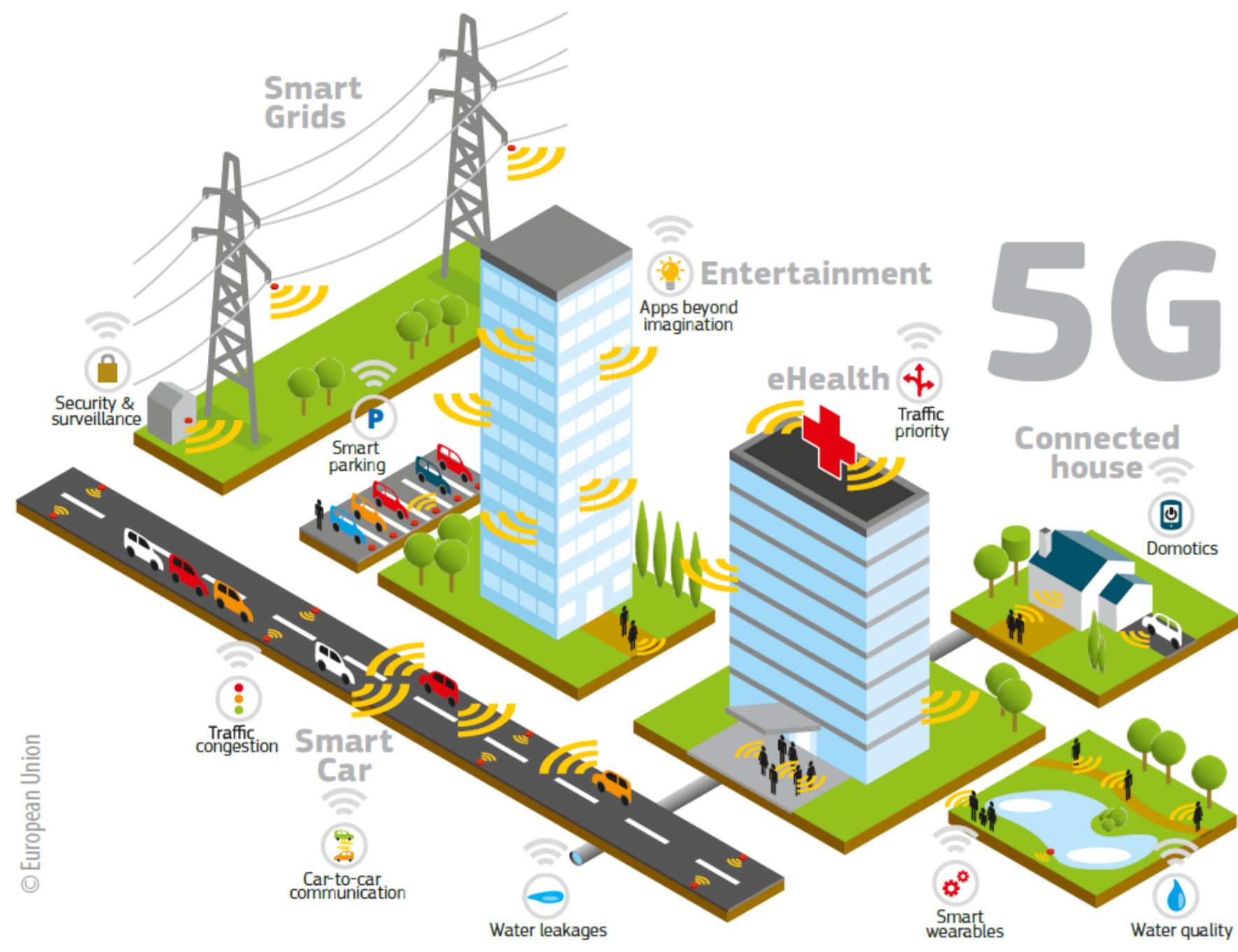


# Prototyping LTE-WiFi Interworking on a Single SDR