# Outline

- ❑ **WiMAX Overview**

- ❑ **WiMAX testing requirements**

- ❑ **Interoperability test for certification**

- ❑ **Problems**

- ❑ **Test bed development and TTCN integration**

- ❑ **Specific integration issues**

- ❑ **Conclusion**

WiMAX Overview

❑ **Broadband wireless Internet access**

❑ **Based on 802.16**

❑ **Uses licensed spectrum**

❑ **Compared to Wi-Fi**
  ➢ **Longer range (50 km)**
  ➢ **Roaming**

❑ **Compared to 3G:**
  ➢ **Higher speed (3 Mbit/s)**
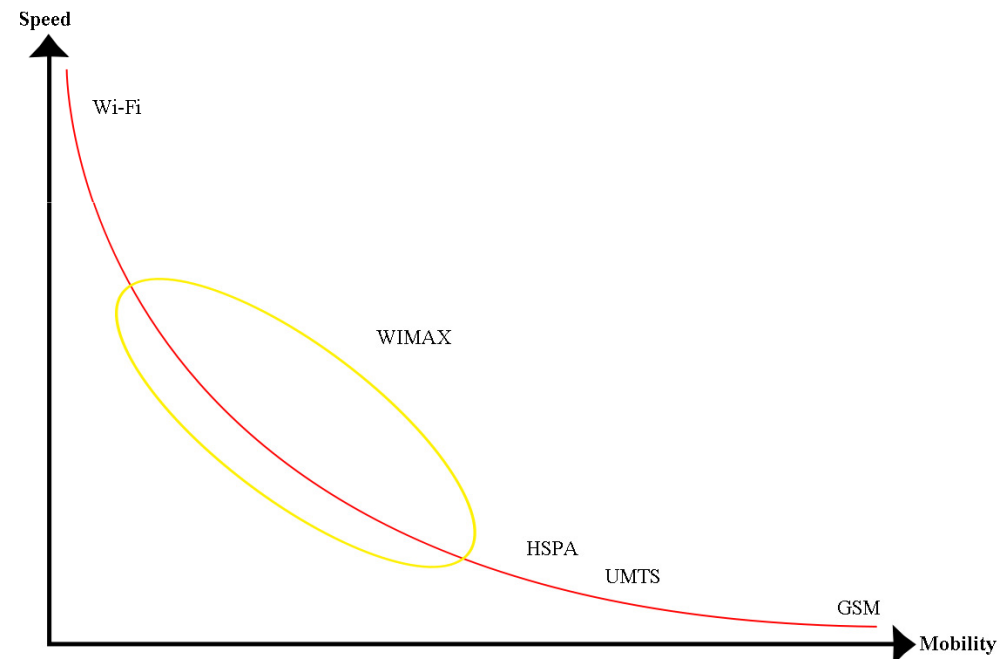
WiMAX Network
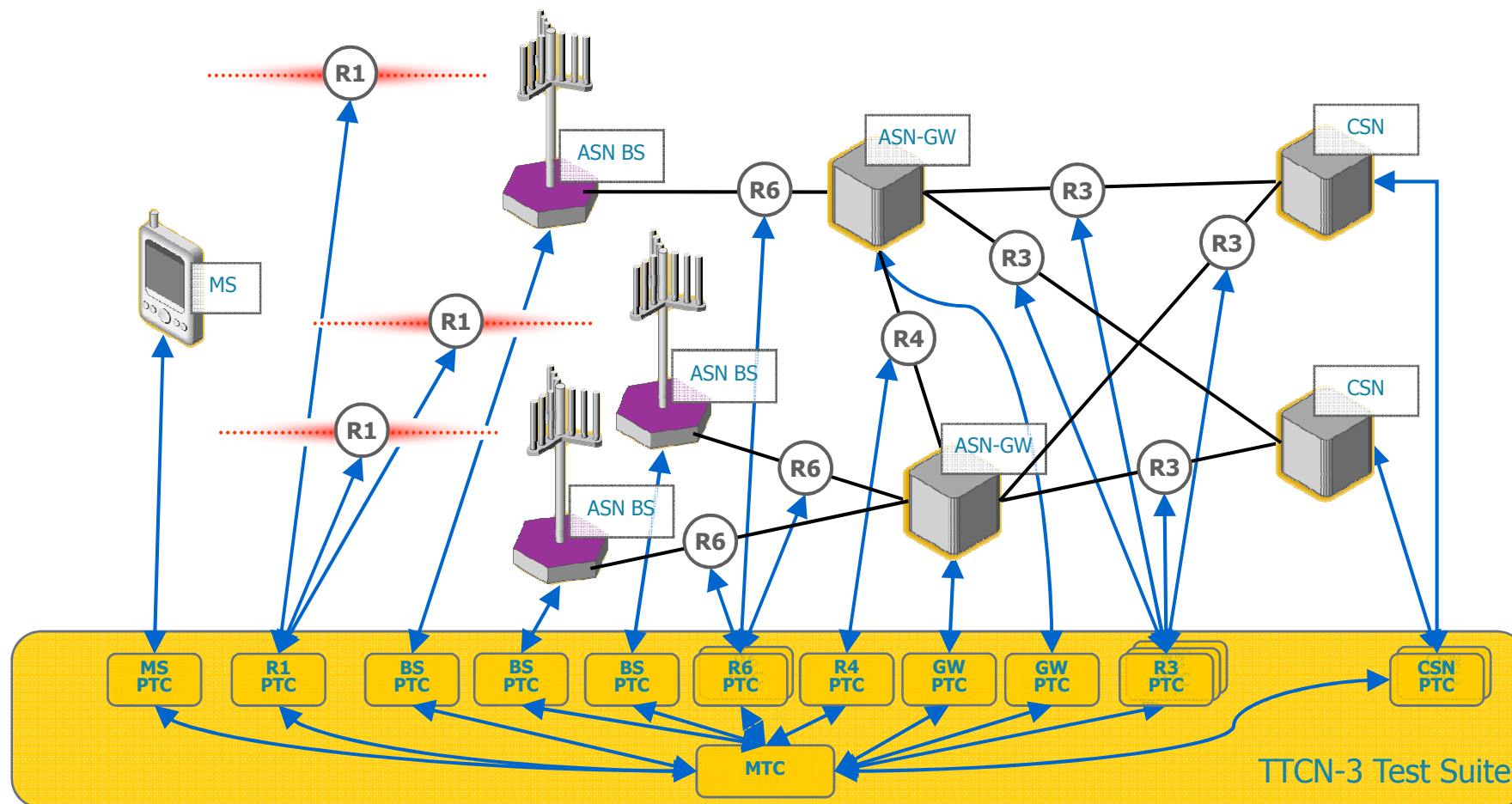
Requirements

