Link Level Broadband Access Research Environment

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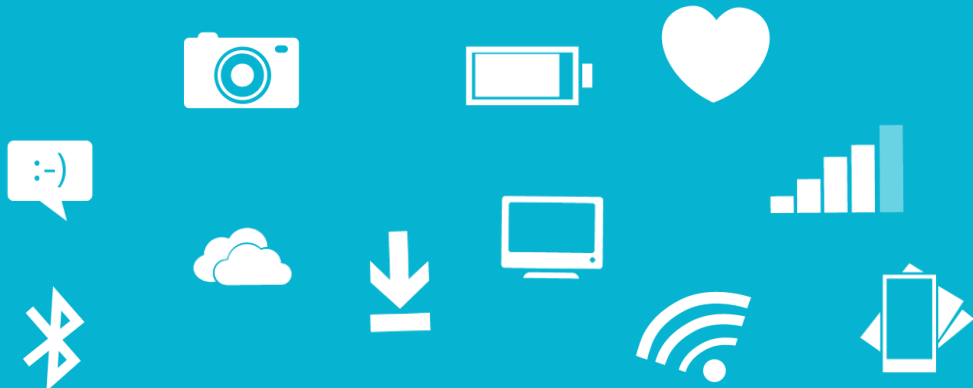
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INDT

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BARE SUMMARY

LINK LEVEL SIMULATOR

- Simulator Type
- Programming Language
- Development Model
- Functional Blocks
- First Simulator Version – Features

LINK LEVEL SIMULATOR

SIMULATOR TYPE

- Semi-static simulator
  - Simplistic support for mobility

- Time Advance Mechanism
  - Time-driven simulator

LINK LEVEL SIMULATOR

- Rapid modelling is a requirement

  - Matlab will be used for development

  - C/C++ language can be used for speedups (using MEX-Files), for computation-intensive parts, as convolutional encoders, turbo decoder, bit interleaver, CRC checks.

- Code Rules / Code Styles

  - Same used for "System Level Simulator"

LINK LEVEL SIMULATOR

DEVELOPMENT MODEL

- Object-Oriented Programming (OOP) will be adopted
  - Object-Orientation (OO) is suitable for complex applications
    - Modularity
    - Scalability
    - Maintainability
  - Performance issues using OOP in Matlab are taken into account in the code rules definition

- Data Structures
  - Handle classes as "data containers" for speedup data manipulations
  - Eventually, global variables can be used for some control information

LINK LEVEL SIMULATOR

FUNCTIONAL BLOCKS

TRAFFIC MODEL	**CHANNEL MODEL**	**STATISTICS**
TRANSMITTER	**RECEIVER**	**SINR MAPPING**

LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION – FEATURES

- Traffic model
  - Full Buffer

- Transmitter
  - FDD
  - OFDMA Downlink
  - Resource Mapping
  - Bandwidth: 1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz
  - Transmission mode: SISO (flexible for MIMO)
  - **No channel coding in first version**
  - Modulations: see Table 1

Table 1. Channel Quality Indicator (CQI) Table

CQI	Modulation	Rate (x 1024)	Efficiency
0	out of range		
1	QPSK	78	0.1523
2	QPSK	120	0.2344
3	QPSK	193	0.3770
4	QPSK	308	0.6016
5	QPSK	449	0.8770
6	QPSK	602	1.1758
7	16QAM	378	1.4766
8	16QAM	490	1.9141
9	16QAM	616	2.4063
10	64QAM	466	2.7305
11	64QAM	567	3.3223
12	64QAM	666	3.9023
13	64QAM	772	4.5234
14	64QAM	873	5.1152
15	64QAM	948	5.5547

