Internet of Radio Light Workshop
5G Radio Access Network
5G Distributed RAN

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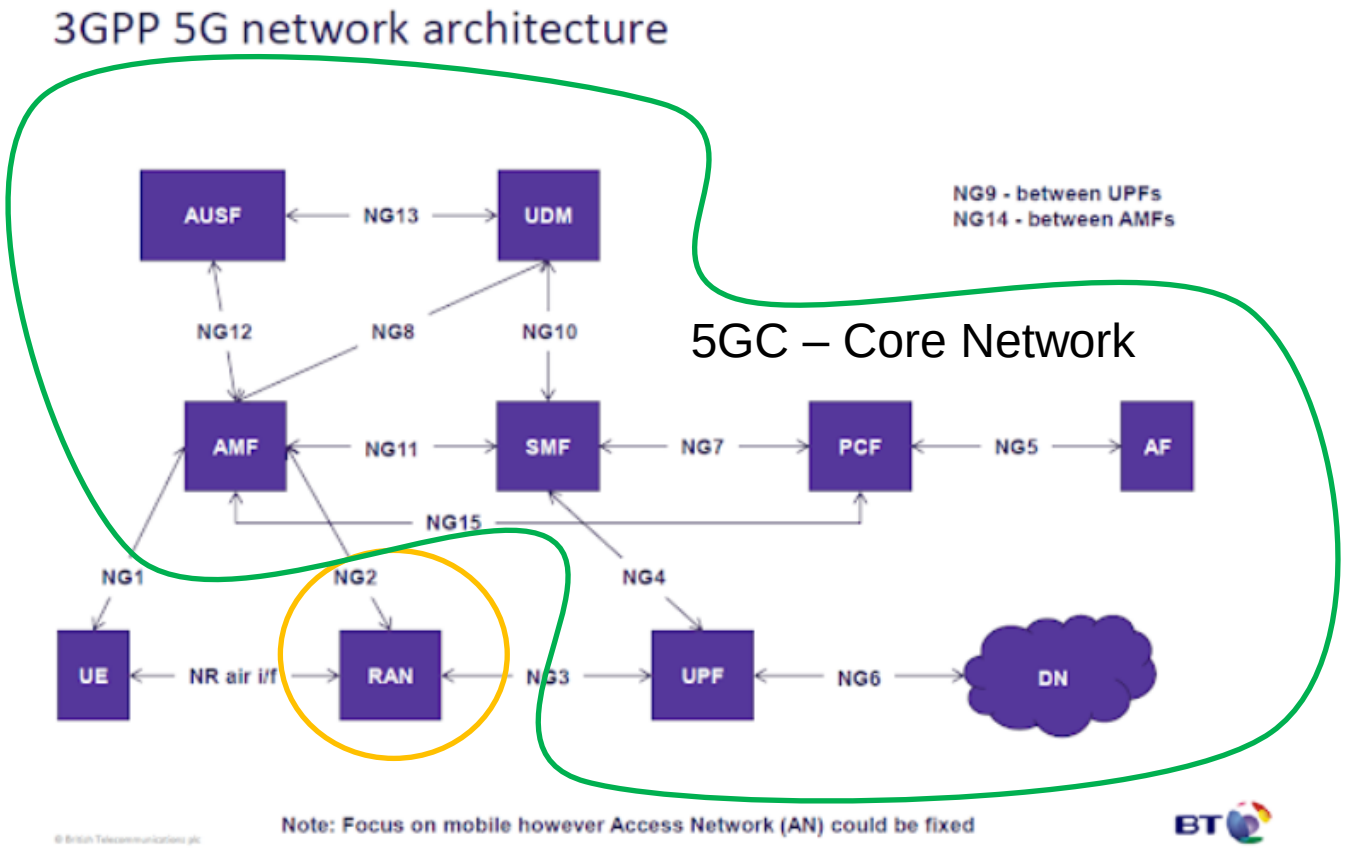
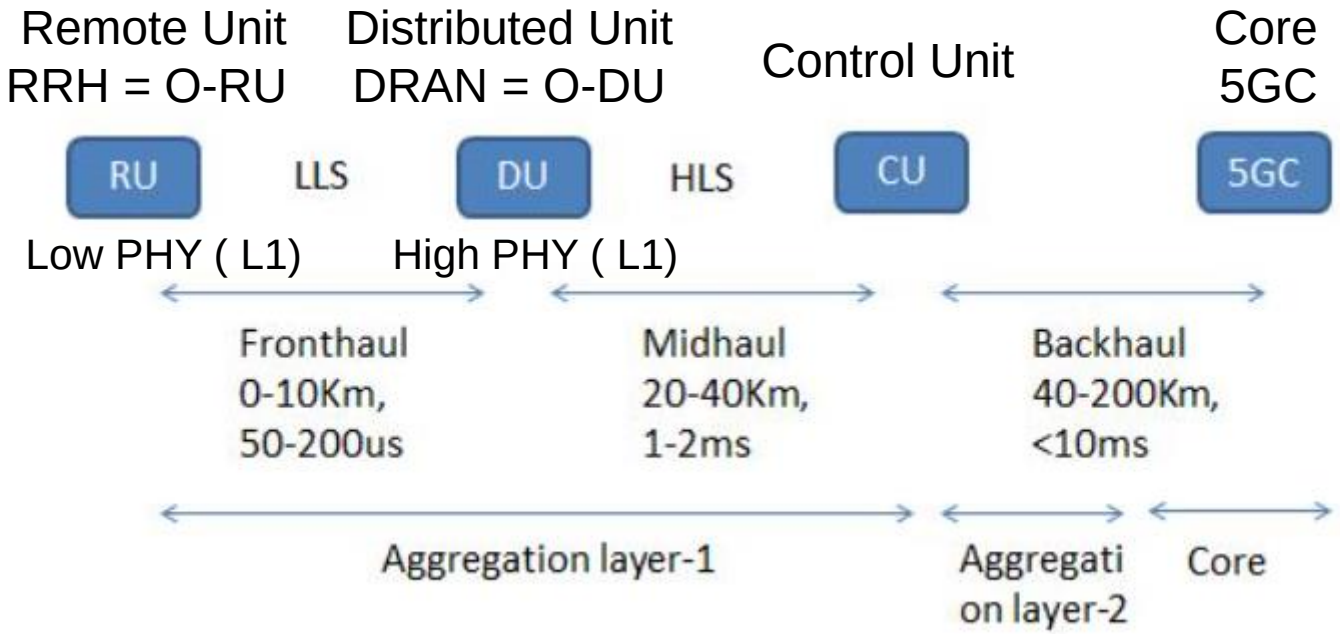
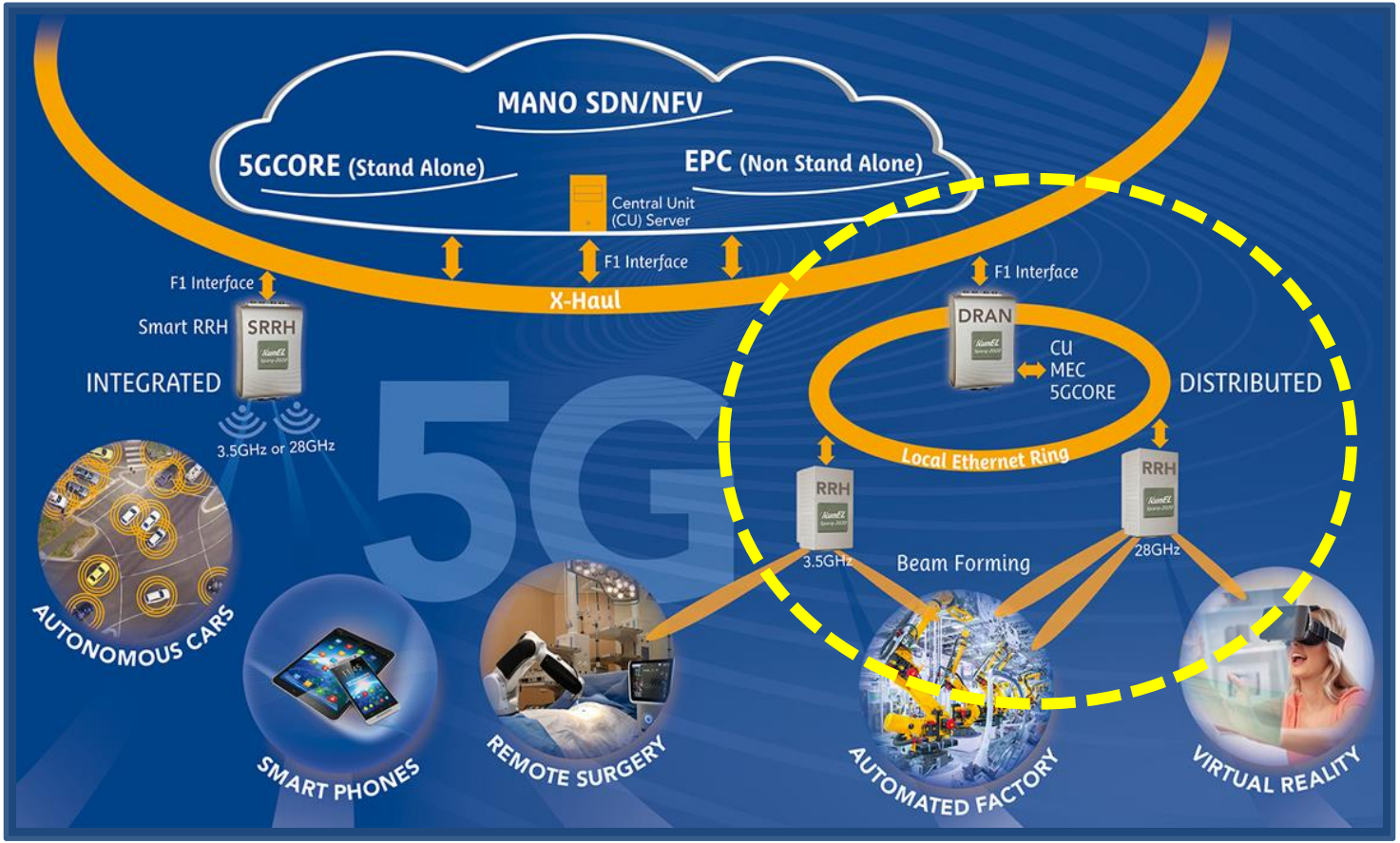
5G Architecture