❑ **Goal is to certify the network elements (not including the MS)**

❑ **Conformance testing is not possible**

➢ **Expensive, slow development, complicated execution, may need expensive testing tools, etc.**

❑ **Traditional interoperability test is not reliable**

❑ **Conformance assisted interoperability test**

➢ **Checking the (not full) content of some (not all) messages**

❑ **Configurable monitoring interfaces**

➢ **Switch monitoring and analysis on and off**

➢ **Independent monitoring components**

❑ **Automated tests**

➢ **Trigger actions (if trigger exists)**

➢ **Start/stop monitoring**

➢ **Analysis of message content**

Conformance assisted interoperability test

❑ **Explicit checking**

➢ **Correctness of a given protocol field (e.g. BS id in HO_Req)**

➢ **No need to check all fields only the important ones**

❑ **Implicit checking**

➢ **How do we know that the not checked fields are correct?**

➢ **There's a reply to a request (HO_Rsp is sent back)**

➢ **A depending function is working**

❑ **Double checking**

➢ **1st check: message content**

➢ **2nd check: behavior of the implementations (MS is able to transfer data)**

❑ **Enables the certification of network elements based on interoperability testing**

Problems

❑ **Real-time monitoring of the radio interface**

  ➢ **Current test equipments can record ~3 sec**

  ➢ **Decode it in ~30 sec**

  ➢ **Synchronization to other components…**

❑ **Encryption of certain messages**

  ➢ **Impossible to check the content of an encrypted message**

  ➢ **Impossible to decrypt the message**

❑ **Action triggers are missing**

  ➢ **Not part of the spec or not defined**
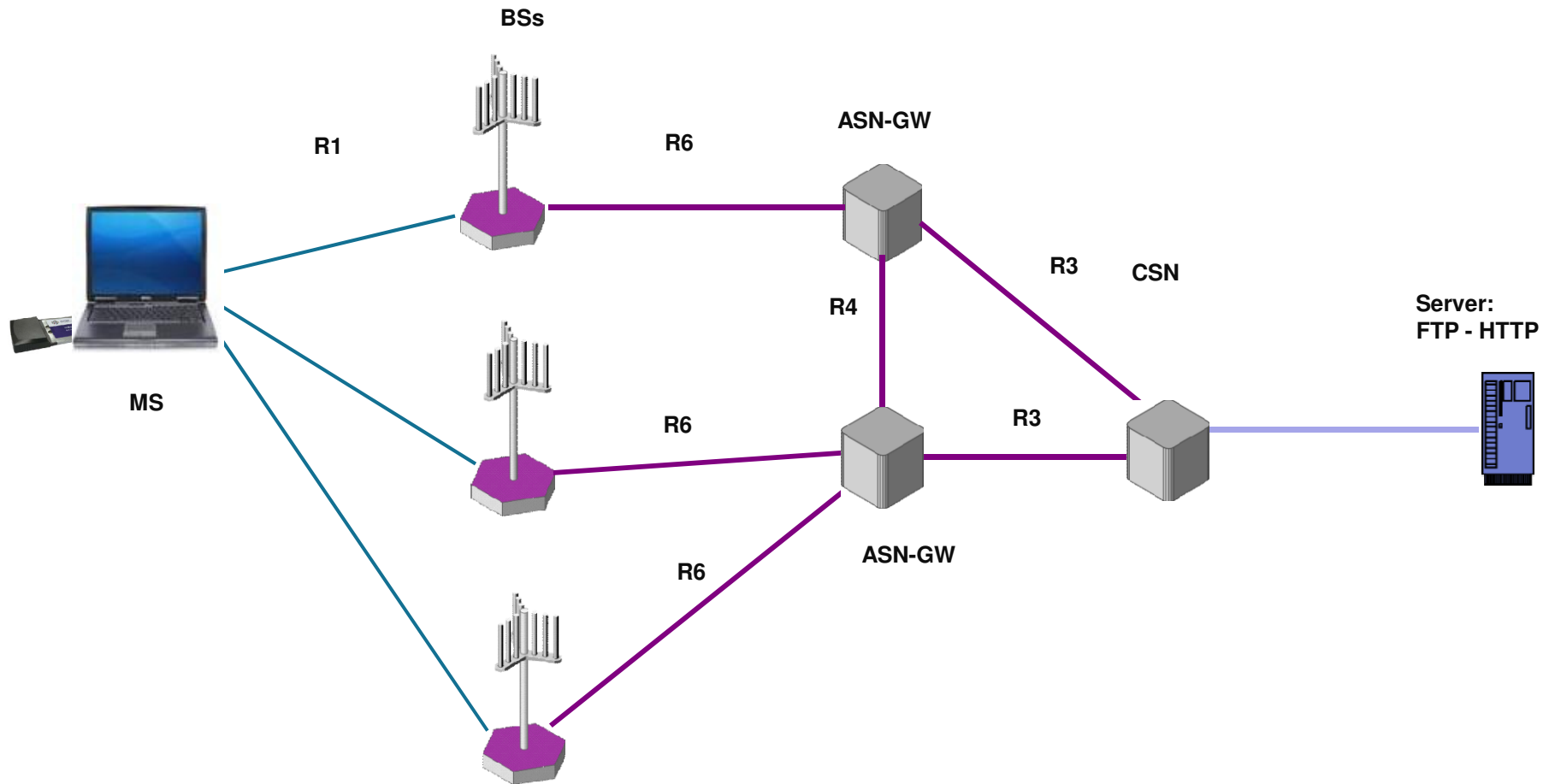
  ➢ **Or defined but not implemented**

The NWIOT test bed integration & development

❑ **IOP test bed architecture:**
  ➢ **The SUT: WiMAX NWIOT network components**
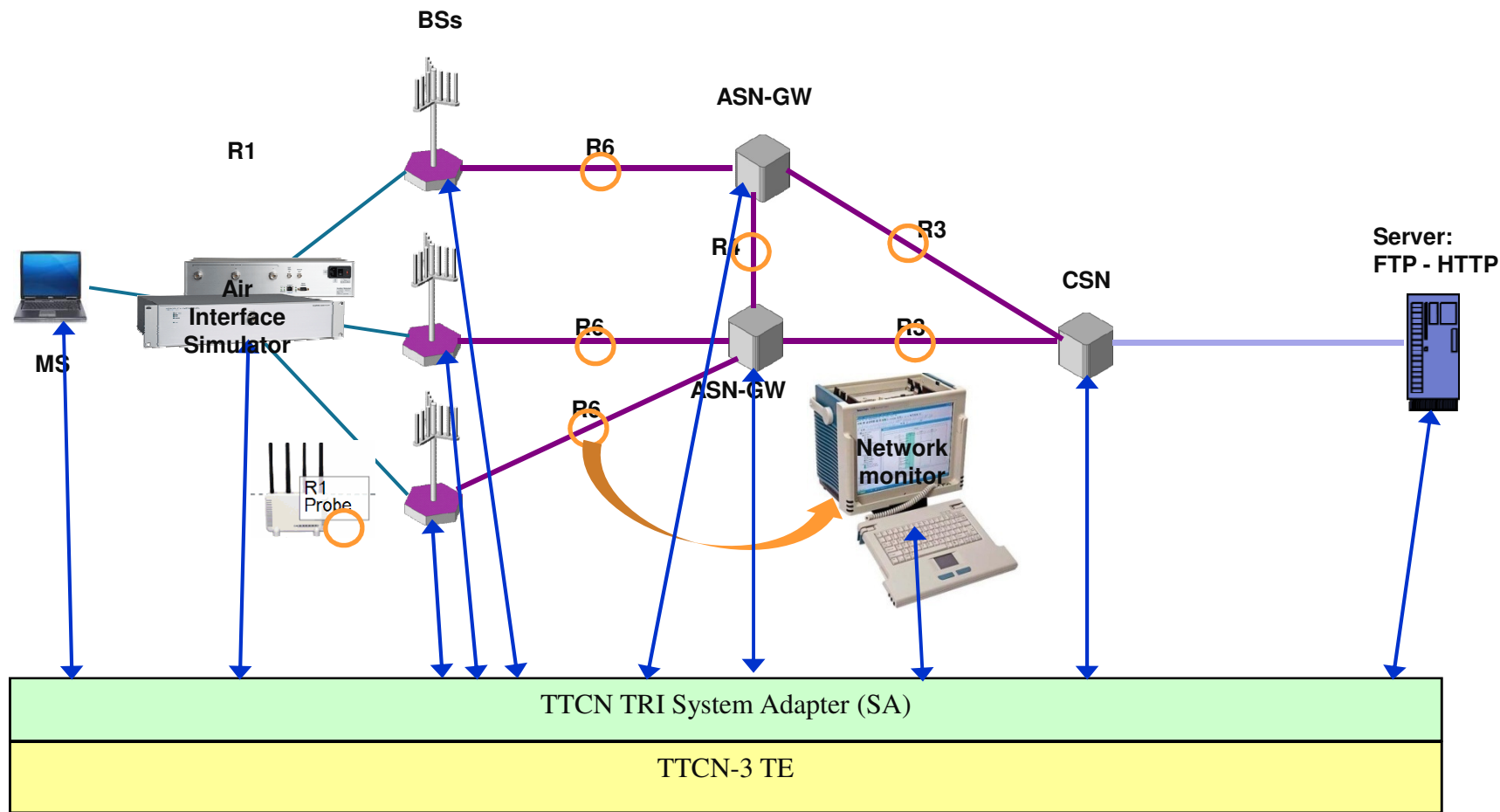 ➢ **The Test System components**

