



The logo for NIDays Engineer Next is centered on a blue gradient background. It features the text "NIDays" in white, enclosed within a white rectangular border. To the right of this, the words "ENGINEER" and "NEXT" are stacked vertically in a large, bold, white sans-serif font. A yellow graphic element, consisting of three parallel lines forming a stylized arrow or chevron shape, is positioned between the two words. The background is decorated with several diagonal stripes: a wide green stripe, an orange stripe, and a red stripe on the left side; and several blue stripes of varying shades on the right side.

NIDays **ENGINEER**
NEXT



Multi DUT Production Testing with NI WTS on Infotainment / Navigation System

Dieter Vreyborg

Supply Chain Management, Industrialization

Make the Most of Your NIDays Session

National Instruments
Technical Marketing Engineer
Lorenz Casper



e.solutions



Test of IoT Products - Modern Infotainment & Connectivity Modules (Head Units)



Product Validation



Flashing



Production

Content

- Introduction of e.solutions
- MIB2+ Manufacturing Supply Chain & Test Process
- MMXF Test Features
- Test System HW, Test SW Architecture
- Evolution of Wireless Testing
- Motivation for WTS Selection
- WIFI / BT / GNSS Test
- NAD Test Strategy & Test Content Overview
- RF Test Time Contribution – Opportunities
- Achievements

Who is e.solutions?



Joint venture EB + Audi
Founded in 2009 & 2012
800+ employees



Ingolstadt

e.rfolgreiche Boomtown mit Charme.



Erlangen

e.rfrischend „kleine“ Großstadt.



Ulm

e.indrucksvolle Spitze im Süden.

What is the mission of e.solutions?

Infotainment for Audi and VW Group



Audi Virtual Cockpit

MIB including next MMX generation



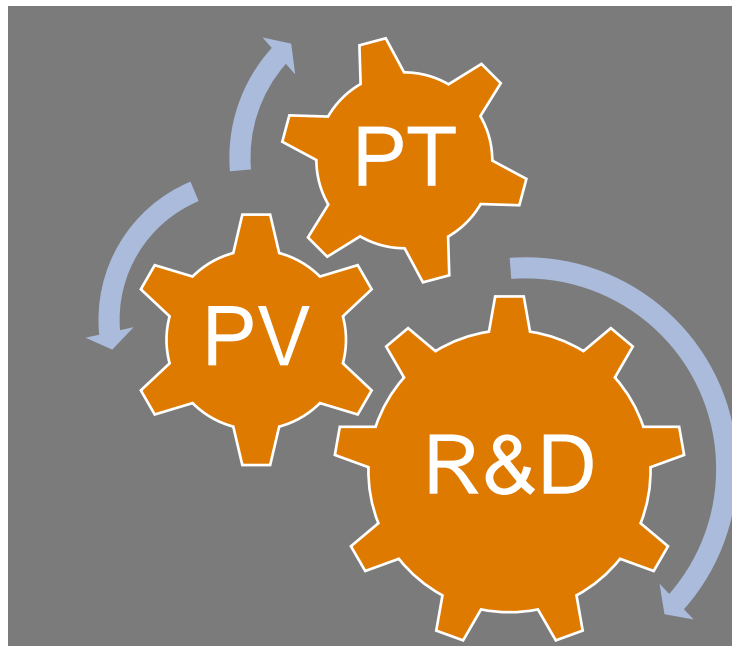
„Wir haben keine Vision, sondern ein klares Ziel: Wir entwickeln die besten Infotainment Systeme der Welt!“

Dr. Riclef Schmidt-Clausen, Geschäftsführer



Automotive 10" Tablet

Develop, Validate & Test



PT = Production Test

PV = Product Validation

e2e test solution

- e.solutions Industrialization team is part of R&D organization
- Test strategy & solution are targeted and developed along with the product in the early design phase, including Six Sigma, DFT and DFMEA analysis
- Common test solutions across entities
- Strong asset in device test SW development, test engineering, product validation
- Early test solution availability supports R&D teams with facts and figures and ensures customer satisfaction