5G RAN Distributed Architecture



IoRL 5G RAN Distributed Architecture

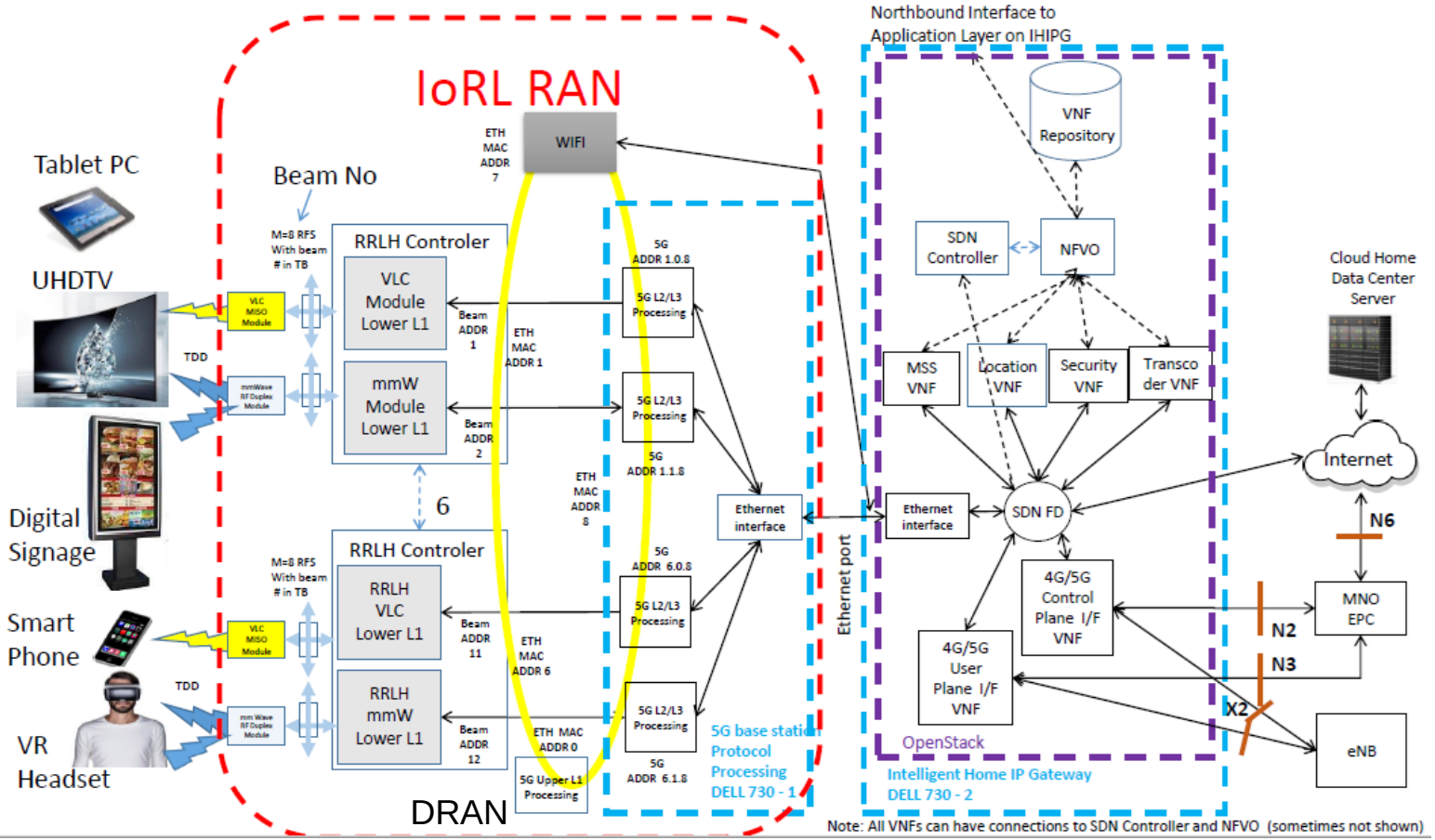


5G Core

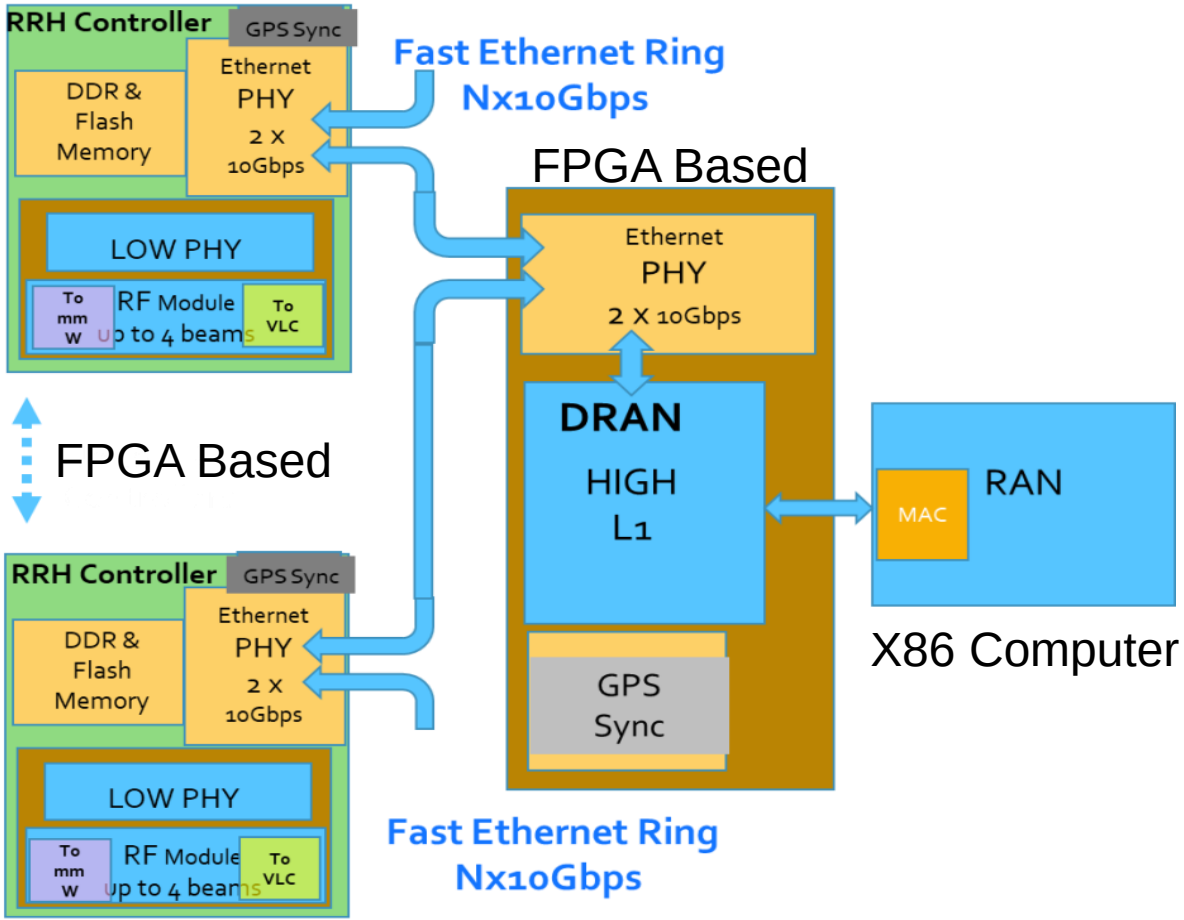
