TTCN-3 Test System for Automotive Emergency Call Service

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TTCN-3 Test System for Automotive Emergency Call Service

Motivation

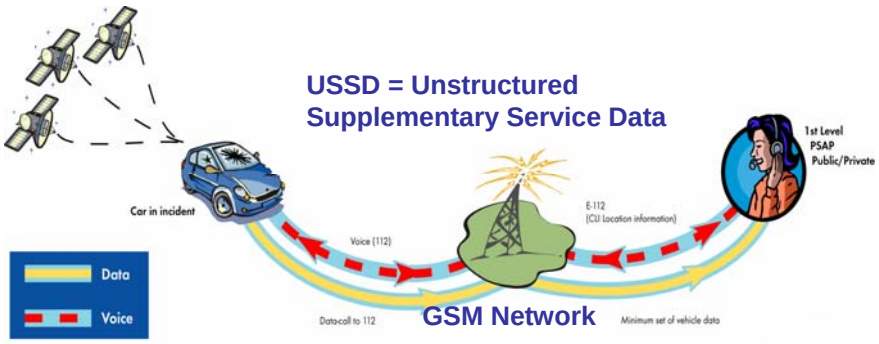
- Road accidents are one of the most common causes of death among EU citizens.
- European Commission Objective:
  - The improvement of road safety and transport efficiency by means of using ICT (Information and Communication Technologies).
- Advances in wireless technologies set the grounds for Intelligent Integrated Systems that help to develop safety and efficiency services.
  - Vehicle to vehicle communications.
  - Vehicle to infrastructure communications.

Environment of this work

- **GST** (Global System For Telematics). *April 2004 – February 2007*
  - Definition: GST is an **EU-funded Integrated Project**.
  - GST Mission: to create an open and standardized end-to-end architecture for automotive telematics services.
  - GST consists of seven **sub-projects**.
    - Service-Oriented SPs: **Rescue**, EFCD (Enhancing Float Car Data), Safety Channel**.**
    - Technology-Oriented SPs: **CERTECS,** Open Systems, Service Payment, Security.
  - GST consists of seven test sites:
    - Paris, Munich, Gothenburg, Stuttgart, Torino, London, Aachen.
- **CERTECS** Sub-project:
  - Definition: CERTECS is specifying, prototyping and validating a **certification process** for telematics components, systems and services, targeted at the automobile industry and supported by relevant methods and information technology.

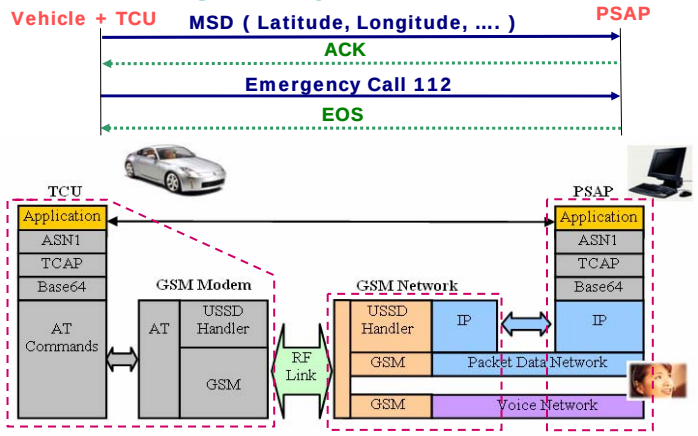
This work is here

Emergency Call Service



After an accident a car generates an emergency call (voice + data) to the emergency number (112) whereby is intended to reduce the rescue services' response time.