MIB2+

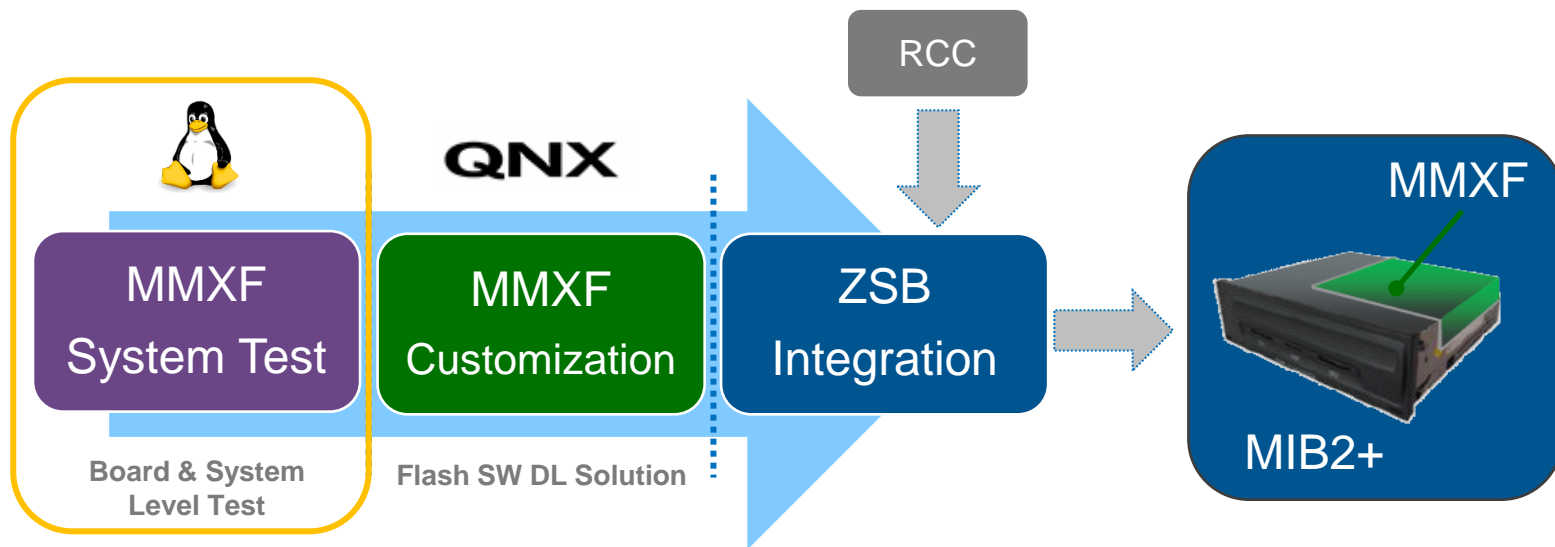


***World premiere of the new Audi A8 flagship
and introduction of new Infotainment System***

<https://www.summit.audi/en>

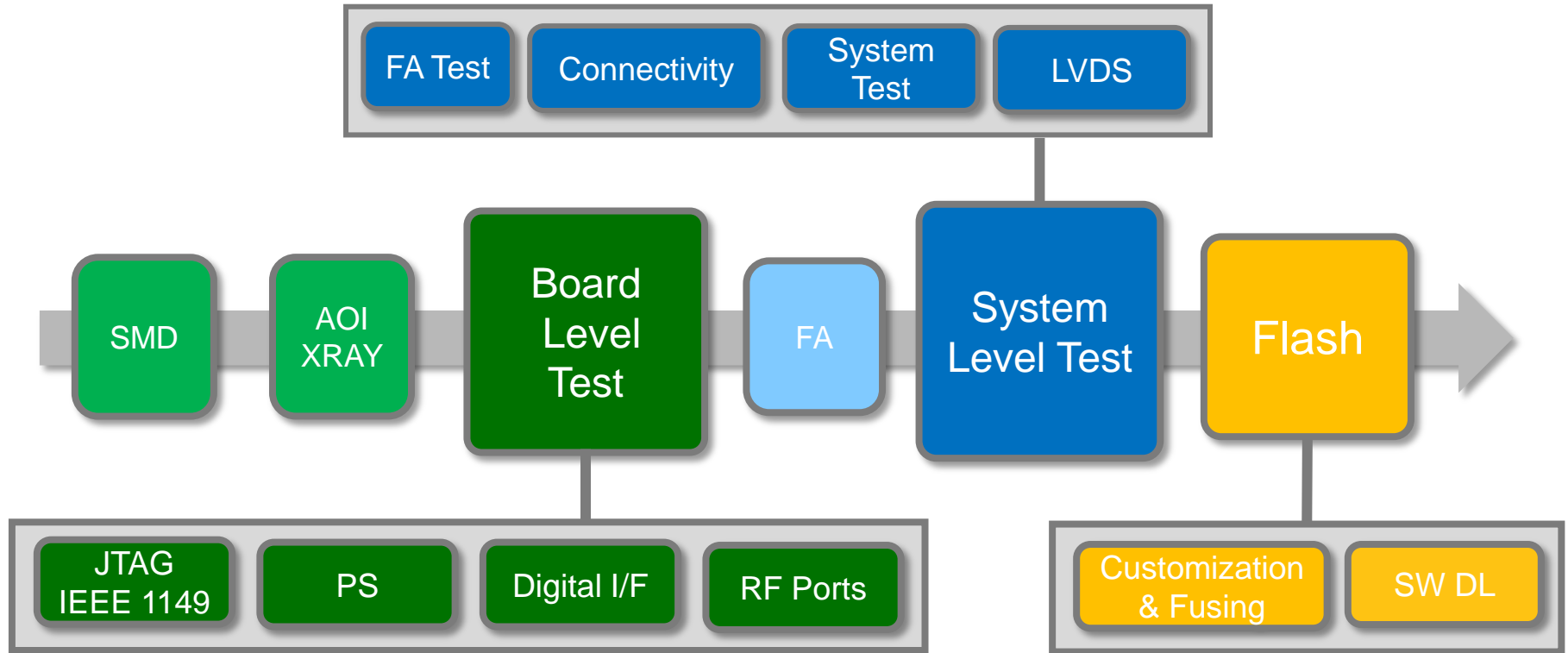
'Audi Summit' in Barcelona July 11th 2017