DRAN

RRLH Controller
mmWAVE Head
VLC HEad

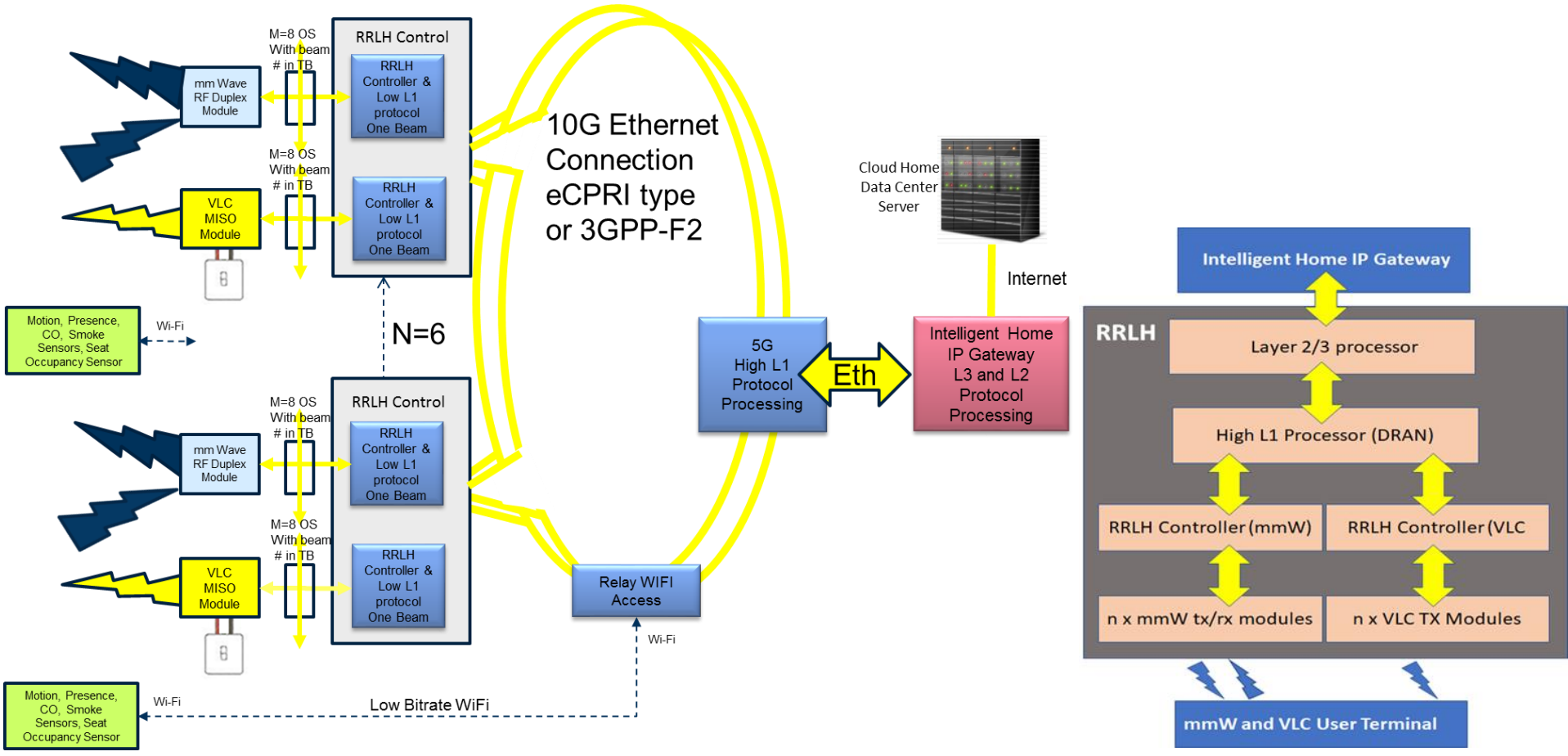
IoRL RAN within its Related Environment