❑ **Specific integration issues:**
  ➢ **Triggering actions and managing configuration on WiMAX components**
  ➢ **How to suit to different configuration interfaces from several NWIOT vendors - use of external Test Adapters**
  ➢ **Routeing Rx interface protocol messages to the TTCN-3 - SA**

❑ **Conclusions**
  ➢ **Advantages of using TTCN-3 for IOP Testing**
  ➢ **Which IOP concepts were validated so far?**

The WiMAX network components

ETSI FSCOM — World Class Standards

BSs

R1

R6

ASN-GW

R3   CSN

R4

MS

Server:
FTP - HTTP

R6

R3

ASN-GW

R6

The WiMAX network IOP test bed

BSs

ASN-GW

R1

R6

Server:
FTP - HTTP

R3

CSN

R4

Air
Interface
Simulator

MS

R6

R3

ASN-GW

R6

Network
monitor

R1
Probe

TTCN TRI System Adapter (SA)

TTCN-3 TE

FSCOM

World Class Standards

Trigerring actions and managing configurations

MS

R1 Probe

BS

R6

ASN-GW

R3

CSN

Application Server

Network monitor

TTCN TRI System Adapter (SA)
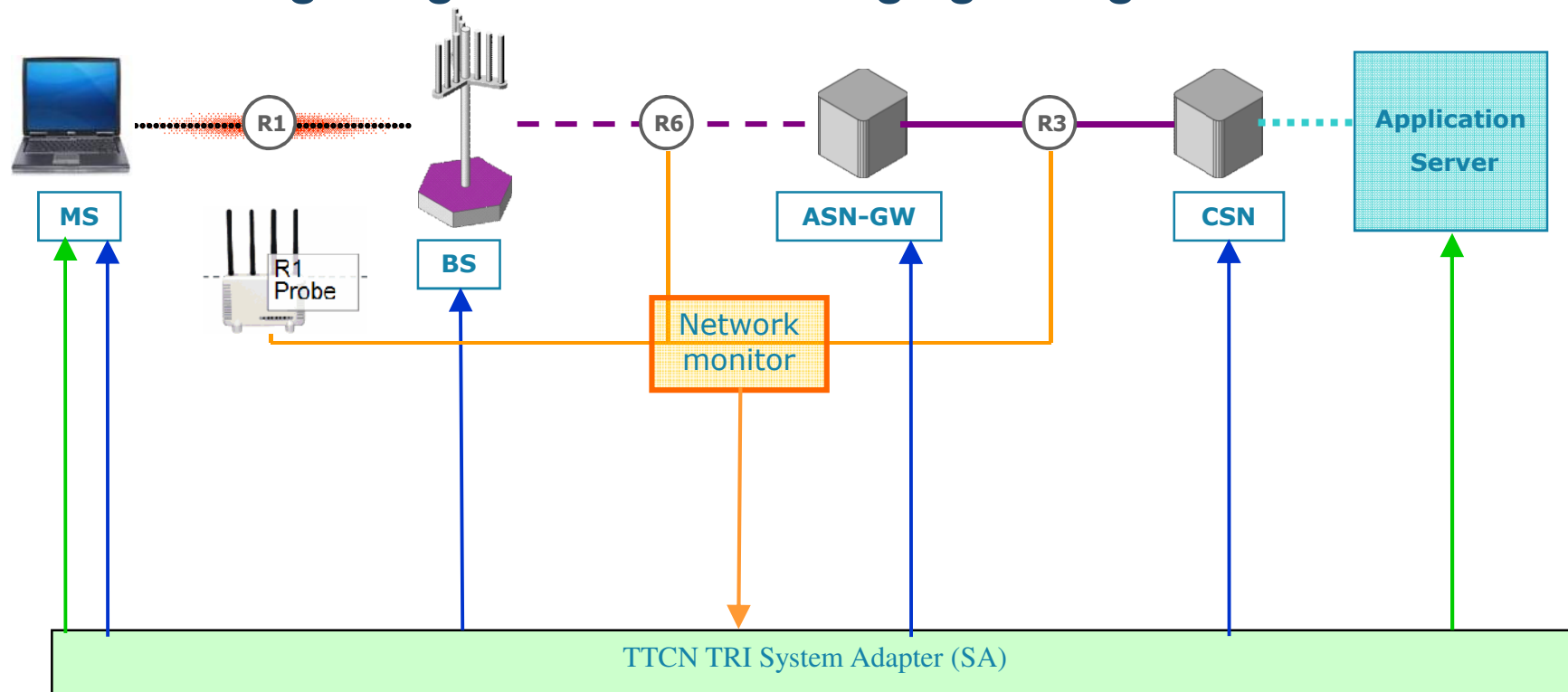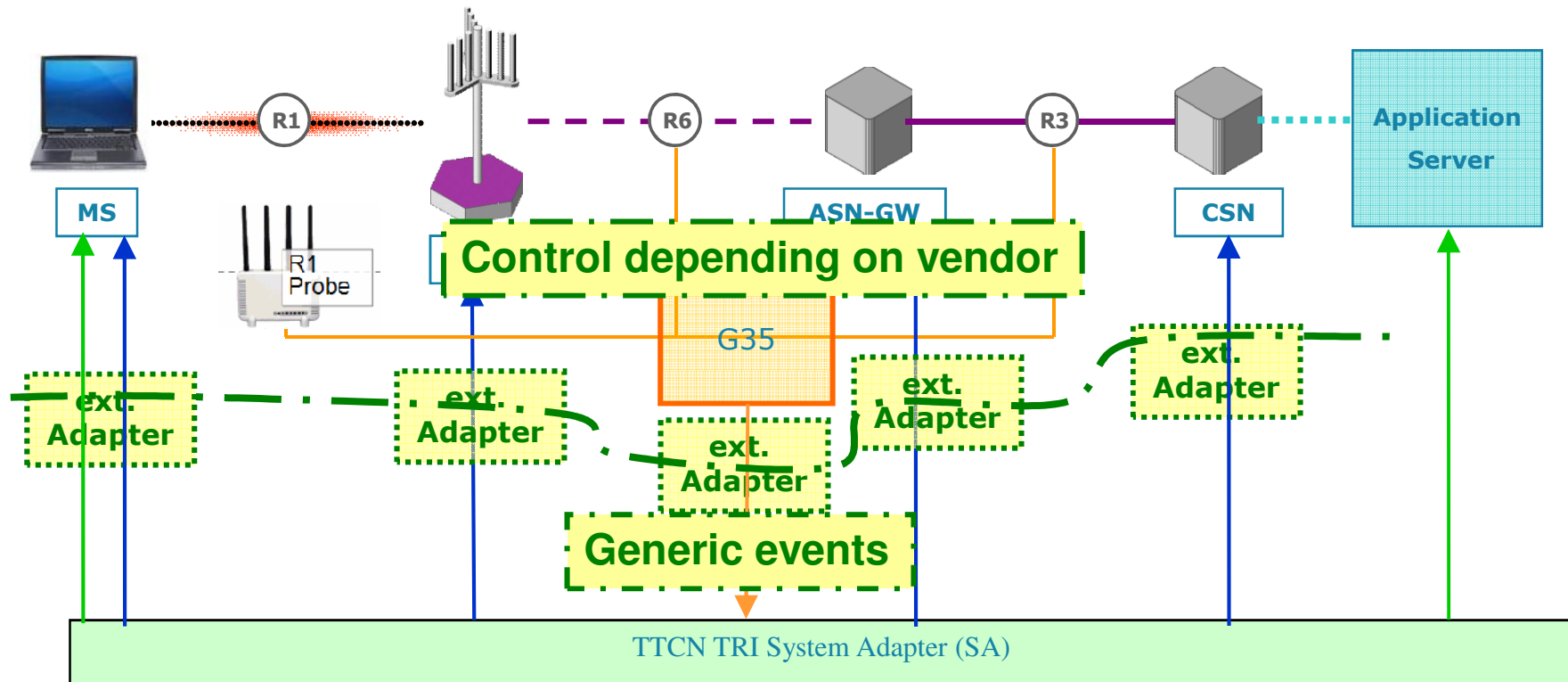
→ Configuration event (send TTCN event)

→ Terminal IUT trigger event (send TTCN events)