MIB2+ Manufacturing Supply Chain

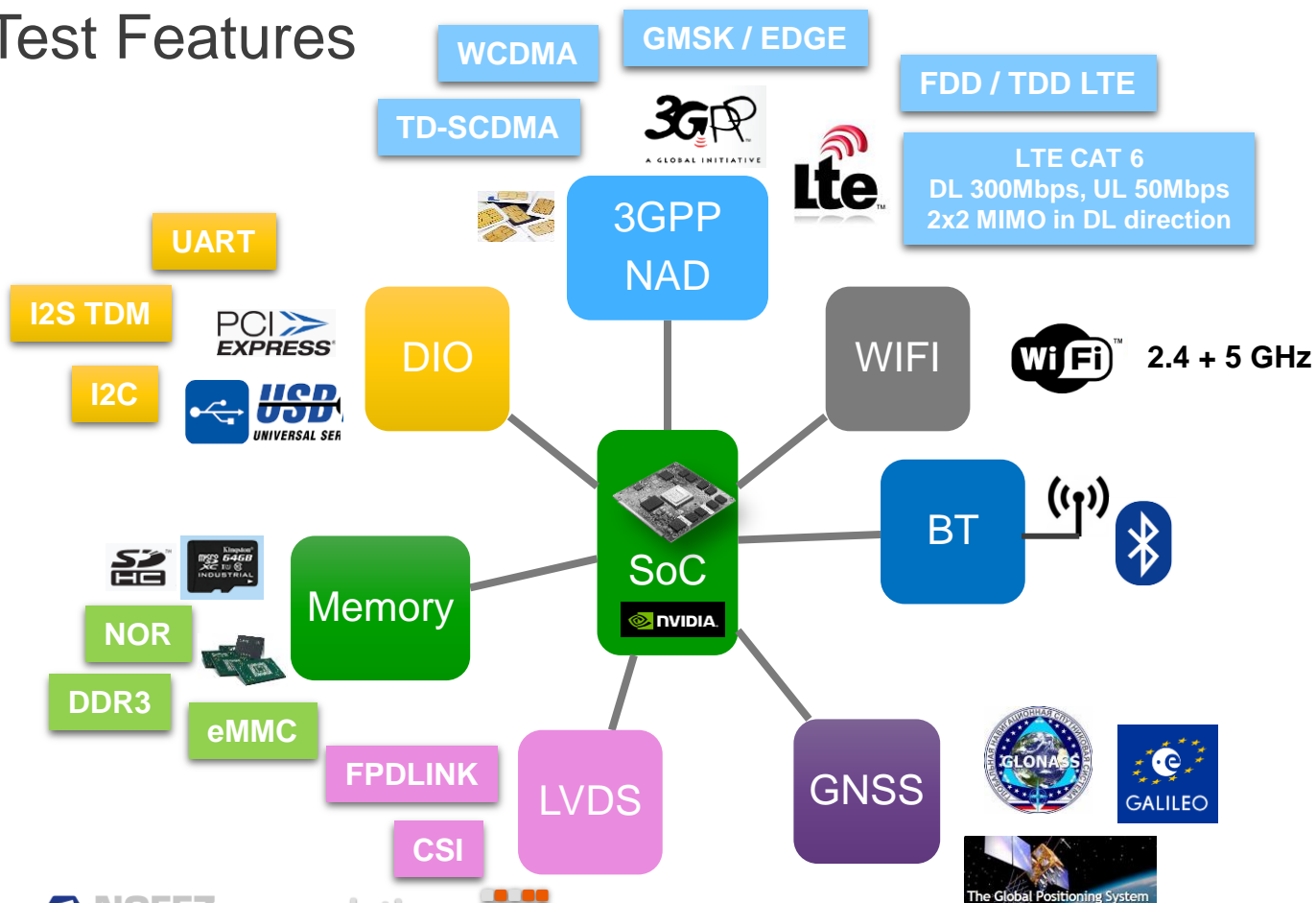


- MMXF (**M**ulti **M**edia **eX**tension **F**usion) is offering a true concept for MIB modularity
- RCC (Radio Car Control) and MMXF are manufactured in a separated line setup