Platform

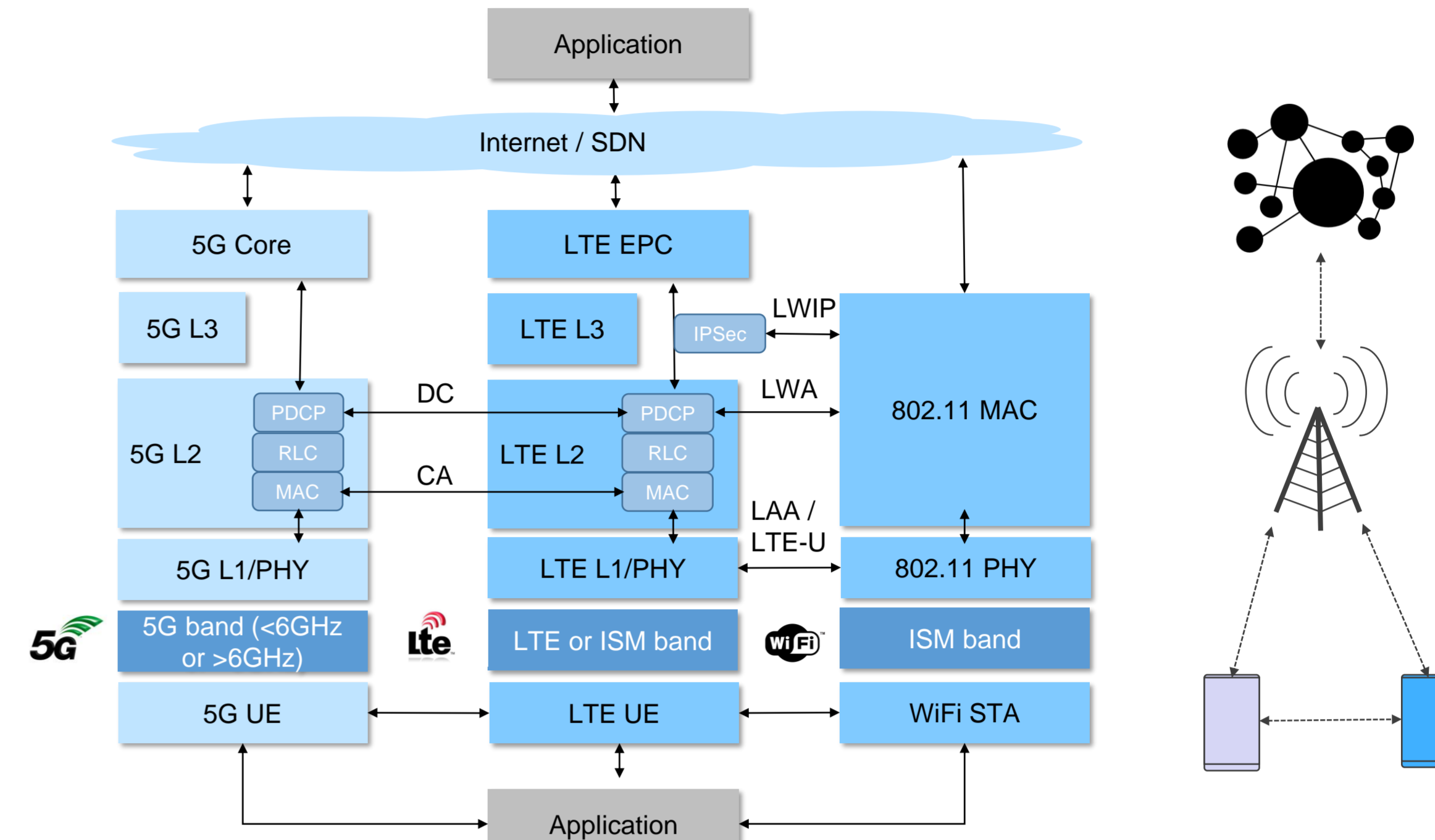
## Challenges in Future Wireless Networks