DRAN, RRLH BD and Connectivity

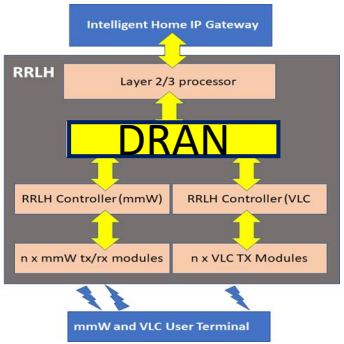


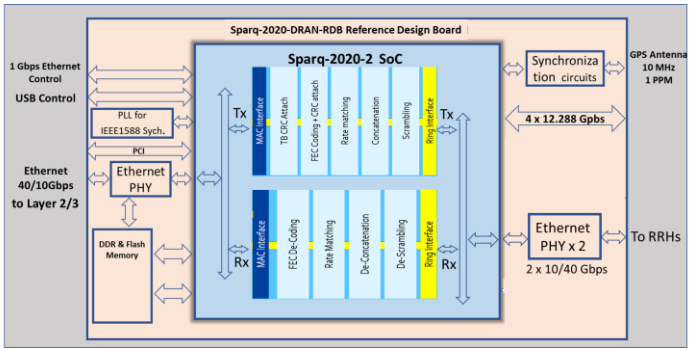
IoRL RAN Hardware BD (right) and Architecture