- MIB (Modular Infotainment building block)

MMXF Manufacturing Test Process



MMXF Test Features



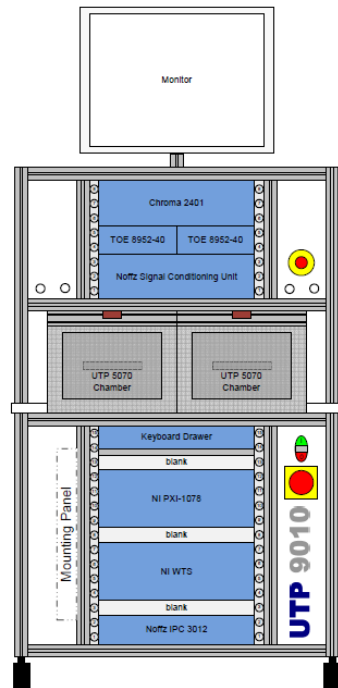
MMXF Test System HW



Test Socket

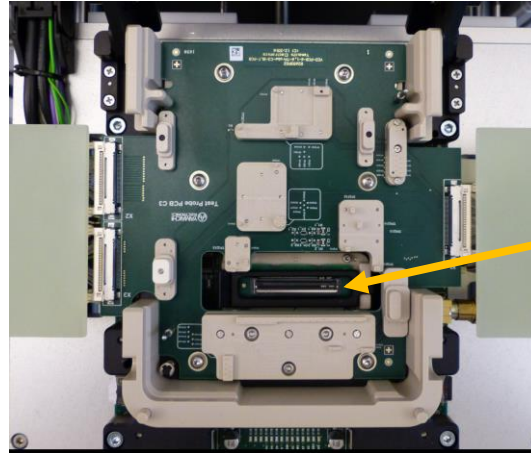
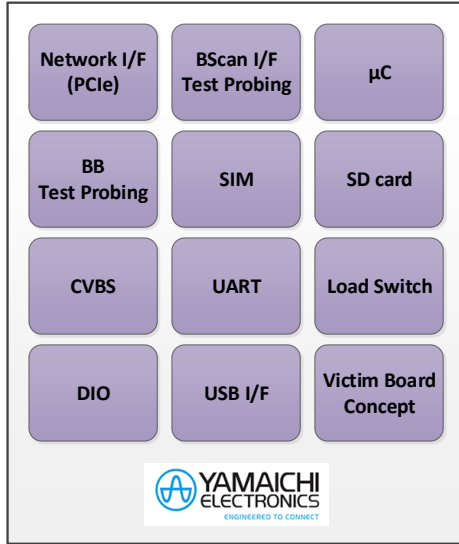


