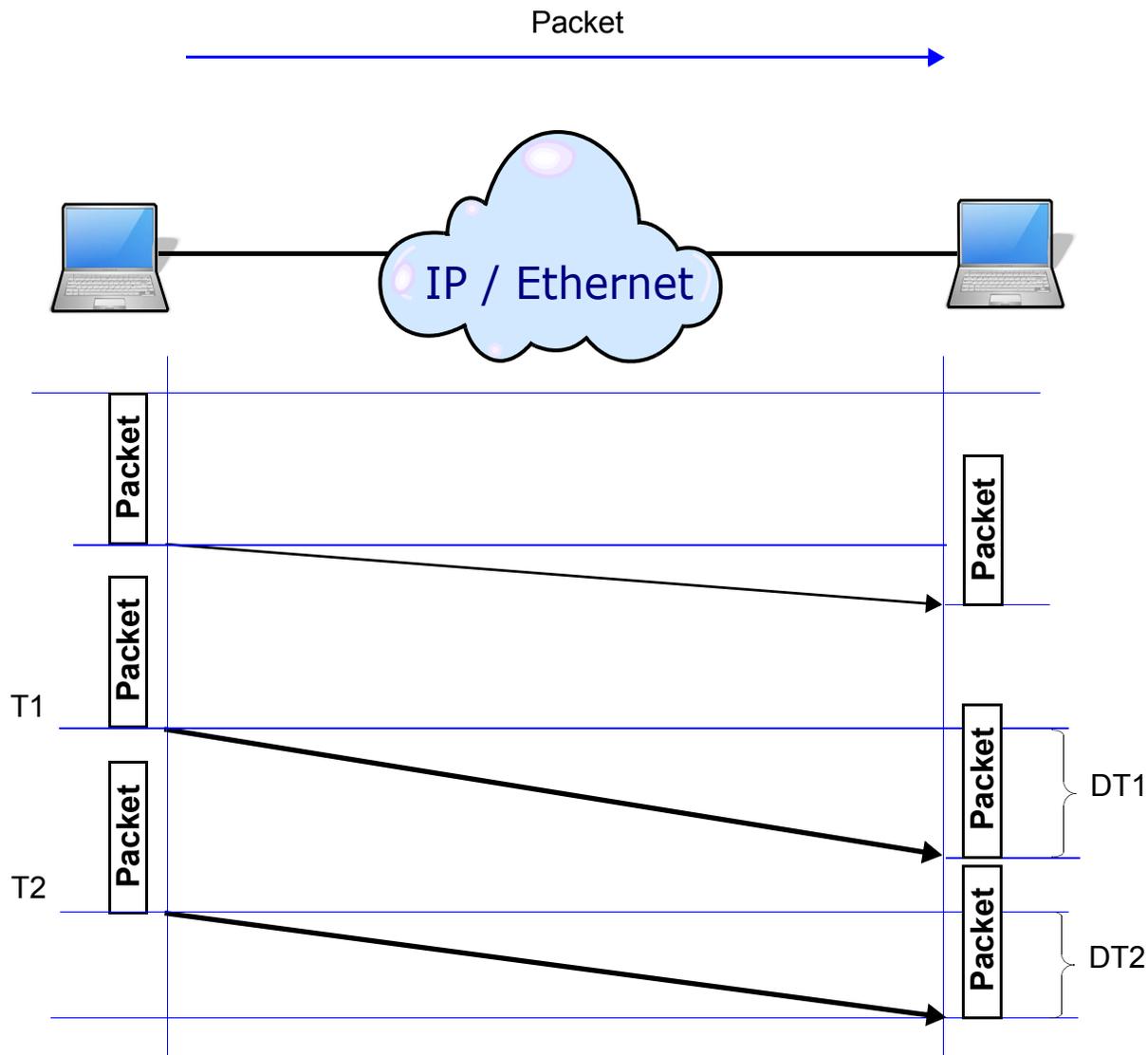
$TC_i$  (propagation) = distance /  $v_P$