Emergency Call Service



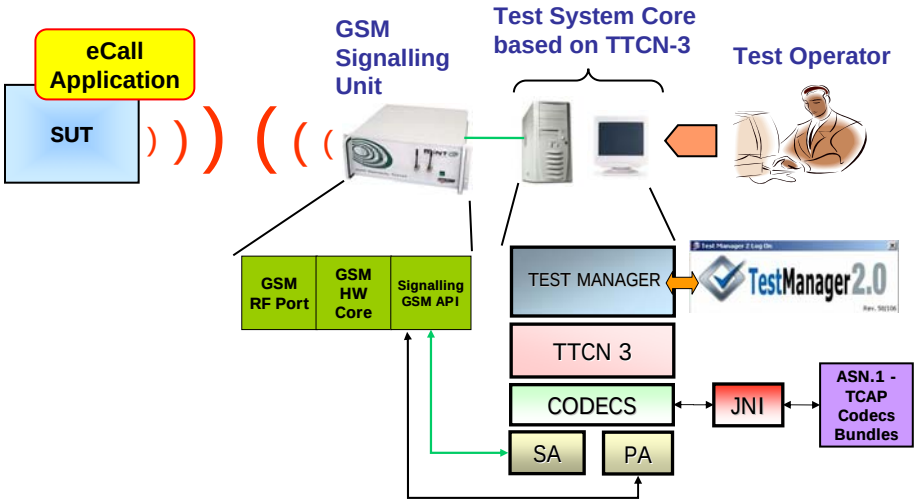
MSD, **ACK** and **EOS** message are encoded using **ASN.1, TCAP and Base64 algorithms**

Why TTCN-3?

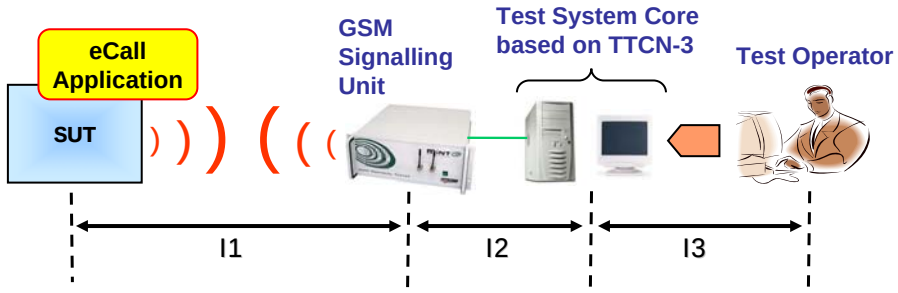
- TTCN-3 defines both testing language and tester architecture in a formal way.
- It is platform independent.
- It facilitates the evolution of a test tool.
- Successfully used in the certification of new challenging technologies, e.g., IPv6, WiMax, 3GPP, etc.

The challenge is to use TTCN-3 benefits in order to develop an eCall TTCN-3 Test System

eCall Test System Overview

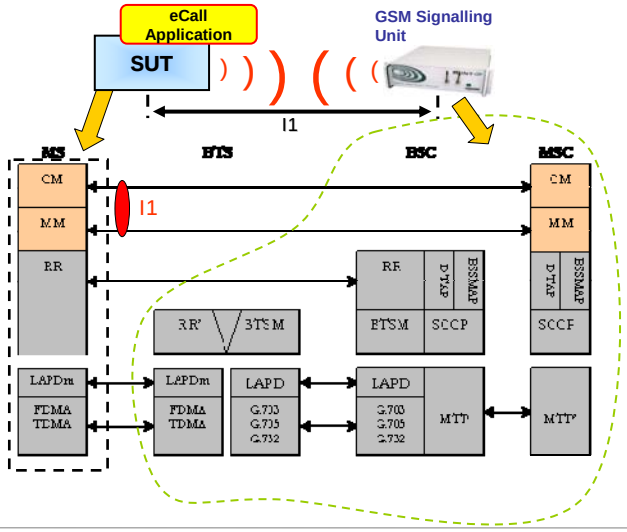


eCall Test System Interfaces

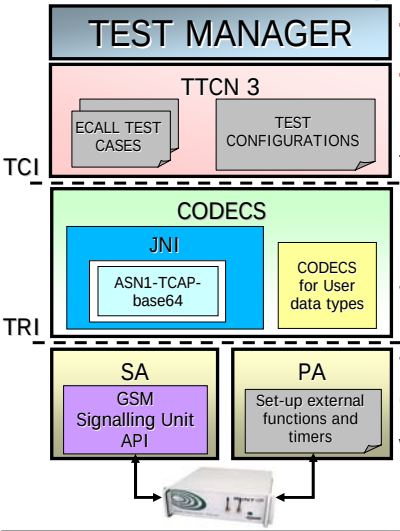


I1: GSM Protocol Layer
I2: API GSM Layer (Adaptor)
I3: Perceptive (Test operator)