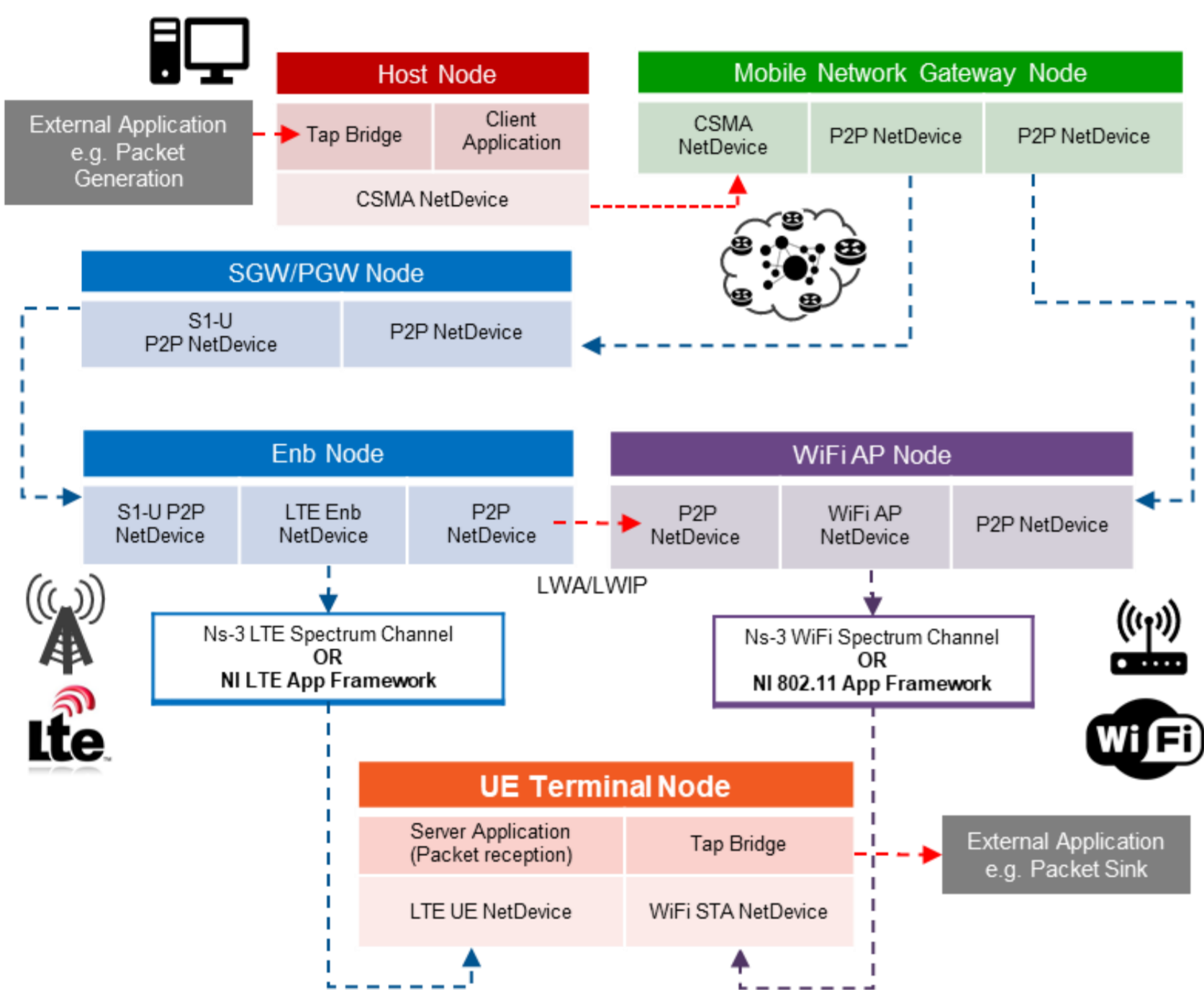
New 5G use cases will bring unprecedented diversity and density to future wireless networks

Source: European Commission, Why the EU is betting big on 5G, 2015

## Multi Radio Access Technologies



## NS-3 End-to-End Multi-RAT Scenario



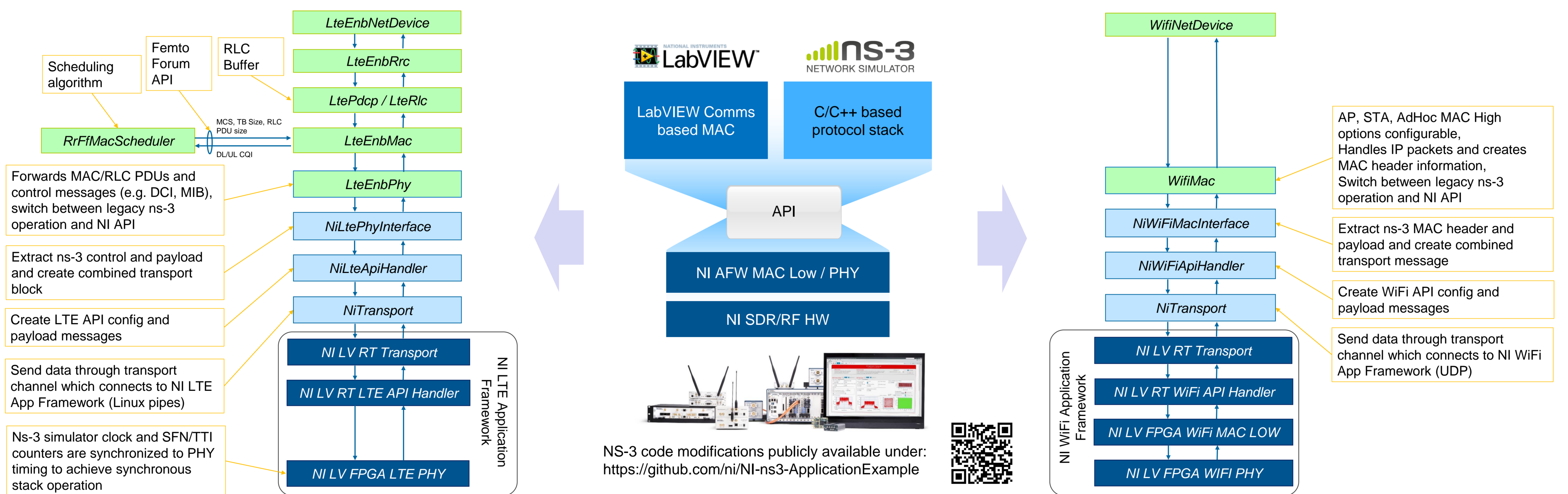
- ❖ Internet emulation using nodes connected via ETH/CSMA
- ❖ Mobile network gateway connects LTE and WiFi access networks to internet via P2P
- ❖ LTE and WiFi access networks can run in parallel supporting interworking options
- ❖ Terminal includes LTE and WiFi network interfaces as in real devices
- ❖ External traffic possible through Tap Bridge