IoRL DRAN

Brief introduction: The DRAN displayed below is one of the main components of the IoRL 5G Link and includes several modules of the 5G PHY Layer as depicted below including LDPC and Polar Forward Error Correction (FEC) codes and more

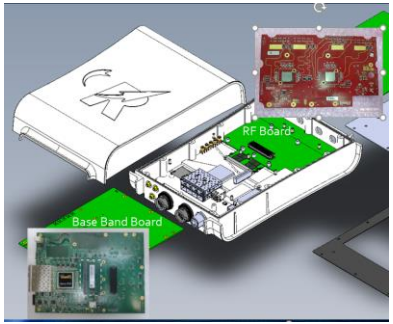


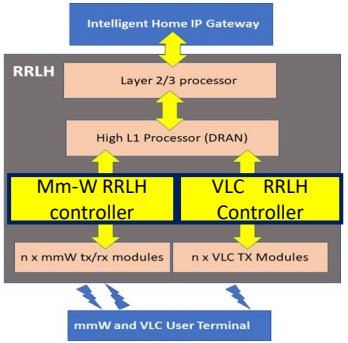


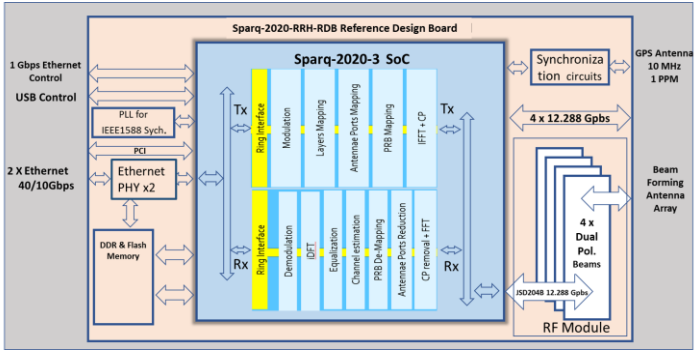
IoRL RRLH

Brief introduction: The RRLH is one of IoRL 5G RAN main and includes several modules of the 5G PHY Layer including OFDM modulation and demodulation and 3.5GHz RF module

Practical importance: The RRLH is a key component of the 5G RAN which complies with the 3GPP Standard Physical Layer (Layer-1) Specifications; The RRLH interfaces northbound with the DRAN via a Nx10Gbps Ethernet ring and with mm-Wave and VLC modules southbound. The RRLH is configured at different frequency bands and bandwidths to match the mm-Wave and VLC functionalities