eCall Test System GSM Interface



eCall Test System Architecture



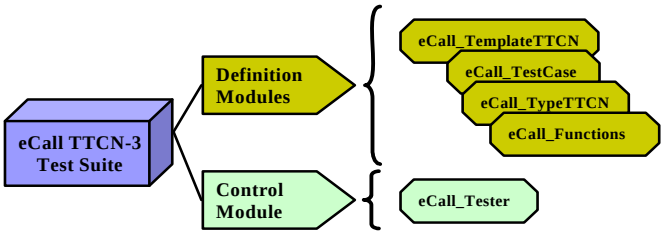
Test Manager manages execution

TTCN-3 is used to write the test cases which are independent from the underlying layers

CODECS, written in native language C, translates data types between TTCN-3 and native language.

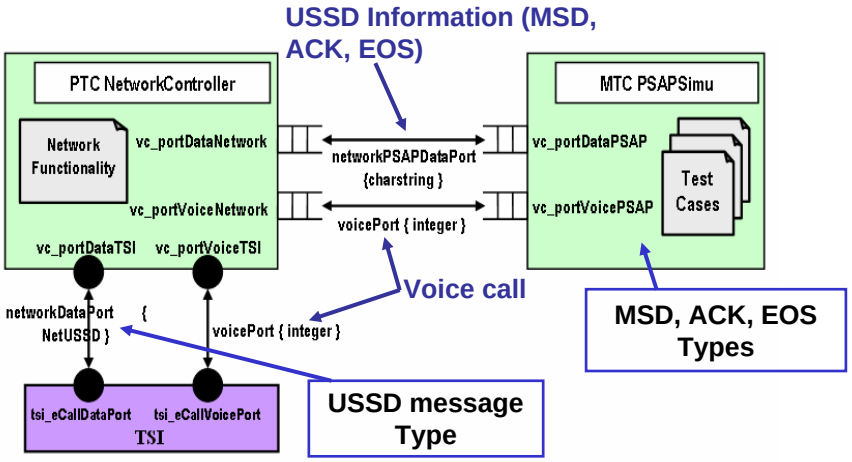
TTCN-3 Platform dependency is "outsourced" into the **Adaptors** written in native language (C).

eCall Test Suite



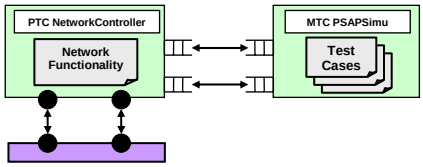
Module	Definition
eCall_TemplateTTCN	Templates
eCall_TestCase	Test Case and PTC behaviour
eCall_TypeTTCN	Types, message, ports and components
eCall_Functions	TTCN-3 functions and external functions
eCall_Tester	Control

