

5G-PICTURE 5G Railway Demonstration

Presenter: ⁴

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5G-PICTURE in a Nutshell



- <u>Project Title</u>: **5G** Programmable Infrastructure Converging disaggregated neTwork and compUte REsources
- <u>History</u>: 19 partners
- <u>Project</u>
 <u>Duration</u>: 01.06.2017 31.05.2020 (36 Months)
- <u>Resources</u>: 893 PM, 7.997,250 Mio €

5G-PICTURE Consortium





Operators (2x), Industry partners (5x), SMEs (4x), Universities (4x), Research Institutes (4x); 6 E

6 EU-Countries, 2 Non-EU

5G-PICTURE Main Objectives



- 5G-PICTURE focused on an integrated, scalable and open 5G infrastructure with the aim to support a variety of *operational* and *end-user services* for both *ICT* and "*vertical" industries*
- This infrastructure exploited a *converged fronthaul* and *backhaul transport network solution*, integrating advanced *wireless access* and novel *packet* and *optical network* domains with *compute and storage* resources
- 5G-PICTURE relied on **network softwarisation** to enable an open reference platform instantiating a variety of **network functions** over a **unified operating platform**
 - exploiting *slicing* for multi-tenancy
- *Demonstration* activities of *ICT* and *vertical industry* use cases



5G-PICTURE Demonstrations



Extensive demonstrations to showcase ICT, and vertical industry services:

- Smart city demo: virtual reality and public safety services in a smart city test-bed in the centre of the city of Bristol, UK
- Railway demo: end user and operational rail services in a real life operational environment in Barcelona Spain
- *Stadium trial:* mega event services including crowdsourcing services and network slicing in a real and demanding operating environment at a stadium in Bristol, UK



5G-PICTURE Rail Demo







Train Details:

- Max speed 90 km/h •
- 3 vehicles (60 m total length)
- Capacity for 780 passengers
- Multitenancy and slicing capabilities to support critical, performance and business services over the converged optical/wireless deployment
- Capability to achieve the required 5G data rates on board the train
- Capability to achieve the required latency for timecritical communications
- Capability to achieve seamless mobility

Service components:

FGC Context - Demonstration





Track Access Network (TAN) Train Communication Network (TCN)

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Demo Deployment

- Track segment East of Olesa de Monserrat station
- Four stanchions equipped with mmWave AP's were interconnected with fibre
- Connecting to a set of on-board devices mounted on a specific train that travelled through this section
- Martorell station was used to simulate a simplified Operations Control Centre (OCC)

Radio planning guidelines:

- Range ~300m
- Train at mid-point between posts should have line of sight of each post
 - 1,5km coverage
 - 1 Gbps throughput target
 - to a train running at 90 km/h



Barcelona, Spain, on November 13th 2019

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Network Components



- Track Access Network (along the track)
 - mmWave APs along the track
 - A **passive WDM** interconnecting the APs with fibre
 - An **Ethernet** Aggregation Level to collect the data along a complete track
- Train Communication Network (on the train)
 - mmWave modems (front and rear)
 - A 10G Ethernet ring along all train
 - Service level equipment (Wi-Fi/CCTV)

Track Access Network

TAN components were installed at several locations:

- **mmWave APs**, distributed across four stanchions along the track
- A **passive DWDM** interconnects the mmWave APs over a single fibre link, and multiplexes all the traffic into Olesa station
- A 100G Ethernet aggregation ring exclusively between Martorell and Olesa stations
- A **FlowBlaze** in Martorell station, to provide the mobility function for session continuity, by associating the traffic with the mmWave APs that the train is passing by.





- One FGC train equipped with a TCN
- Two on-board mmWave units, mounted at the front and rear of the train, with their Host Processor Modules connected to both ends of a 10G Ethernet ring.
- This 10G ring consisting of three Ethernet switches interconnected (ADVA FSP 150CC-XG210); each of them in a different vehicle
- One Wi-Fi AP connected to each switch to provide Internet Access
- CCTV cameras connected at some points of the TCN

High Performance Solution Architecture mmwave RAN



Low TCO multi-service network to facilitate 5G deployment in railways

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Field Test Results

• Train stopped at test point "2"



Train-to-CO throughput

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Demo Sites Train Network













Demo sites Track Network









Demo Sites Olesa Room







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Demo sites Martorell Room













Conclusions

- Europe's first 5G Rail deployment in an operational environment:
 - Integrated 5G wireless and optical transport solution,
 - Broadband wireless mmWave track-to-train connectivity
 - Passive WDM optical transport
 - Programmable mobility function for seamless onboard train connectivity
- Implementation of the 5G-PICTURE architecture
- Contribution towards the FRMCS vision
- Provision of coverage to approximately 1,5 km of track with over 1
 Gbps throughput to a train running at 90 km/h

SG-PICTURE

Thanks for your attention!

5G-PICTURE Project

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