2 x RF chambers

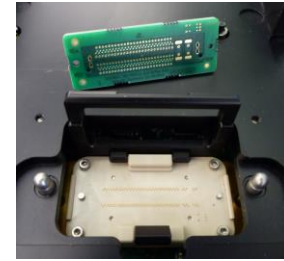
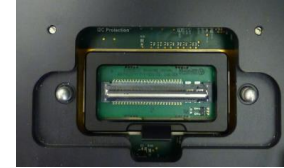


- NOFFZ UTP 9010 framework with signal control unit (SCU)
- 2 independent test sockets with RF chamber 5070
- Small footprint of 1 sqm floor space
- Advanced test socket adapter
- NI Infrastructure with PXI System
- NI Wireless Test Solutions
- Boundary Scan Integration
- FPDLINK III test application

Test Socket Adapter



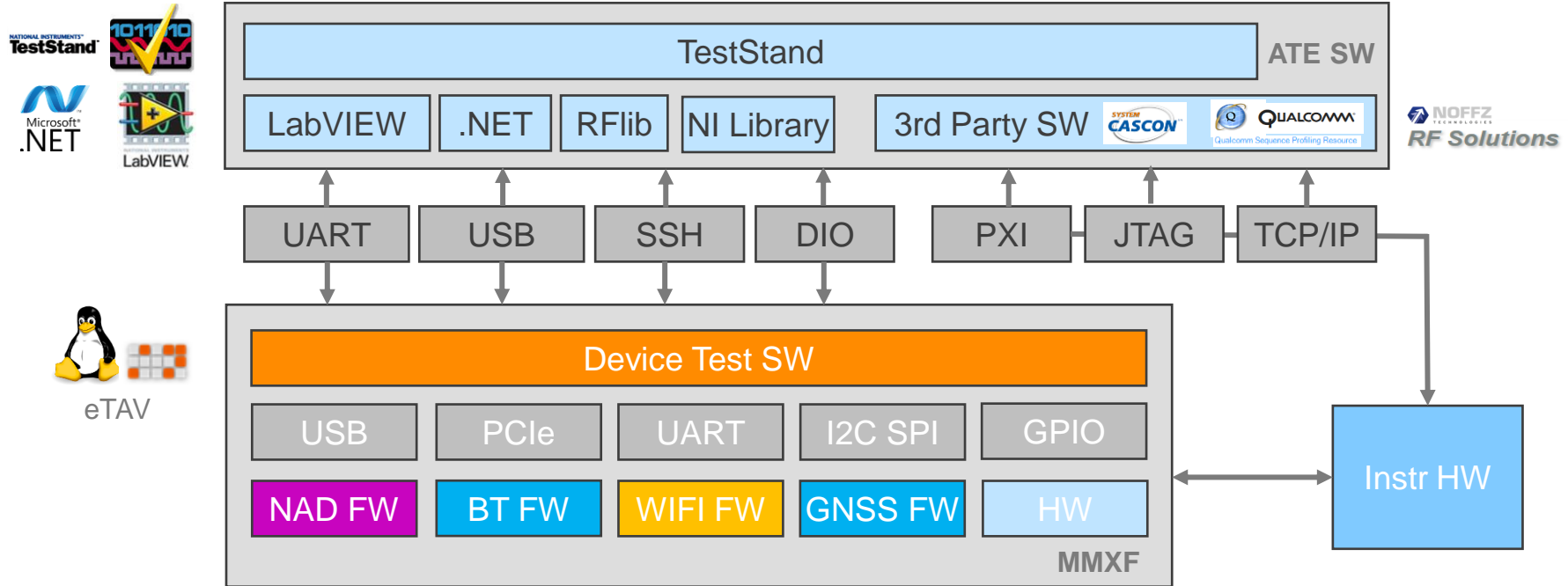
Board Level Test Adapter



Victim Board Test Socket

- Victim Board Concept for B2B Connector, including traceability
- Impedance controlled PCB design (Boundary Scan, USB, SD, SIM I/F)
- 60+ Test pattern used for JTAG and Base Band test
- Modular test adapter concept, flexibility for design changes / test probing
- μController incl. FW, API for test software driver