eCall Test Configuration



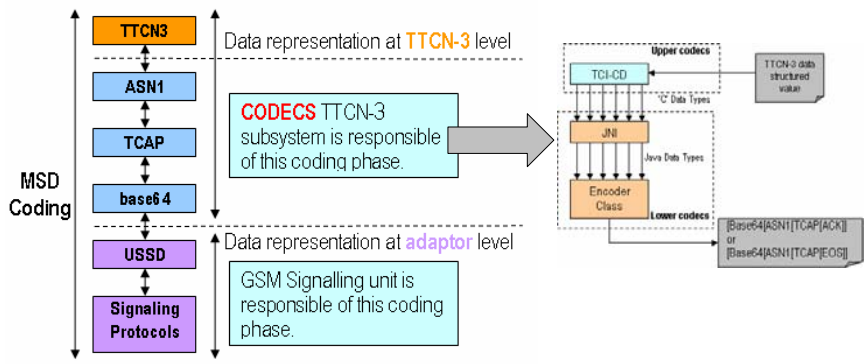
eCall Test Configuration

- **NetworkController (PTC)** is in charge of GSM layer 3 packet management. It emulates the behaviour of a GSM network receiving the **USSD messages** and **voice call**. This PTC resends the USSD information and voice call toward PSAPSimu.
- **PSAPSimu (MTC)** simulates the behaviour of a PSAP receiving and sending the message included inside the USSD: it simulates one end of the eCall application. This component uses external function in order to **decode MSD and encode ACK and EOS messages**. Finally, this component decides the **verdict** of the test cases.



CODECS

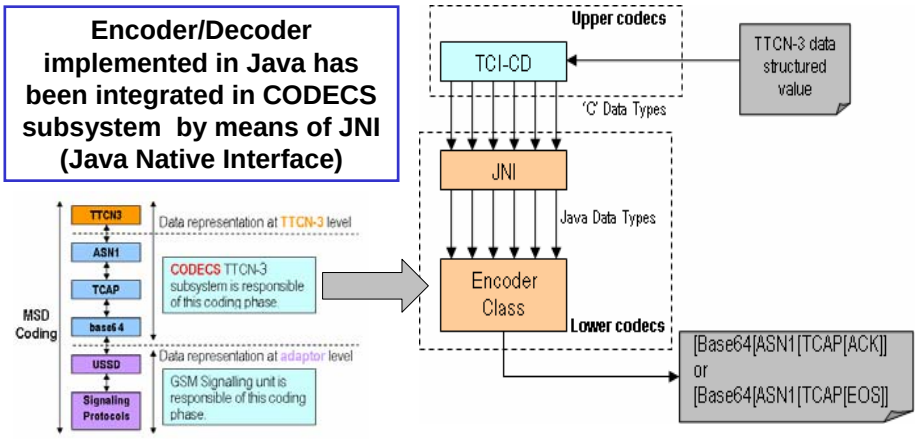
This schema is used to encode and decode USSD information (MSD, ACK and EOS types)



USSD messages type has been encoded using a recursive algorithm and decoded using a lineal algorithm

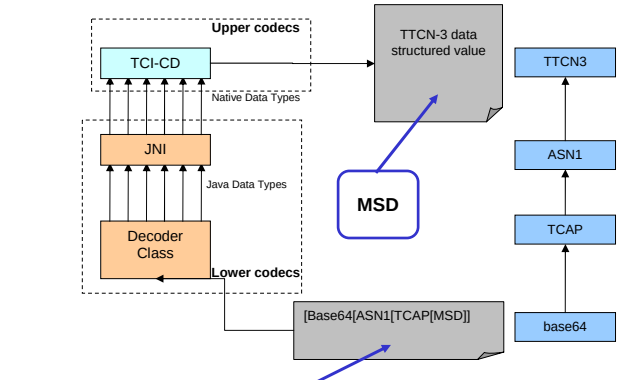
CODECS based on JNI

Encoder/Decoder implemented in Java has been integrated in CODECS subsystem by means of JNI (Java Native Interface)



JNI allows TTCN-3 test systems not to be dependent on the core language

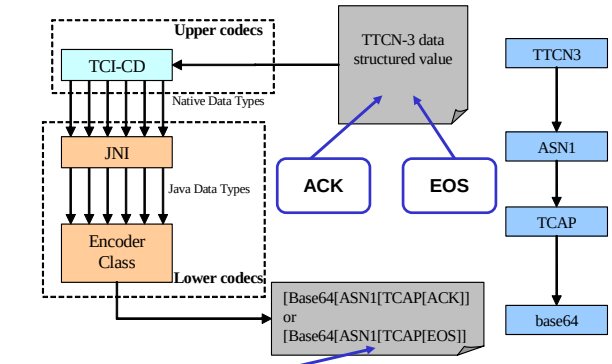
Decoder with JNI



External functions are used to stimulate CODECS module in order to **decode** MSD types