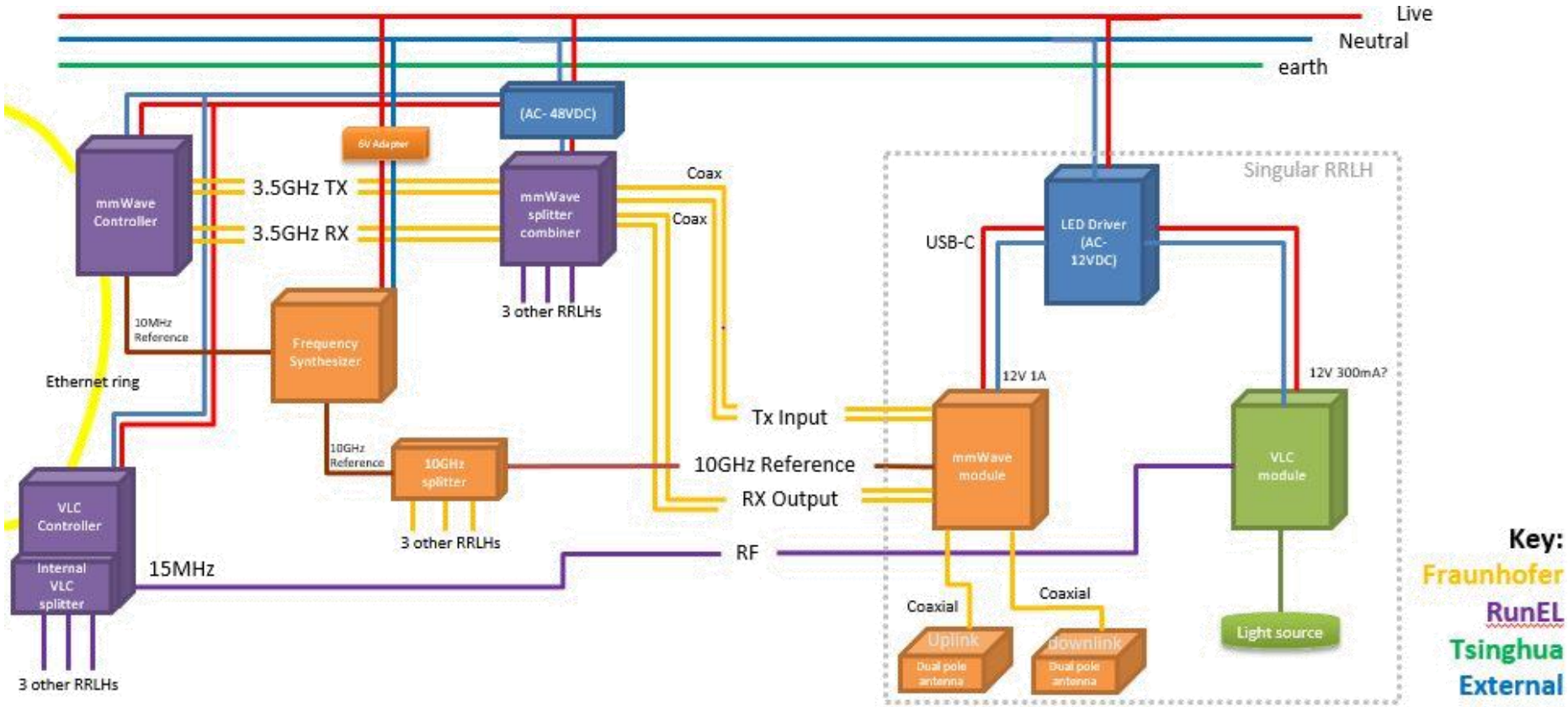


RRLH Processing Tasks

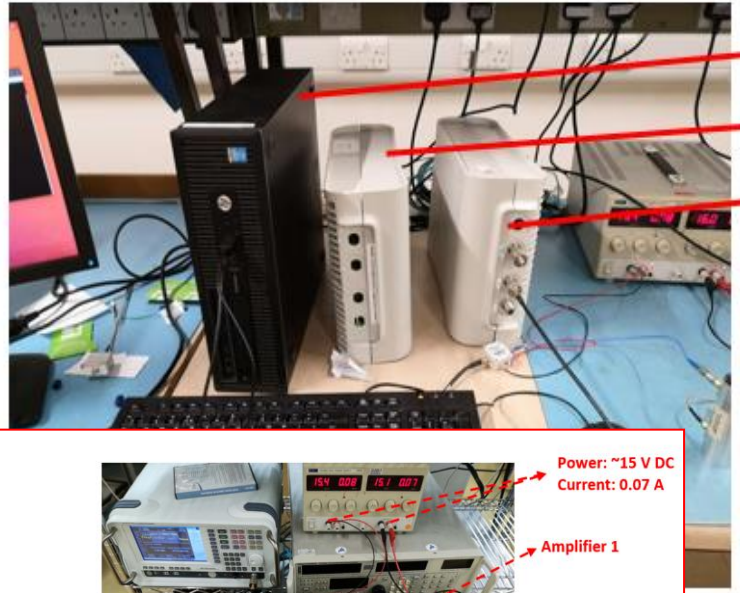
The RRLH carries out:

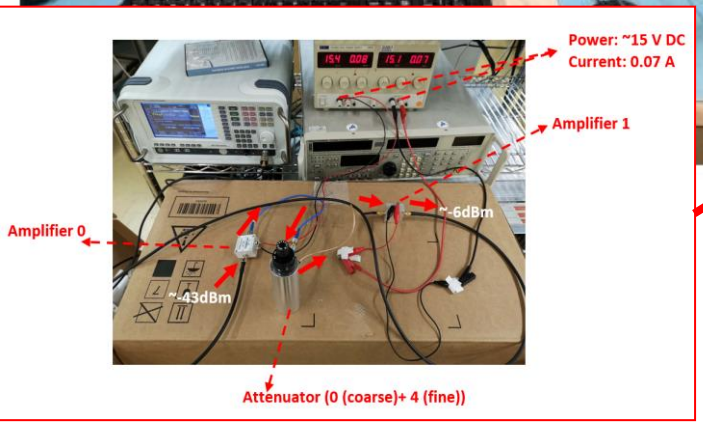
- Data modulation and demodulation,
- PRACH process,
- Precoding,
- Resource elements mapping,
- iFFT/FFT,
- Cyclic prefix insertion,
- Digital to analog and analog to digital conversion,
- Low IF generation for VLC air interface,
- 3.5 GHz RF modulated signal generation and detection for mmW air interface.