$TS_i$  (serialization) = distance /  $v_T$

$TP_i$  (processing) = queuing + switching

- Requires synchronization between TX & RX
- Related metric: Latency

# One-Way Delay Variation



## One-Way Delay Variation

$$DDT = DT2 - DT1$$

DT1 : delay of the first packet

DT2 : delay of the second packet

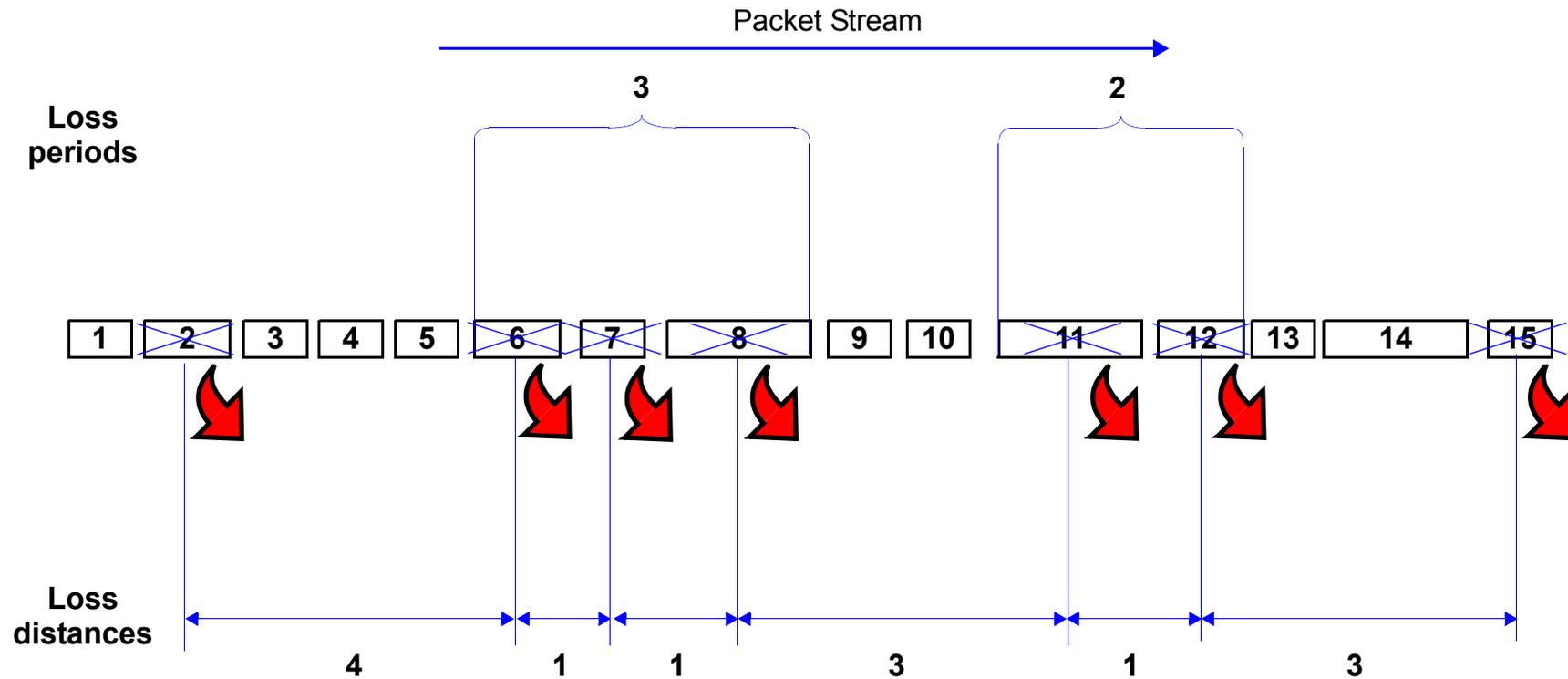
- Does not require synchronization

- Related metrics:

Jitter

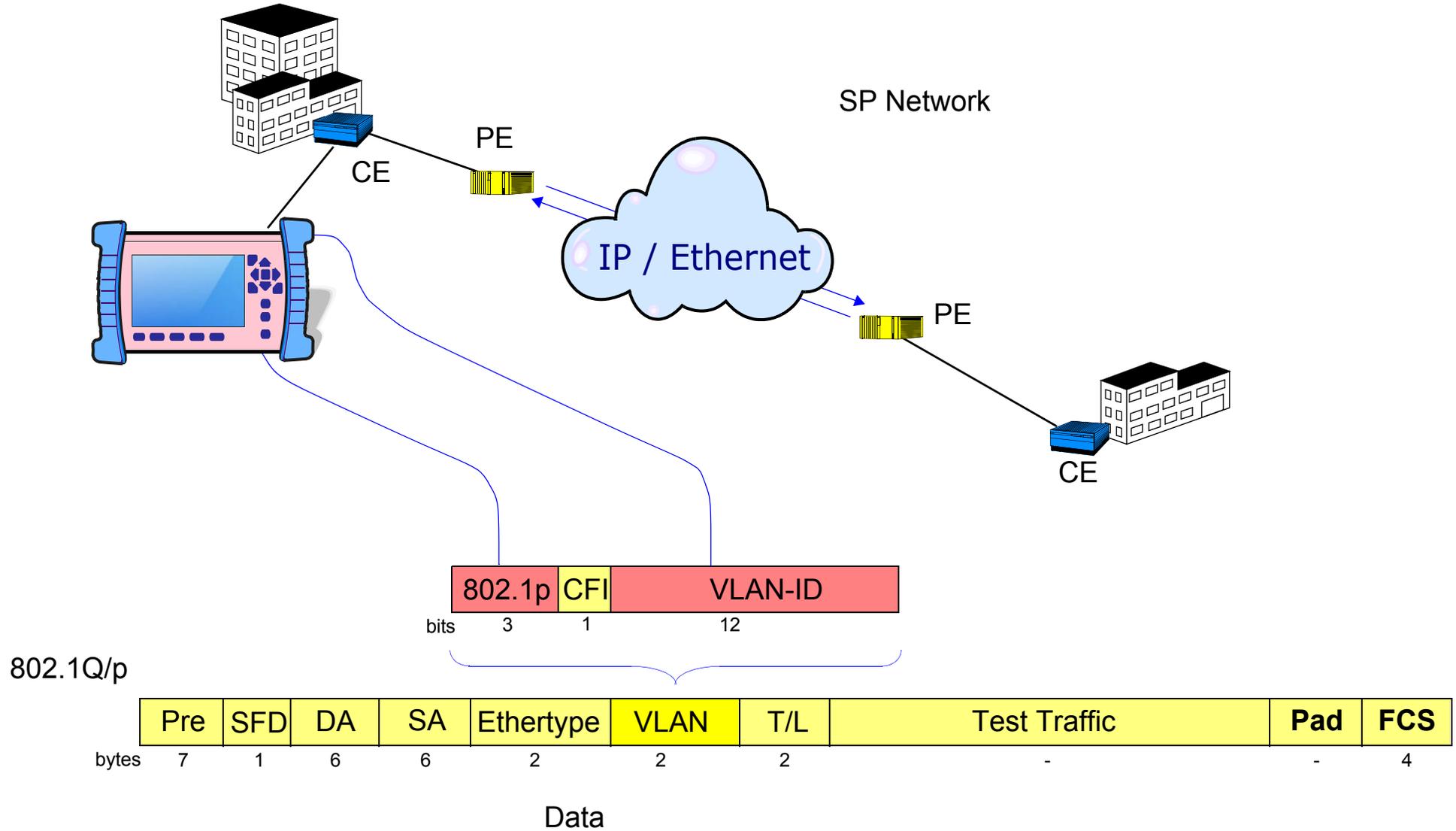
One-way delay variance

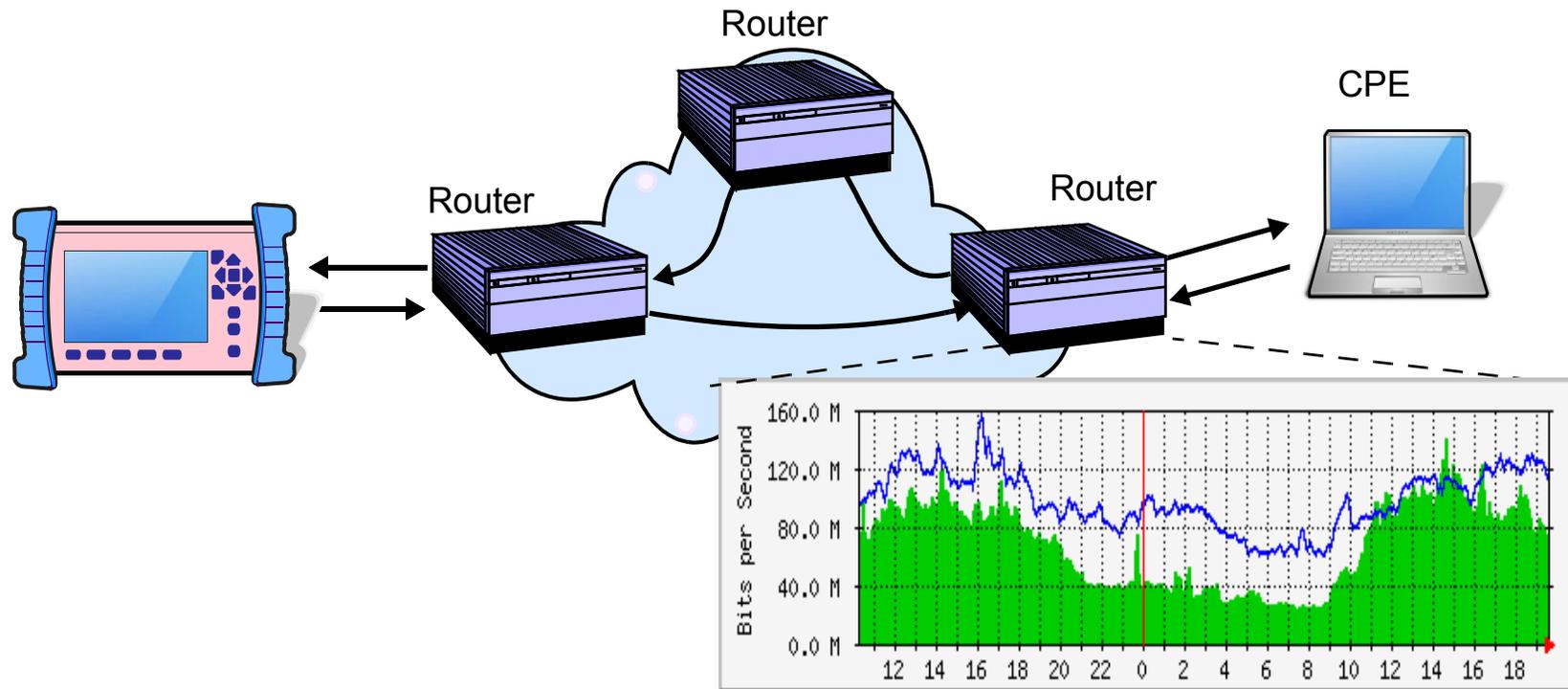
Interarrival time



- Packet loss distribution is important
- Complementary metrics: Loss distance, loss period