This data is a charstring which is sent through NetworkPSAPDataPort

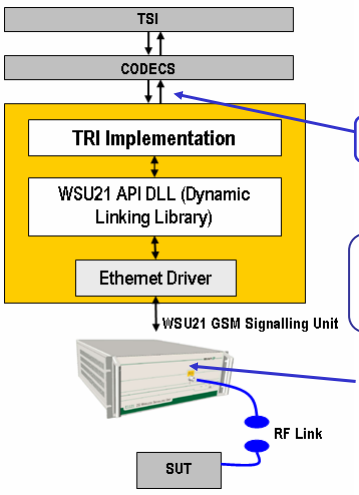
Encoder with JNI



External functions are used to stimulate CODECS module in order to **encode** ACK and EOS types

These data are charstring which are received from NetworkPSAPDataPort

System Adaptor (SA)



SA is composed of the GSM Signalling Unit (WSU21) equipment and the necessary software to manage it.

NetUSSD

TRI Operation Name	WSU21 API
triSend	Send_SS_Message
triEnqueue	Recv_SS_Message

SA depends on the underlying technology (GSM) which transports MSD and Voice Call

GSM Signalling Unit is a hardware developed by AT4 wireless enabling the test tool the capabilities needed to support the lower protocol layers based on GSM technology.

Platform Adaptor

Main adaptation is focused on external functions implementations

- Initialization and release WSU21 Signalling Unit
- Configuration WSU21 Signalling Unit
- Detect a voice call in WSU21 Signalling Unit
- Decode and Encode MSD, ACK and EOS

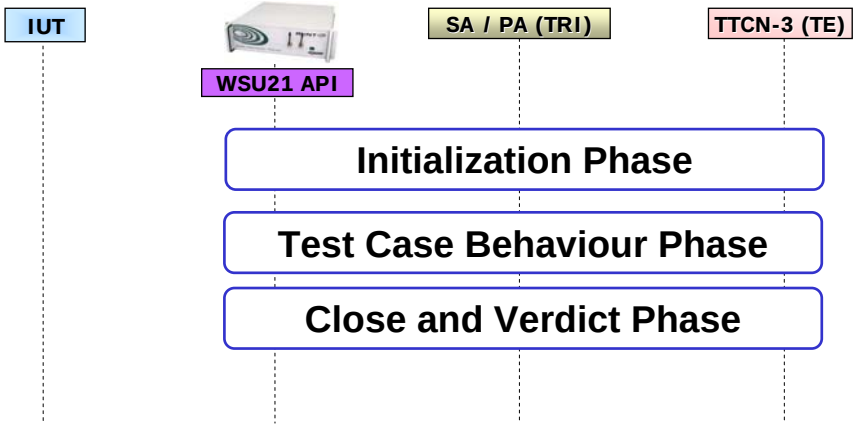
The implementation of timers is based on Windows Operating System temporizations because the test system is developed and executed in this Operating System.