→ Rx Message received event (receive TTCN event)
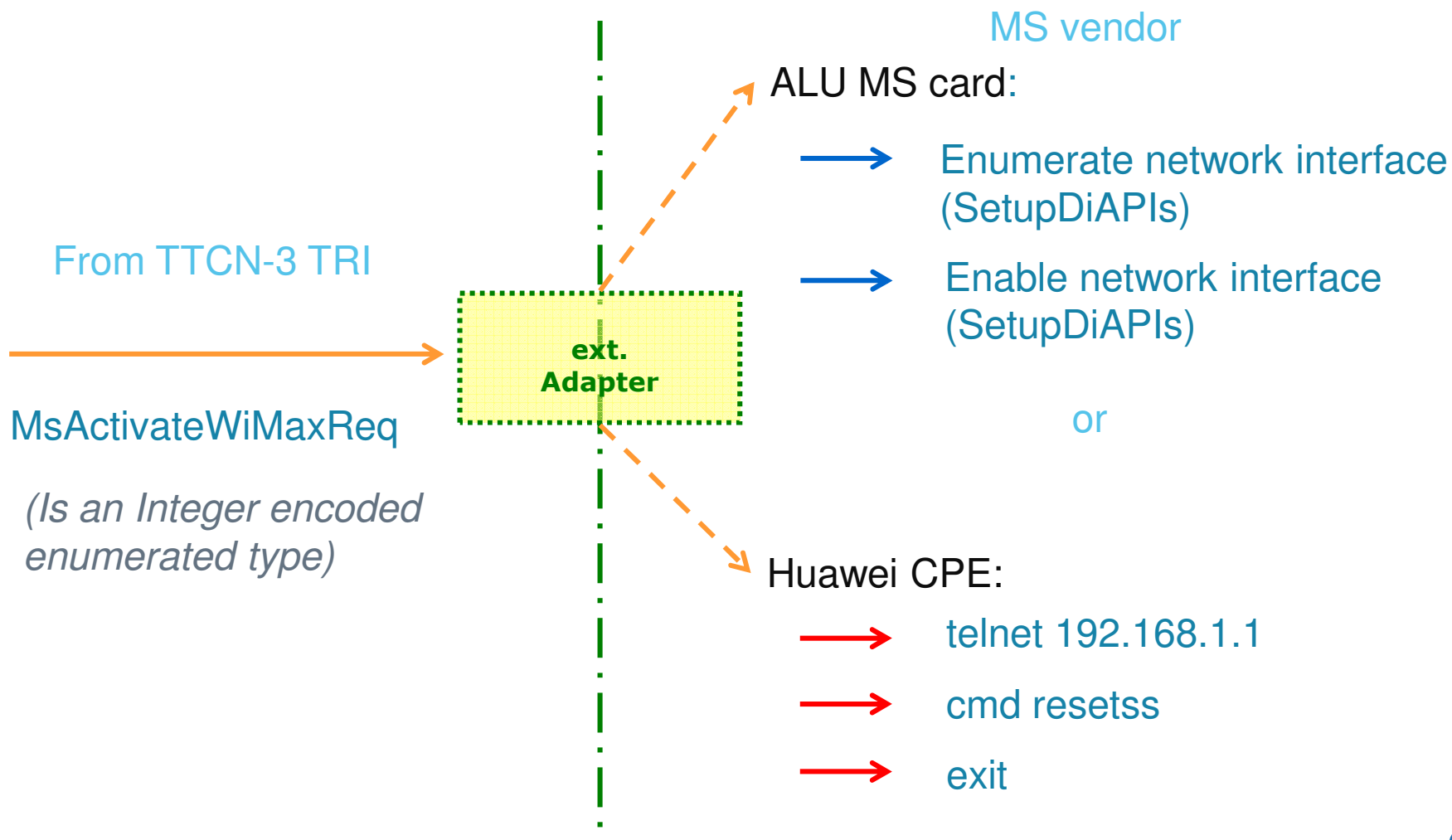
Note: all events are followed by ACK (receive events)

FSCOM

World Class Standards

How to suit to different configuration interfaces from several NWIOT vendors - use of external Test Adapters

Control depending on vendor

Generic events

TTCN TRI System Adapter (SA)

→ Terminal IUT trigger event (send TTCN events)
→ Rx Message received event (receive TTCN event)
→ Configuration event (send TTCN event)
Note: send events (configuration and IUT trigger) can be followed by ACK (receive events)

Example: the MS external adapter

MS vendor

ALU MS card:

→ Enumerate network interface
(SetupDiAPIs)

→ Enable network interface
(SetupDiAPIs)

From TTCN-3 TRI

ext.
Adapter

MsActivateWiMaxReq

*(Is an Integer encoded
enumerated type)*

or

Huawei CPE:

→ telnet 192.168.1.1

→ cmd resetss
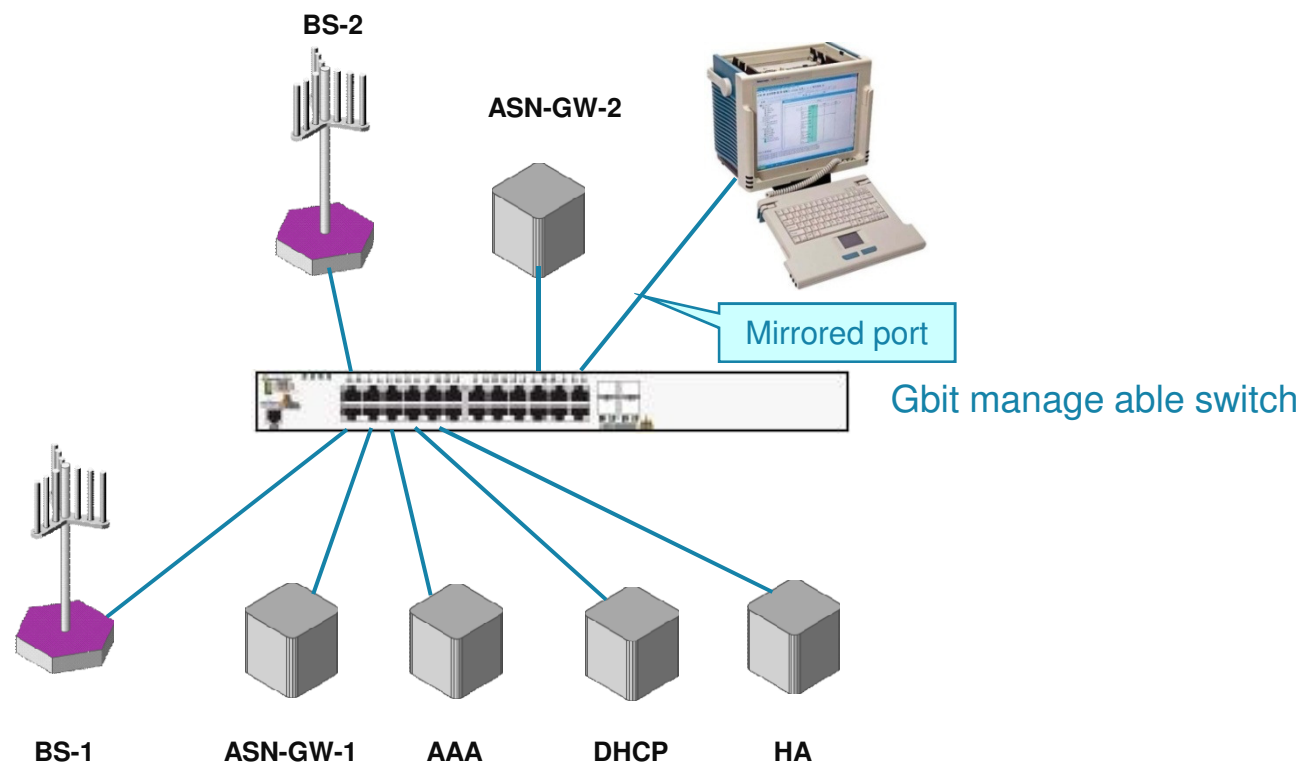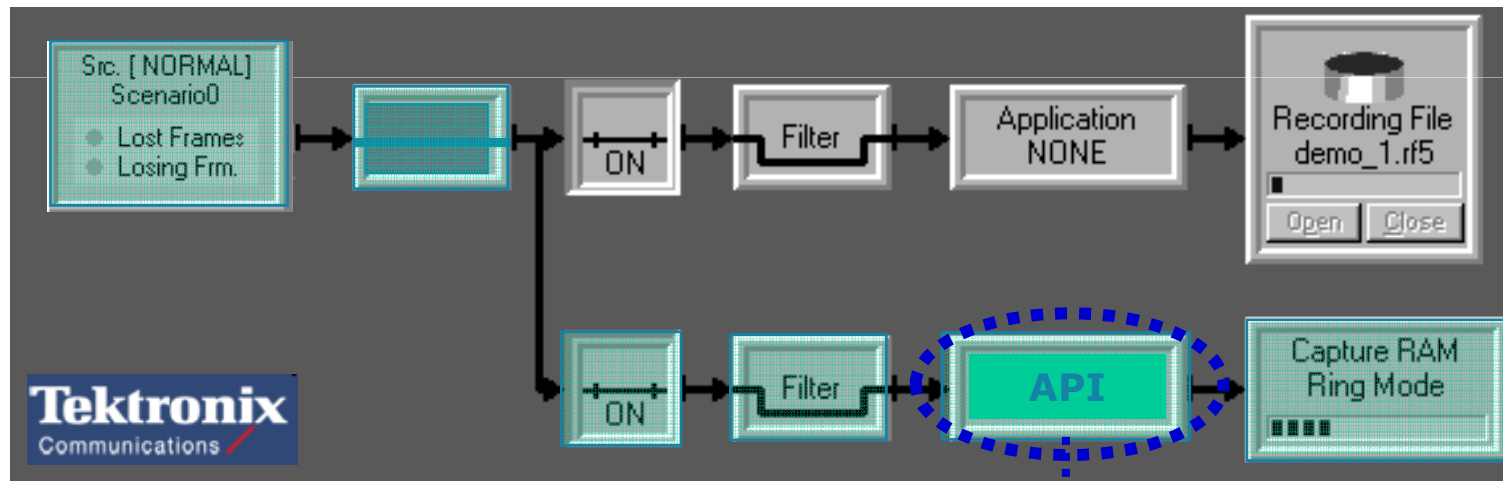
→ exit

The physical network architecture

❑ **All Ri reference points are Ethernet interfaces using IP.**

Routeing Rx interface protocol messages to the TTCN-3 - SA

❑ **Network monitor tools are designed to record and display the PDU traffic. But not necessarily to use these PDU as part of a testing application.**