Test SW Architecture

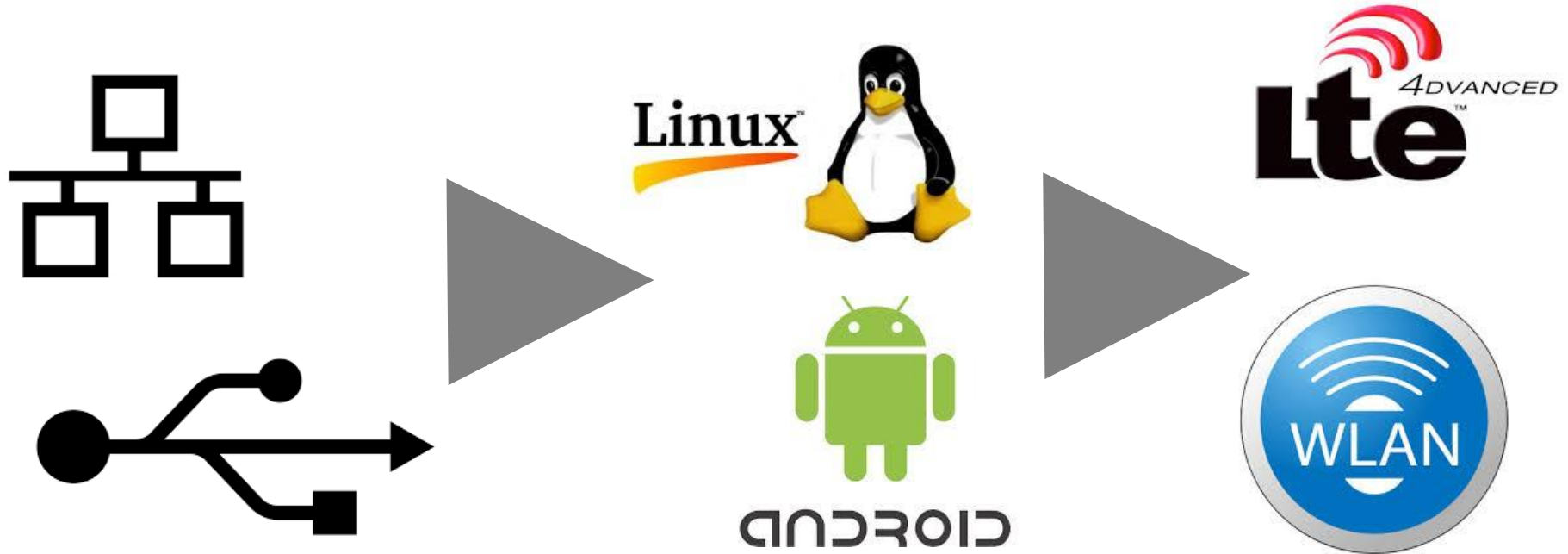


RF Testing with NI WTS

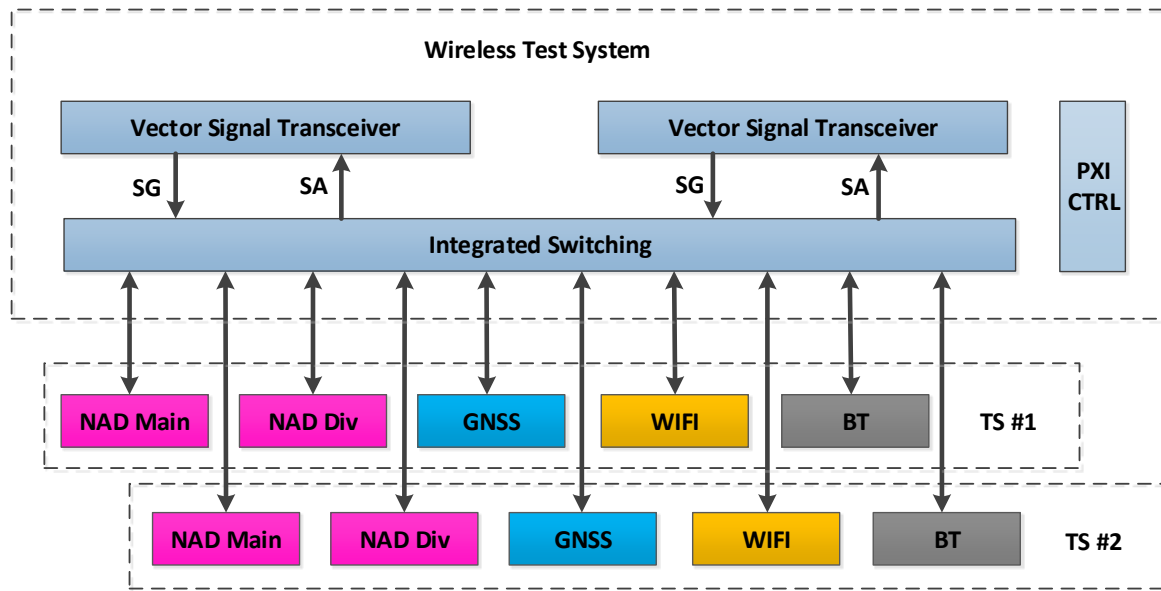
Evolution of Wireless Testing

- Signaling Test
 - Connection established between two devices in order to perform testing
 - Advantages:
 - Can test any wireless device
 - Comprehensive testing
 - Disadvantages
 - Tends to be expensive and relatively slow
- Non-Signaling Test
 - Communication established between PC and chip in order to put device in specific mode to transmit or receive
 - Advantages:
 - Faster testing
 - Disadvantages
 - Less “comprehensive” testing

How do we test – Signaling / Non-Signaling Test



Motivation for WTS Selection



- 80 MHz Bandwidth
- 16 RF port setup for Multi DUT
- Turn key solution for connectivity RF test requirements