External Functions

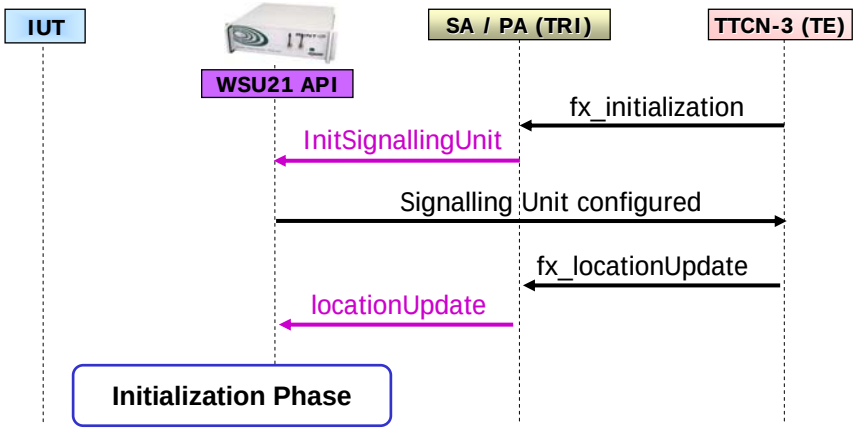
External Function	Description
fx_initialization	Initialize Signalling Unit
fx_closeTester	Release correctly the Signalling Unit
fx_locationUpdate	Configure the Signalling Unit to detect when a mobile is switched on
fx_mo_SS_Scenario	Configure the Signalling Unit to begin a messages exchange scenario of USSD originated from Mobile
fx_mt_SS_Scenario	Configure the Signalling Unit to begin a message exchange scenario of USSD originated from network
fx_emergencyCall	Detect if a voice call is received from Mobile
fx_decodeTCAPMSD	Decode a charstring with MSD information coded in base64+TCAP+ASN1 in a MSD TTCN-3 type
fx_encoderACK	Encode a ACK TTCN-3 type in a charstring with ACK information coded in base64+TCAP+ASN1
fx_encoderEOS	Encode a EOS TTCN-3 type in a charstring with EOS information coded in base64+TCAP+ASN1

Test Case Detailed

Test Purpose: To verify that the MSD message is sent with the correct fields after the activation procedure has been performed



Test Case Detailed



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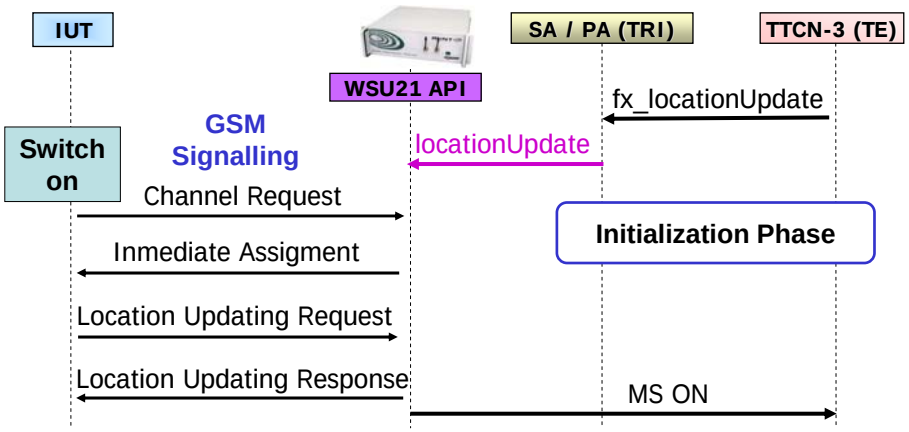

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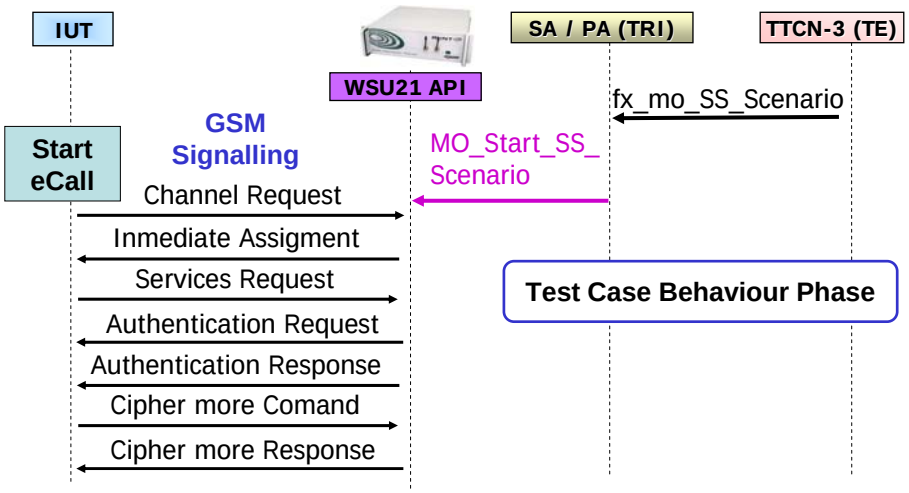