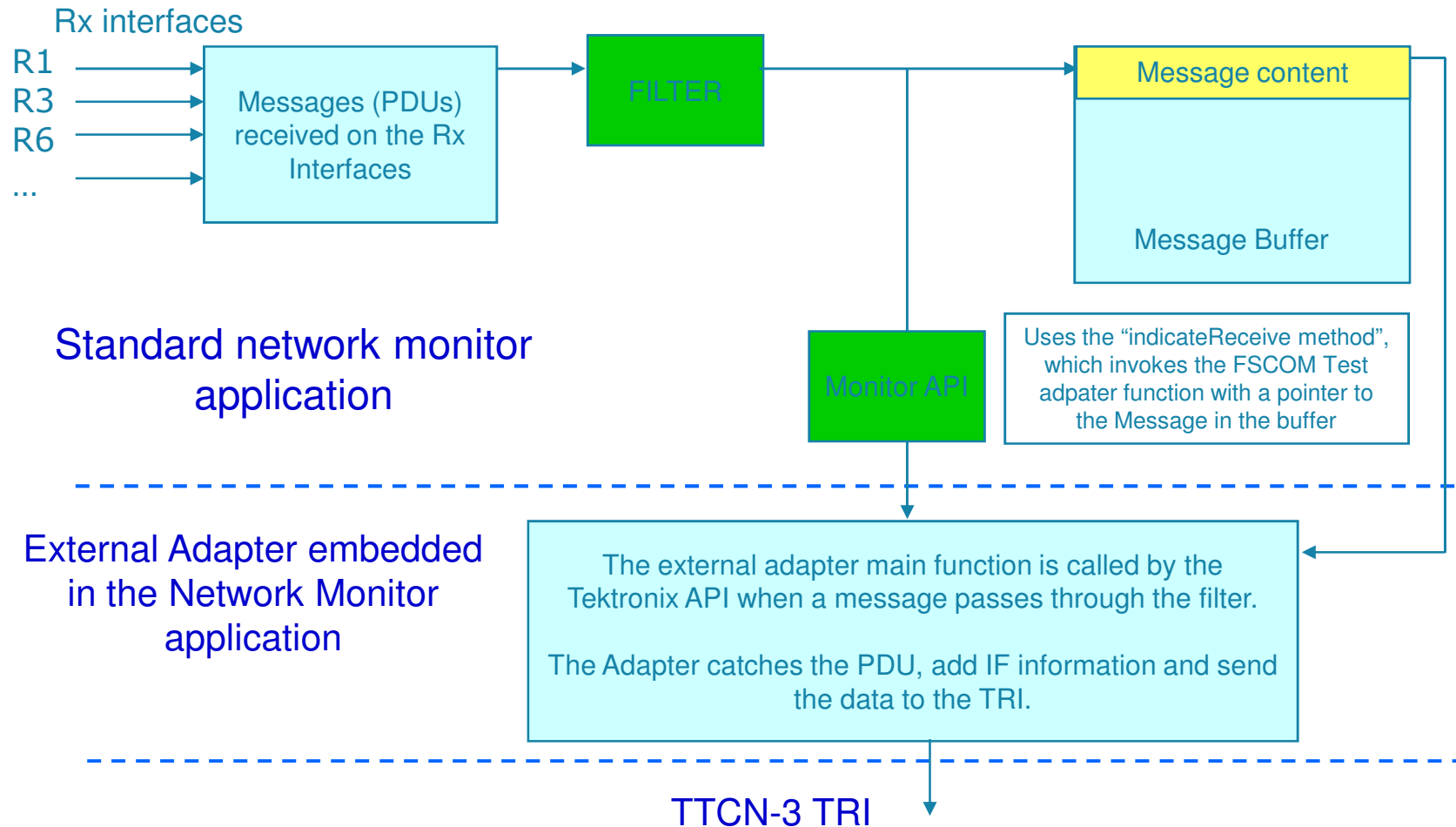❑ **Need to add a specific function in the monitor tool.**

A subroutine is activated in the Tektronix G35 API to send the PDU to the TTCN-3 port

TTCN-3 System Adapter

Network Monitor external adapters

Rx interfaces

R1
R3
R6
...

Messages (PDUs) received on the Rx Interfaces

FILTER

Message content

Message Buffer

Standard network monitor application

Monitor API

Uses the "indicateReceive method", which invokes the FSCOM Test adpater function with a pointer to the Message in the buffer

External Adapter embedded in the Network Monitor application

The external adapter main function is called by the Tektronix API when a message passes through the filter.

The Adapter catches the PDU, add IF information and send the data to the TRI.

TTCN-3 TRI

Conclusion

❑ **Advantage of using TTCN-3**
  ➢ **Seamless development of Test Cases and Integration of the Test system, even when the 2**
  ➢ **TTCN-3 enable a good testing architecture applying to test an heterogenic system:**
    • **No need to develop a test concept**
    • **TTCN-3 offers all required features to control the IOP test process**
  ➢ **TCI/TRI offering a standardized "turn key" system adapter (ready to use, well documented)**
  ➢ **Quick execution and easy to debug test cases, accelerate validation.**

❑ **IOP testing with TTCN-3**
  ➢ **This project validates the concept of IOP testing with a complex SUT:**
    • **Uses TTCN-3 send/receive for SUT configuration**
    • **Uses TTCN-3 send/receive for triggering SUT actions (MS activation, …)**
    • **Uses TTCN-3 receive event to check PDU content on the reference points in the SUT**
    • **TTCN-3 verdict are used like in conformance testing.**

Thanks for your attention

Questions?

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