# Verifying QoS in Converged Ethernet Networks

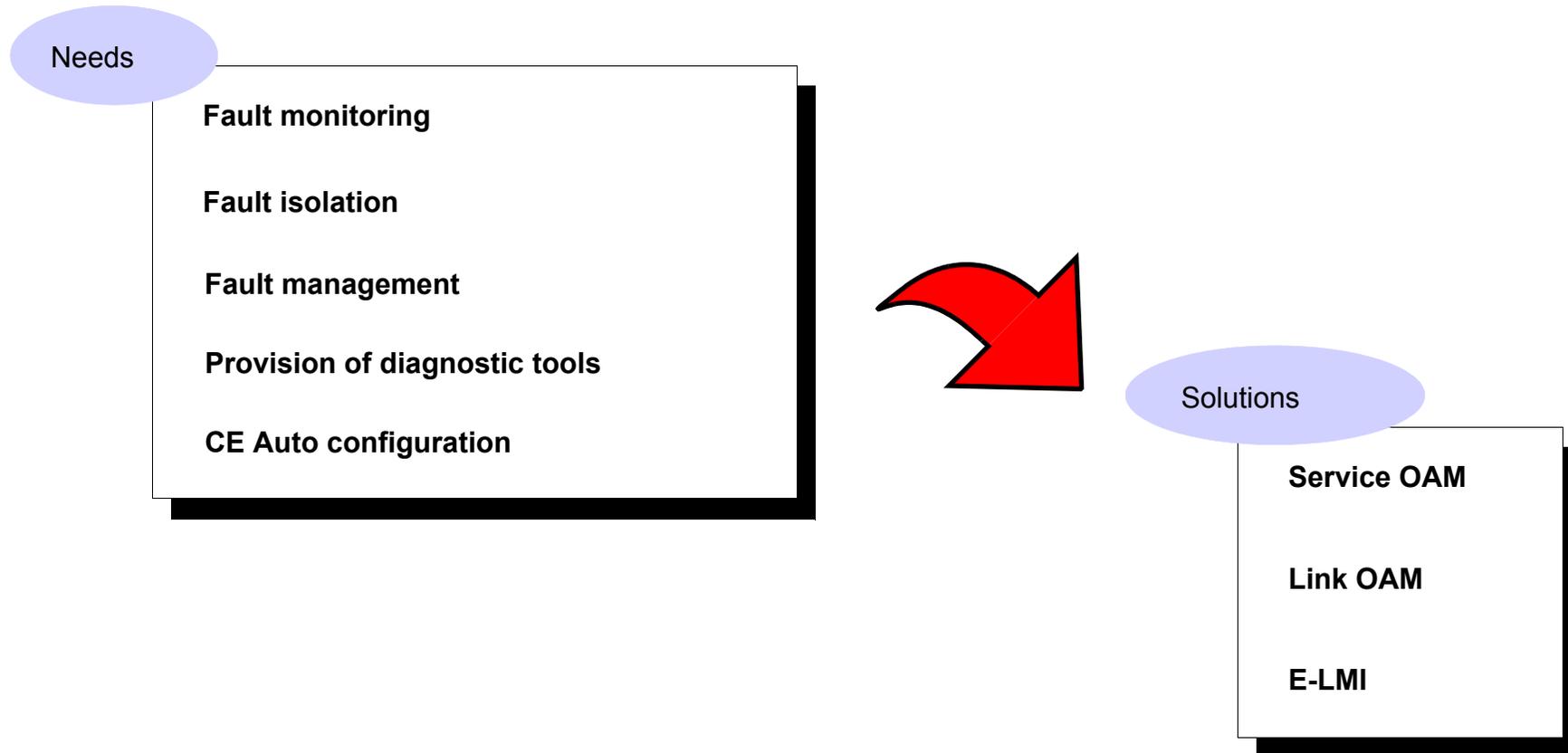


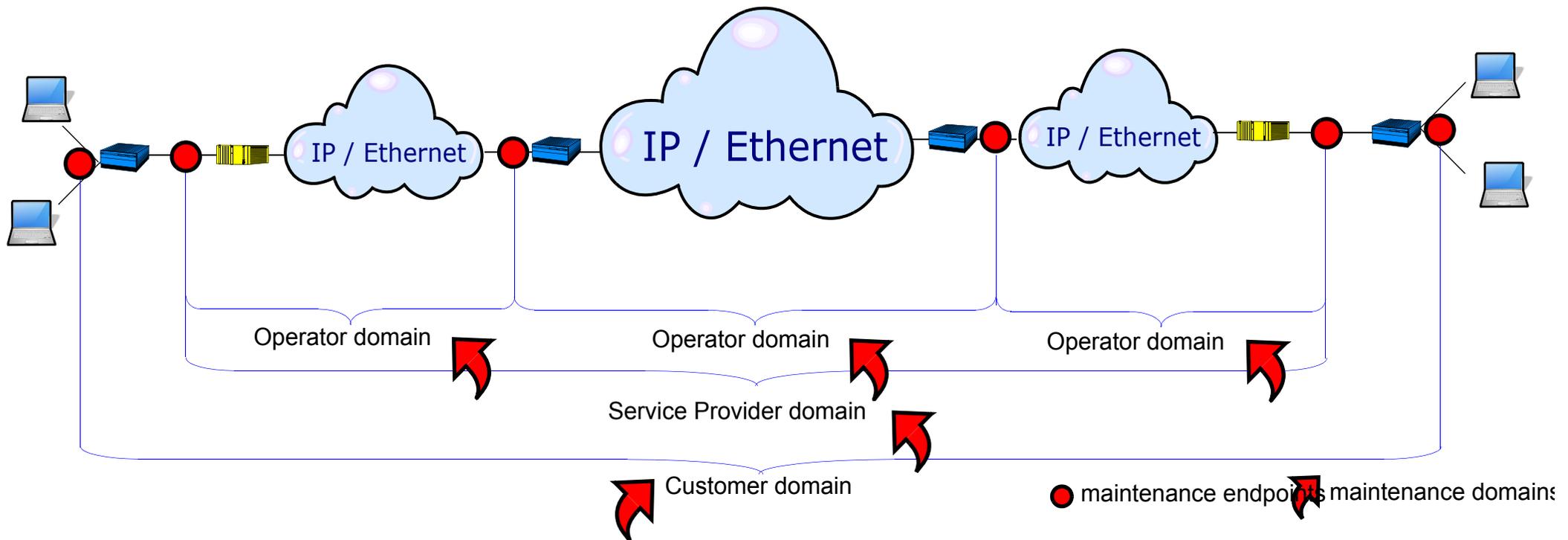


The *Internet Control Message Protocol* (ICMP) works closely with the TCP/IP used for error reporting and analysis, transferring messages (not data!) from routers and stations, and for reporting network configuration and performance problems. ICMP applications are:

- IP Ping
- Trace Route

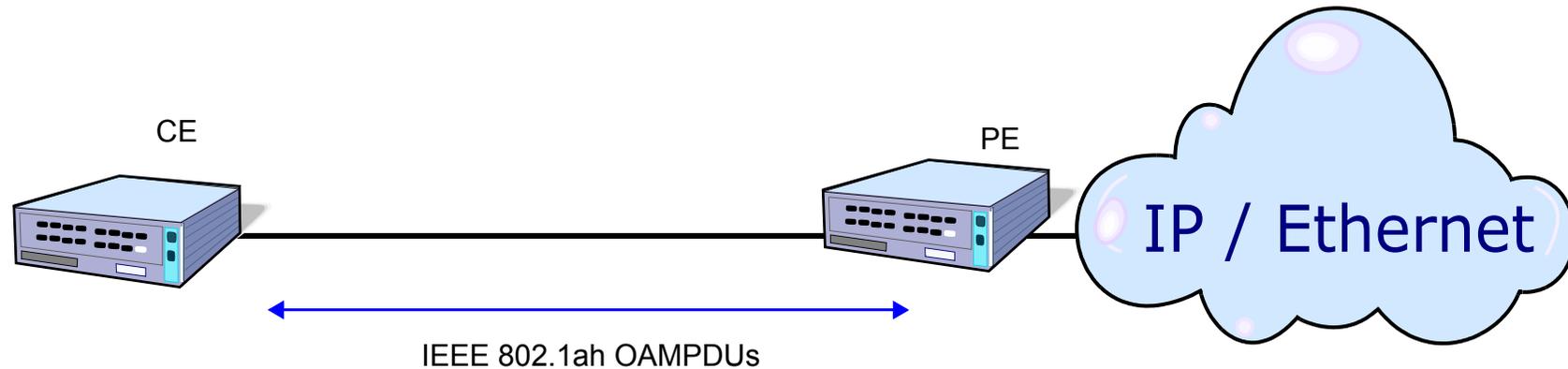
Traffic statistics are an important source of information to plan and re-engineer services. The Ethernet level can include a large number of parameters, such as *Common Address, Packet sizes, Pattern, Counts, Sizes, Errors, Delays, Utilization*, etc.