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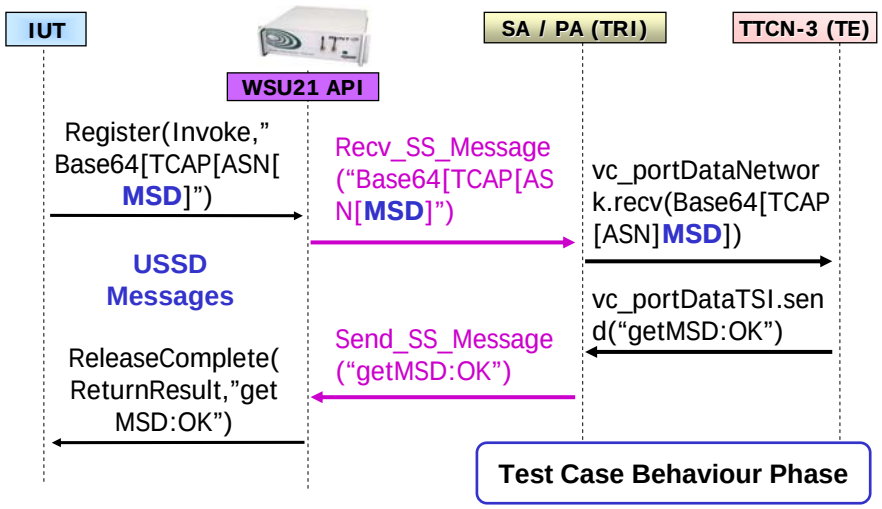

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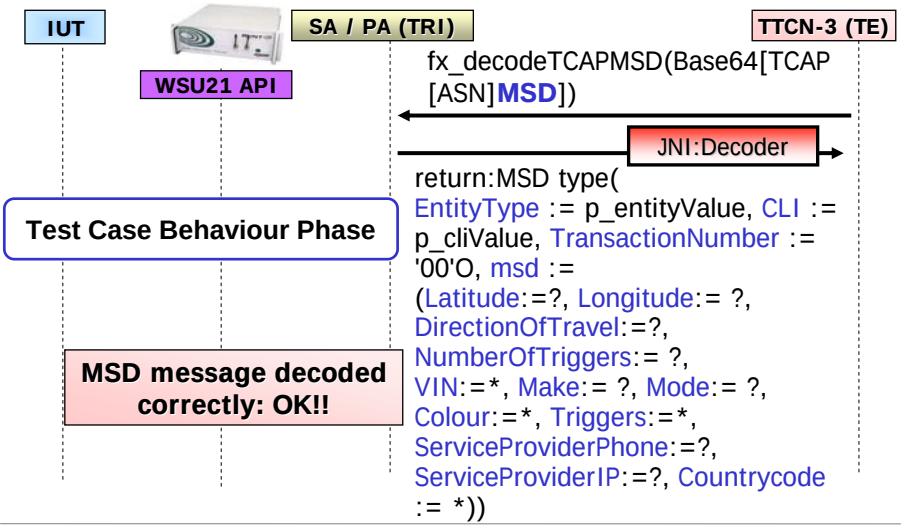

