The mobile industry in numbers Mobile penetration is approaching saturation in most markets around the world, e

[h] [width=3.54 in, height=1.85in]1.PNG 4G vs 5G connections

The next generation – 5G NR Despite LTE being a very capable technology, there are requirements not possible to

5G Use Cases In the context of 5G, one is often talking about three distinctive classes of use cases: enhanced mobil
eMBB corresponds to a more or less straight forward evolution of the mobile broadband services of today, enabling even
mMTC corresponds to services that are characterized by a massive number of devices, for example, remote sensors, actu
URLLC type-of-services are envisioned to require very low latency and extremely high reliability. Examples hereof are t
It is important to understand that the classification of 5G use cases into these three distinctive classes is somewhat artif

[h] [width=4.76in, height=2.37in]2.PNG 5G Use cases classification

Waveform, Numerology, and Frame Structure

The choice of radio waveform is the core physical layer decision for any wireless access technology. After assessment
FR1: 450 MHz – 6 GHz, commonly referred to as sub-6 GHz.
FR2: 24.25 GHz – 52.6 GHz, commonly referred to as millimeter wave.

Scalable numerologies are key to support NR deployment in such a wide range of spectrum. NR adopts flexible sub

A frame has a duration of 10ms and consists of 10 subframes. This is the same as in LTE, facilitating NR and LTE

5G Data Channels: Logical, Transport & Physical

In order to be able to carry the data across the 5G radio access network, the data and information is organized into
systems. This is true for 5G systems, and accordingly the hierarchy is given below.
Logical channel: Logical channels can be one of two groups: control channels and traffic channels:
Control channels: The control channels are used for the transfer of data from the control plane
Traffic channels: The traffic logical channels are used for the transfer of user plane data.
Transport channel: Is the multiplexing of the logical data to be transported by the physical layer and its channels over t
Physical channel : The physical channels are those which are closest to the actual tr-ansmission of the data over the rad
The physical channels often have higher level channels mapped onto them of provide a specific service. Additionally, the

5G NR logical channels There are several different logical channels that are used within the 5G NR radio access net
Broadcast Control Channel (BCCH): The BCCH is used within the downlink, and it is used for sending broadcast style
Master Information Block (MIB): There is one MIB and this is mapped onto the BCH transport channel and then to th
System Information Block (SIB): There are several system information blocks, SIBs. These are mapped onto the DL-SC
Paging Control Channel (PCCH): This is a Downlink channel. It is used to page the UEs whose location at cell level is
Common Control Channel (CCCH): This 5G channel is used on both the downlink and uplink for transmitting control i
Dedicated Control Channel (DCCH): The DCCH is used within the uplink and downlink to carry dedicated control info
Dedicated Traffic Channel (DTCH): This 5G channel is present in both the uplink and downlink. It is dedicated to one

5G NR transport channels There are five different transport channels. Some are used on the uplink, others on the d
Broadcast Channel (BCH): The BCH 5G channel is used in the downlink only for transmitting the BCCH system inform
Paging Channel (PCH): The PCH is used for carrying paging information from the PCCH logical channel. The PCH su
In order that the PCH is received by all mobiles / UEs in the cell, the PCH must be broadcast over the entire cell as a
Downlink Shared Channel (DL-SCH): As the name indicates, this is a downlink only channel. It is the main transport c
The DL-SCH is also used for transmitting some parts of the BCCH system information, specifically the SIB. Each UE h
Uplink Shared Channel (UL-SCH): This is the uplink counterpart to the DLSCH that is, the uplink transport channel u
Random-Access Channel (RACH): The RACH is a transport channel, which carries the random access preamble which

5G NR physical channels The 5G physical channels are used to transport information over the actual radio interfac

5G NR Downlink Physical Channels

Physical downlink shared channel (PDSCH): The 5G NR physical downlink shared channel, PDSCH carries data sharin
The PDSCH uses an adaptive modulation format dependent upon the link conditions, i.e. signal to noise ratio. It also u
Physical downlink control channel (PDCCH): As the name implies, the 5G physical downlink control channel carries do
The PDCCH uses QPSK as its modulation format and polar coding as the coding scheme, except for small packets of d
Physical broadcast channel (PBCH): This 5G channel forms part of the synchronization signal block. Its function is to
The PBCH uses a fixed data format and there is one block that extends over a TTI of 80ms, uses QPSK modulation an

5G NR Uplink Physical Channels

Physical random access channel (PRACH): This 5G channel - the physical random access channel, PRACH, is used for
A long sequence is 839 which is applied to the subcarrier spacings of 1.25kHz and 5 kHz
Short sequence lengths of 139 are applied to subcarrier spacings of 15 kHz and 30 kHz (FR1 bands) and 60 kHz and 120
Physical uplink shared channel (PUSCH): The 5G physical uplink shared channel, PUSCH, is the counterpart of the PD
Like the PDSCH, The PUSCH also has a very flexible format. The allocation of frequency resources is undertaken using
To support the channel link estimation and demodulation, the PUSCH contains DMRS signals.
Physical uplink control channel (PUCCH): The 5G physical uplink control channel, PUCCH, carries the uplink control

The use of these 5G channels provide a method for organizing the data flow over the radio interface of the 5G comm

Figures 4 & 5 shows the mapping between logical, transport and physical channels in both DL and UL [h] [width=4.31i

[h] [width=4.31in, height = 2in]5.PNG 5G Uplink logical, transport and physical channel mapping

5G NR PDSCH

PDSCH overview & Motivation

The Physical Downlink Shared Channel (PDSCH) is a crucial component of 5G wireless communication systems th

We were also motivated by the technical challenges involved in simulating the PDSCH channel accurately. 5G is a comp

In this section, we will delve into the technical details of PDSCH and explain how our simulation model was designed a

Designing and implementing a simulation model for PDSCH requires a detailed understanding of the 5G standard speci

The channel coding block is responsible for protecting the data from errors that may be introduced during wireless tran

The reference signals block provides important information about the wireless channel, such as channel state informatio

In the following sections, we will discuss each of these blocks in detail, including the technical details of how they were i