- One Vector Signal Transceiver (VST) is dedicated to one test socket
- RF sequence can be executed in parallel, independent execution of test sockets is possible due to RF chamber (test socket isolation ~ 40 dB / ~80 dB between both sockets)

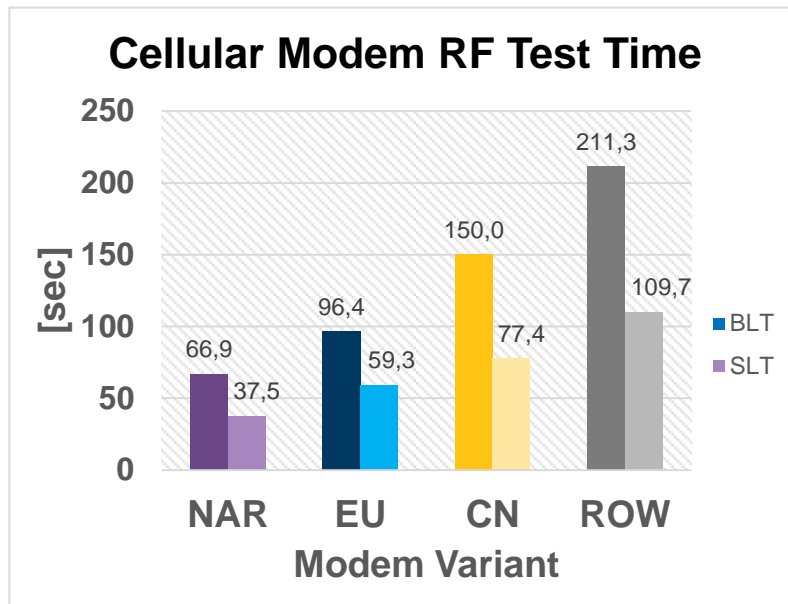
WIFI / BT / GNSS Test Content Overview

WIFI		BT	GNSS
2.4 + 5 GHZ		2.4 GHz	1.6 GHz
TX Power	RSSI	TX Power	ClockDrift
SEM	PER	ICFT	CNO
EVM	FreqErr	EVM	Gain
		LE PER	RtcFreq
			Sat ID

- WIFI and BT parameter test are implemented in non signaling mode through NOFFZ RF library
- WIFI test is performed across multiple channels for both frequency bands
- DH5 and 3DH5 data rates are used for BT TX evaluation; the receiver is tested in addition in low energy mode
- GNSS receiver test is covered through an enhanced production test method