Ref.: 3GPP TS 36.213

LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION – FEATURES

- Bandwidth

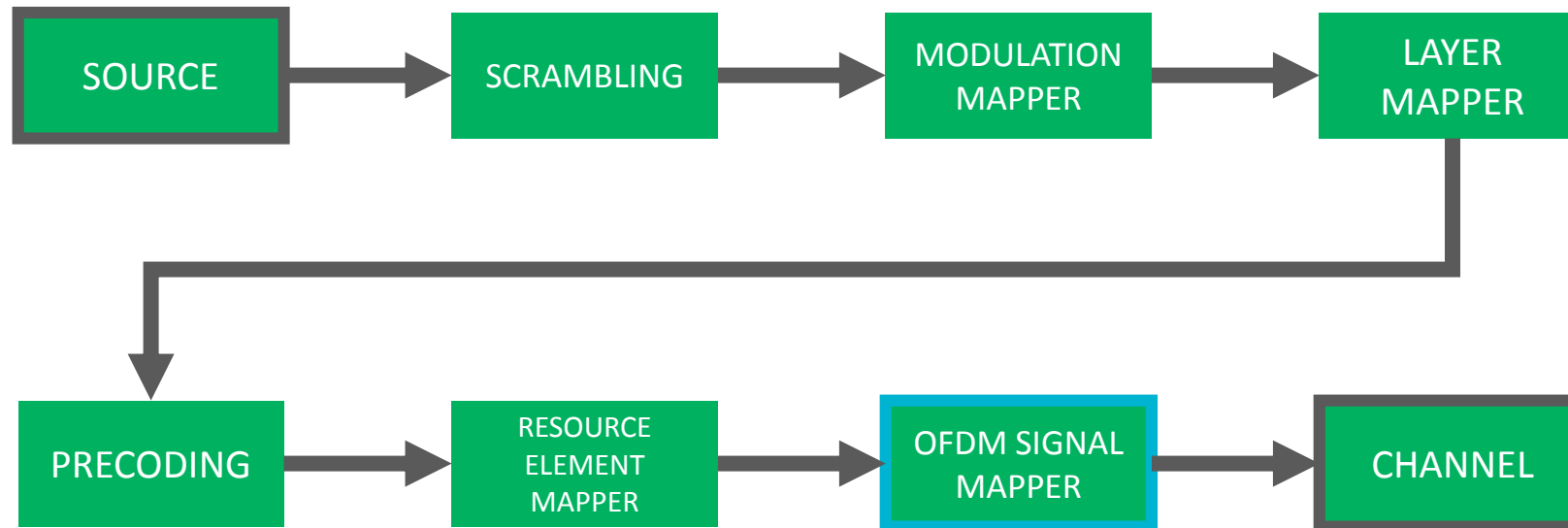| Channel Bandwidth [MHz]	1.4	3	5	10	15	20
Number of Resource Blocks	6	15	25	50	75	100
Number of occupied subcarriers	72	180	300	600	900	1200
IFFT / FFT Size	128	256	512	1024	1536	2048
Subcarrier spacing	15 kHz					
Cyclic Prefix	Normal					

LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION – FEATURES

- Channel model
  - Multipath model
    - Simplified Rayleigh model
    - White noise with no antenna correlation
    - Leave it flexible for other channel models, e.g. 3GPP SCM

- Receiver
  - Channel Estimation: Perfect and Least Square Estimator
  - Channel Equalization: Zero Forcing and MMSE

- Statistics
  - MCS (beta values), SINR, BLER, throughput

- Link-to-System interface
  - Exponential Effective Signal-to-Interference plus noise ratio Mapping (EESM)

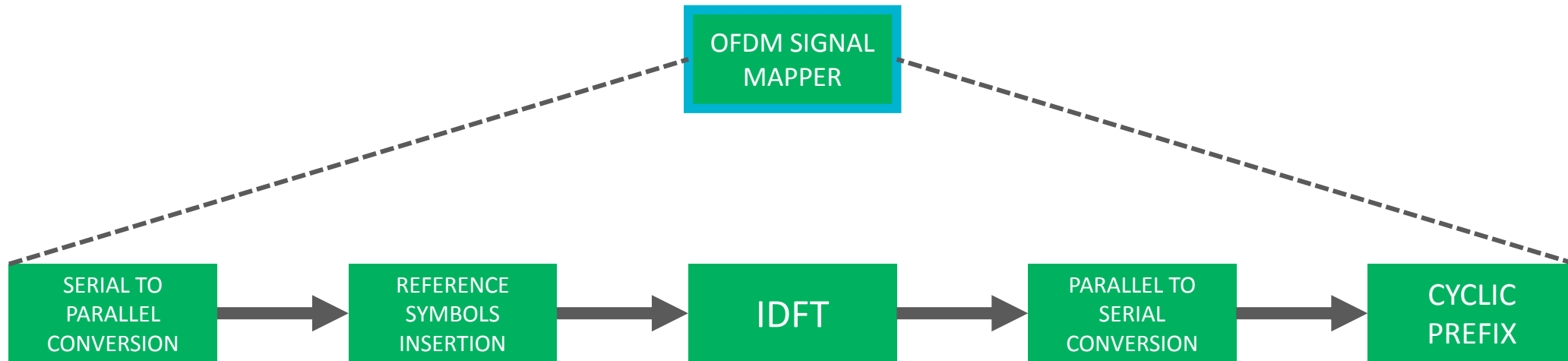# LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION

- Transmitter (first version) – Downlink Only

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SOURCE → SCRAMBLING → MODULATION MAPPER → LAYER MAPPER
PRECODING → RESOURCE ELEMENT MAPPER → OFDM SIGNAL MAPPER → CHANNEL
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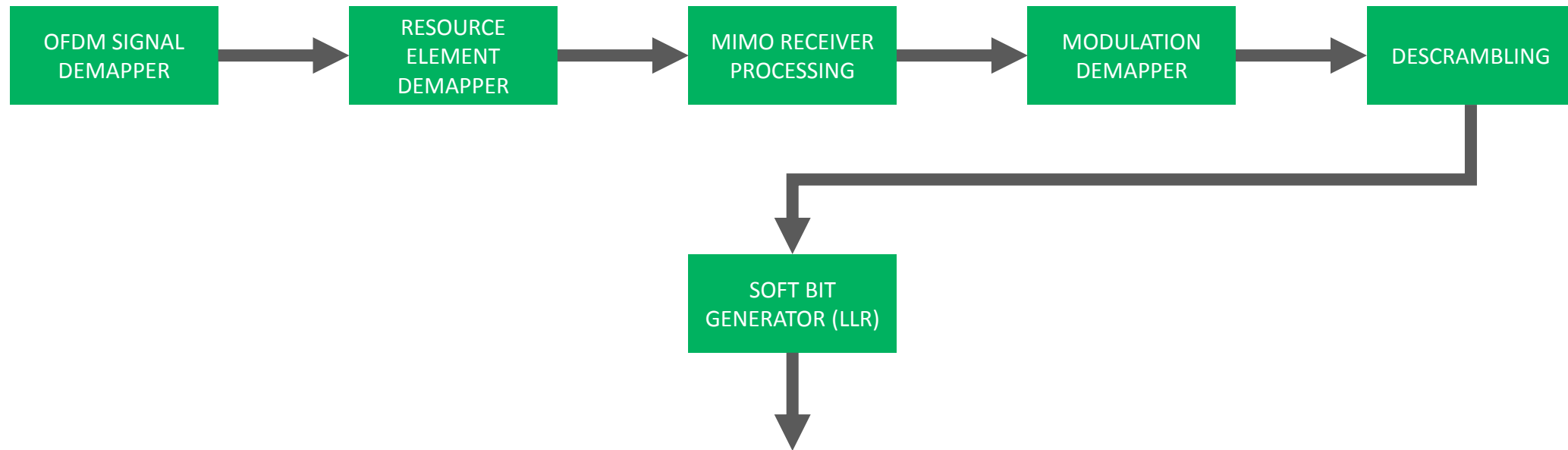# LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION

- Transmitter (first version) – Downlink Only

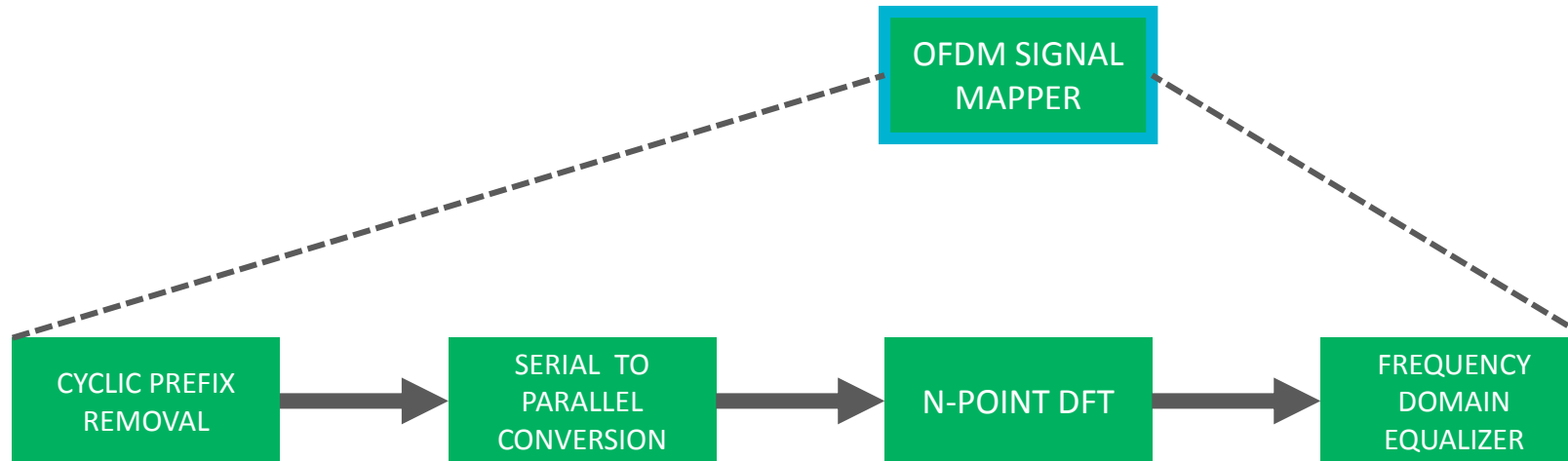# LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION

- Receiver (first version) – Downlink Only

LINK LEVEL SIMULATOR

FIRST SIMULATOR VERSION

- Transmitter (first version) – Downlink Only

LINK LEVEL SIMULATOR

REFERENCES

- 3GPP TS 36.201, "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description".
- 3GPP TS 36.211, "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".