## LabVIEW Communications Application Frameworks

LTE	802.11	MIMO	mmWave
<p><b>Key Features</b></p> <ul style="list-style-type: none"> <li>• 20 MHz Real-Time Bandwidth</li> <li>• TDD/FDD Uplink &amp; Downlink Modes</li> <li>• Multi-UE &amp; Multi-eNB Support</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• LTE &amp; Wi-Fi Coexistence</li> <li>• Cellular Network Layer Research</li> <li>• New Waveform Research</li> </ul>	<p><b>Key Features</b></p> <ul style="list-style-type: none"> <li>• 20/40/80 MHz Real-Time Bandwidth</li> <li>• Up to 256-QAM</li> <li>• Fully Bidirectional Communication</li> <li>• Lower MAC support</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• LTE &amp; Wi-Fi Coexistence</li> <li>• MAC Layer Research</li> <li>• 802.11ax Multi-User Prototyping</li> </ul>	<p><b>Key Features</b></p> <ul style="list-style-type: none"> <li>• 20 MHz Real-Time Bandwidth</li> <li>• Supports up to 128 eNB Antennas and 12 Single Antenna UE's</li> <li>• TDD Uplink &amp; Downlink Modes Based Upon LTE</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Massive MIMO</li> <li>• Multi-User MIMO Research</li> </ul>	<p><b>Key Features</b></p> <ul style="list-style-type: none"> <li>• 2 GHz Real-Time Bandwidth</li> <li>• Supports 2x2 MIMO</li> <li>• Fully Bidirectional TDD Uplink &amp; Downlink Modes</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Enhance Mobile Broadband Research</li> <li>• Ultra-Dense Cellular Research</li> <li>• Cellular Backhaul</li> </ul> <p>* Lead User Availability *</p>

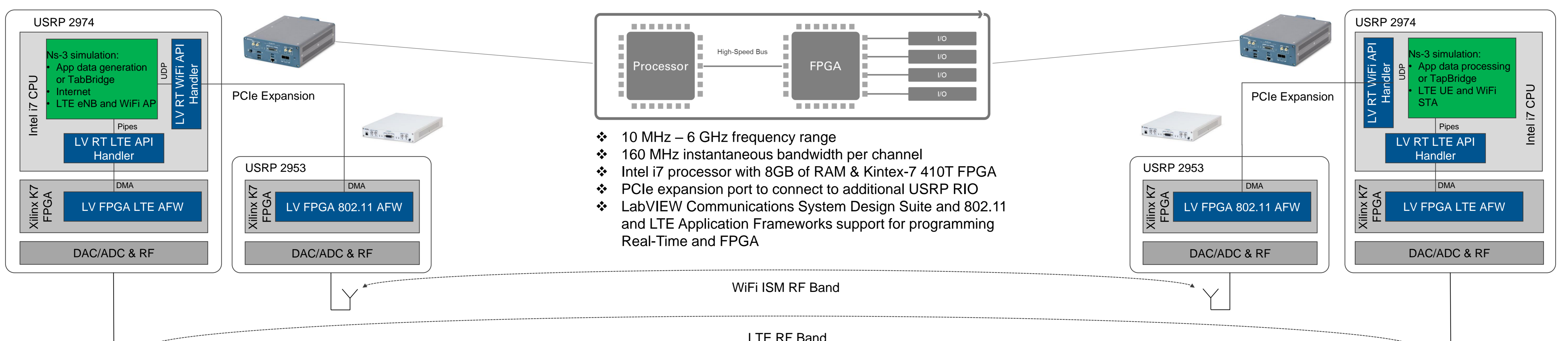
❖ Advanced FPGA IP for Real-Time, Over-The-Air, Wireless System Prototyping

## Flexible API Concept to Connect Upper Layer to NI Application Frameworks



NS-3 code modifications publicly available under: <https://github.com/ni/NI-ns3-ApplicationExample>

## Multi-RAT SDR Experimentation Platform based on USRP 2974



- ❖ 10 MHz – 6 GHz frequency range
- ❖ 160 MHz instantaneous bandwidth per channel
- ❖ Intel i7 processor with 8GB of RAM & Kintex-7 410T FPGA
- ❖ PCIe expansion port to connect to additional USRP RIO
- ❖ LabVIEW Communications System Design Suite and 802.11 and LTE Application Frameworks support for programming Real-Time and FPGA