NAD Test Strategy

Technology	EU	CN	NAR	ROW
GSM / EDGE	2/2	2/2	2/4	2/2
WCDMA	2/3	2/3	2/3	3/5
FDD LTE	5/7	2/4	3/6	6/11
TDD LTE	N/A	3/4	N/A	3/4
TD-SCDMA	N/A	1/2	N/A	1/2
# bands	9/12	10/15	7/13	15/24



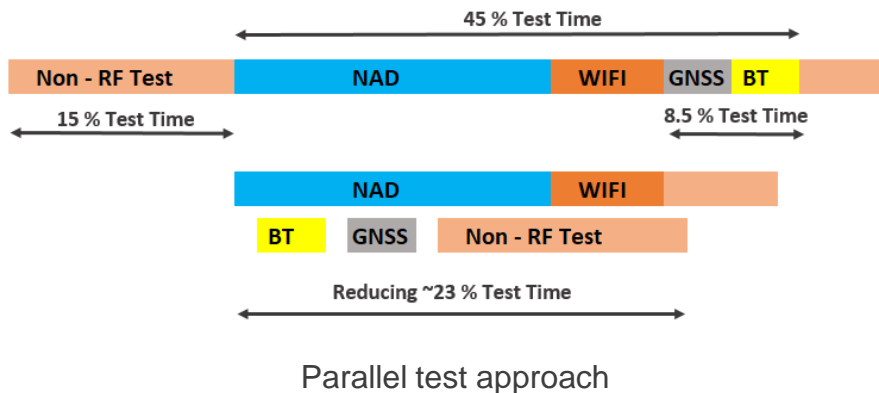
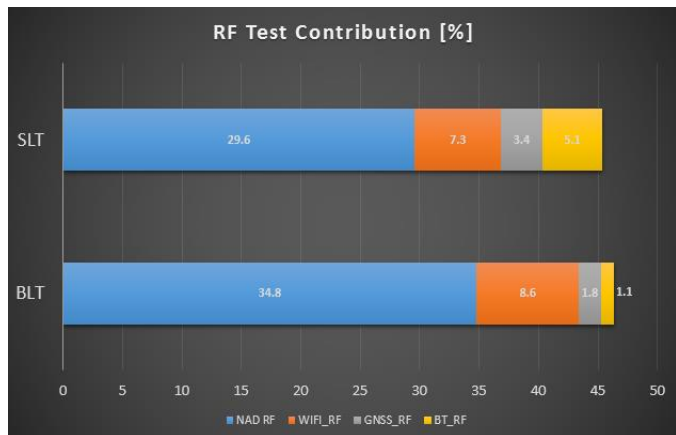
- To reduce test time impact, specific bands are selected for verification to test all major RFFE (RF Front End) components like band filter and TX power amplifiers, diplexer and the wideband transceiver interface
- Example for ROW variant: testing 15 from 24 bands (~ 62%) is sufficient for verification

NAD Test Content Overview



- Frequency Bands from 800 MHz to 3.5 GHz
- Network Access Device (NAD) is tested with different scope:
- TX Power and RX quality test are done across frequency in Board Level Test (BLT)
- Extensive RF test cases are executed on Mid channel in System Level Test (SLT)
- RX test are performed on both antenna ports, including Throughput (BLER) measurement
- Mid channel is used for comparison purpose to track the system calibration between test stations

RF Test Time Contribution & Opportunities



- Approx. 45% RF test time contribution
- NAD RF testing consumes a third of test time
- Parallel test execution can further decrease overall test time by 23 %

Summary



Achievements

- MMXF test system with small foot print of 2 x 1 sqm for efficient factory layout
- Parallel development in prototyping phase, flexible and optimized adaption to product design cycle changes
- Several thousand samples tested without major line stop; onsite support through NOFFZ staff ensures smooth production
- Seamless integration of WTS turn key test solution into Noffz Test framework including adaption to DUT SW requirements
- Rapid development of test content by utilizing NOFFZ RF and Test library in close collaboration with e.solutions
- Synergies (cost and time) for e2e test systems development from validation to manufacturing

Questions?

Thank You!

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