RRH with Radio/Light Assemblies Block diagram



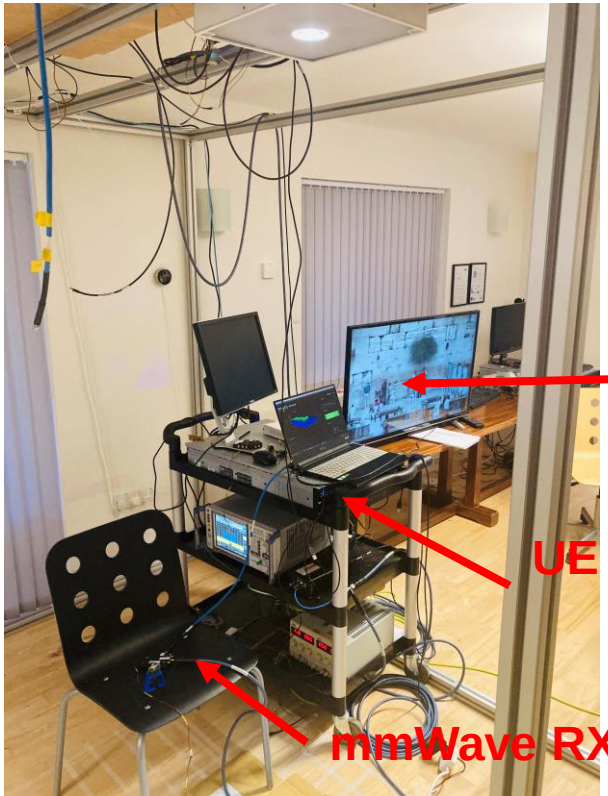
RAN Devices and Setup(BS side)

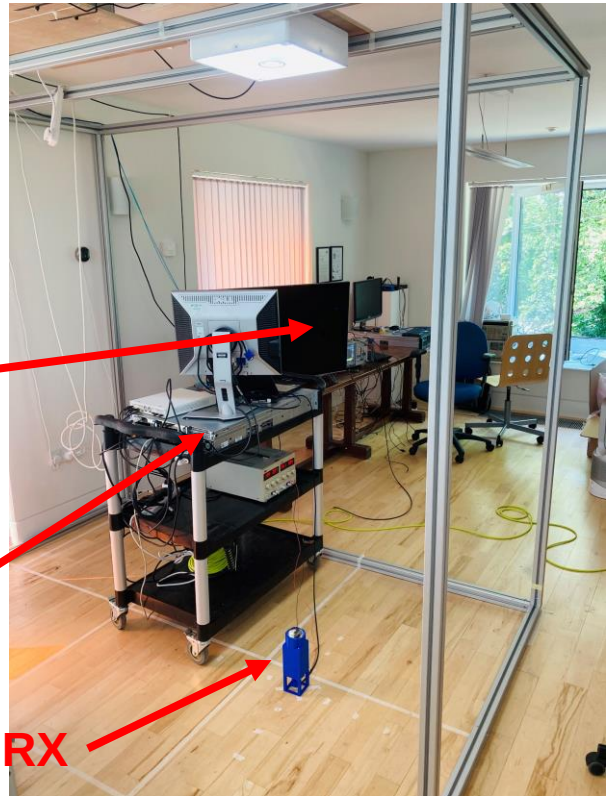




RRH and VLC power amplifier model are set on ceiling

RAN Devices and Setup(UE side)





RAN Main Features

- Dual connectivity (VLC and mmW) can be maintained over the air
- The RRLH is based on RunEL Sparq-2020 FPGA including 4 ARM cores.
- The RRLH can maintain up to 4 beams. (For IoRL, a single beam is allocated for VLC and another for mmW).
- To extend the coverage area
- For the DL air-interface several VLC lamps, up to 8 can be connected in parallel to the RRLH analog output.
- For the DL and UL air-interface several, up to 4 mmW modules can be linked to the RRLH via an RF splitter.

RAN Main Features (cont.)

- Channel Bandwidth
  - For VLC the channel bandwidth is 10 MHz. The bandwidth should be extended to 20MHz.
  - For mmW the channel bandwidth is 20, 50 or 100 MHz.
- Data rate -
  - The Ethernet ring maximum data rate is 10 Gbps
  - For each user the DL peak rate in the VLC interface is limited to 20 Mbps. It can be enhanced if VLC bandwidth is extended.
- For each user the peak rate in the mmW DL is limited to 200 Mbps for 100 MHz channel bandwidth
- Duplex - RRLH supports FDD and TDD. TDD is applied for IoRL project.

IoRL Project RAN Innovation

- IoRL First to do Distributed Architecture with PHY Split (Before ORAN)
- IoRL First to do 5G Over VLC Spectrum

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