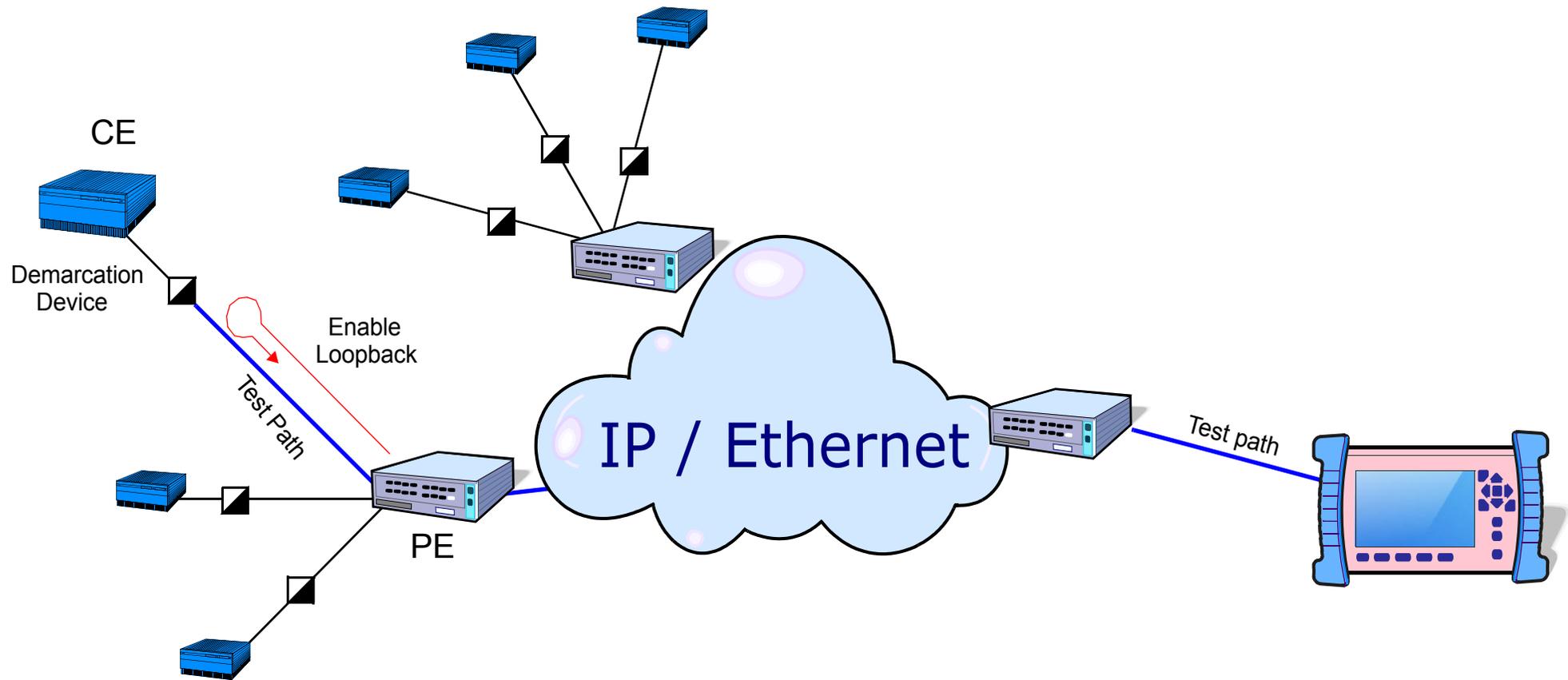
The Service OAM provides:

- **Continuity Check (CC):** Endpoint discovery and endpoint loss of connectivity detection.
- **Link Trace:** Discovery of connectivity data between endpoints. Multicast L2 trace route.
- **Loopback:** Check connectivity with selected endpoints. Multicast L2 ping.
- **Alarm Indication Signal (AIS):** Asynchronous fault notification.



The Link OAM provides:

- **Discovery functions:** Peer device identification along with its OAM capabilities.
- **Link monitoring:** Detection and communication of link faults including error statistics.
- **Remote Failure Indication (RFI):** Failure communication to the peer device.
- **Remote Loopback:** Allows a switch to put its remote peer in loopback mode.



- Demarcation devices isolate the customer network and the service provider network.
- They can be configured in transparent mode and loopback mode.
- They are useful to verify the link between the CE and PE.

That's all



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