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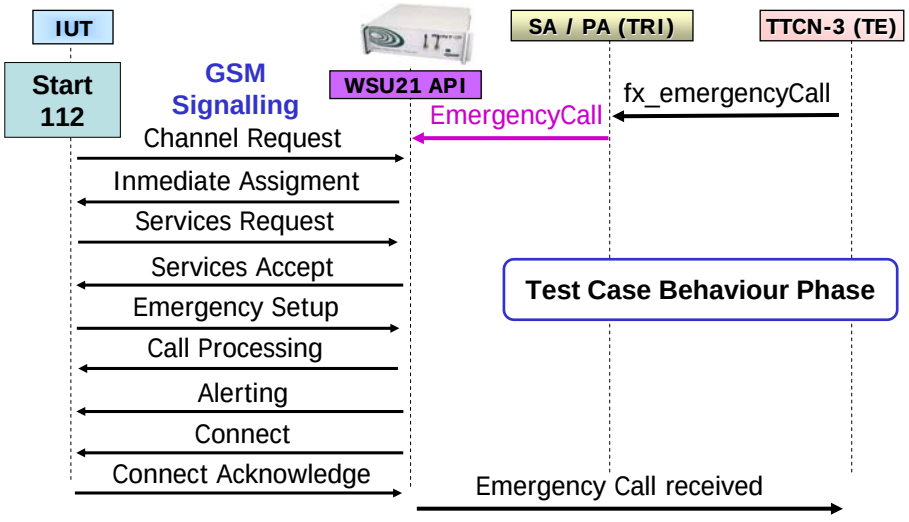

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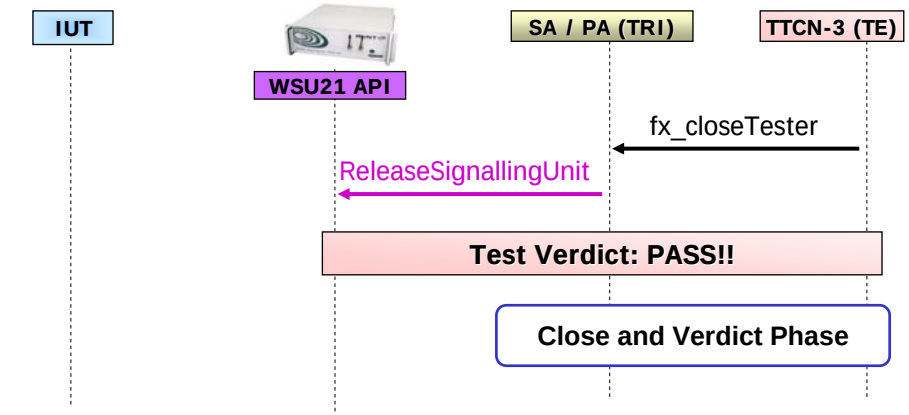

Results and Validation

The trials selected for validating the eCall test system developed come from GST partners and they were:

Munich TCU (SW)

Torino TCU (HW)

TP ID	Validated with TCU Torino and Munich	Verdict
TP/TCU/eCall/BV-02-C	YES	PASS
TP/TCU/eCall/BV-03-C	YES	PASS
TP/TCU/eCall/BV-04-C	ACK packet is not supported	Not applicable
TP/TCU/eCall/BV-05-C	EOS packet is not supported	Not applicable
TP/TCU/eCall/BV-06-C	CANCEL is not supported	Not applicable
TP/TCU/eCall/BV-07-C	CANCEL is not supported	Not applicable
TP/TCU/eCall/BV-08-C	Resending packet is not supported	Not applicable
TP/TCU/eCall/BV-09-C	YES	PASS

Conclusions

- Technology to build intelligent vehicle safety systems is available today.
- TTCN-3 Test System have been developed for testing automotive application (eCall) in a heterogeneous network
- TTCN-3 Test System architecture is able:
  - To keep the TTCN-3 test suite.
  - Adaptation to different underlying technologies (e.g., UMTS, WiMAX) only requires a change in the Adaptor module.
  - To cope with the evolution of the intelligent vehicle safety
- All test cases are edited in TTCN-3 and can be executed against an eCall application.
- Measurements using eCall prototypes have been successfully performed.

Thanks for your attention !

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