IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

BATAAN LICENSING LLC, Plaintiff, v. **QUIDEL CORPORATION,** Defendant.	C.A. NO. ______________ **JURY TRIAL DEMANDED** **PATENT CASE**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Bataan Licensing LLC files this Original Complaint for Patent Infringement against Quidel Corporation, and would respectfully show the Court as follows:

I. THE PARTIES

1. Plaintiff Bataan Licensing LLC ("Bataan" or "Plaintiff") is a Texas limited liability company having an address at 6009 W Parker Rd, Ste 149 – 1117, Plano, TX 75093-8121.

2. On information and belief, Defendant Quidel Corporation ("Defendant") is a corporation organized and existing under the laws of Delaware, with a registered agent at The Corporation Trust Company, Corporation Trust Center 1209 Orange St, Wilmington, DE 19801.

II. JURISDICTION AND VENUE

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction of such action under 28 U.S.C. §§ 1331 and 1338(a).

4. On information and belief, Defendant is subject to this Court's specific and general personal jurisdiction, pursuant to due process and the Delaware Long-Arm Statute, due at least to its business in this forum, including at least a portion of the infringements alleged herein.

Furthermore, Defendant is subject to this Court's specific and general personal jurisdiction because Defendant is a Delaware corporation.

5. Without limitation, on information and belief, Defendant has derived revenues from its infringing acts occurring within Delaware. Further, on information and belief, Defendant is subject to the Court's general jurisdiction, including from regularly doing or soliciting business, engaging in other persistent courses of conduct, and deriving substantial revenue from goods and services provided to persons or entities in Delaware. Further, on information and belief, Defendant is subject to the Court's personal jurisdiction at least due to its sale of products and/or services within Delaware. Defendant has committed such purposeful acts and/or transactions in Delaware such that it reasonably should know and expect that it could be haled into this Court as a consequence of such activity.

6. Venue is proper in this district under 28 U.S.C. § 1400(b). On information and belief, Defendant is incorporated in Delaware. Under the patent venue analysis, Defendant resides only in this District. On information and belief, from and within this District Defendant has committed at least a portion of the infringements at issue in this case.

7. For these reasons, personal jurisdiction exists and venue is proper in this Court under 28 U.S.C. § 1400(b).

III. COUNT I
(PATENT INFRINGEMENT OF UNITED STATES PATENT NO. 7,423,982)

8. Plaintiff incorporates the above paragraphs herein by reference.

9. On September 9, 2008 United States Patent No. 7,423,982 ("the '982 Patent") was duly and legally issued by the United States Patent and Trademark Office. The '982 Patent is titled "Adaptive Communication Modes." A true and correct copy of the '982 Patent is attached hereto as Exhibit A and incorporated herein by reference.

10. Bataan is the assignee of all right, title and interest in the ‘982 patent, including all rights to enforce and prosecute actions for infringement and to collect damages for all relevant times against infringers of the ‘982 Patent. Accordingly, Bataan possesses the exclusive right and standing to prosecute the present action for infringement of the ‘982 Patent by Defendant.

11. The invention in the ‘982 Patent relates to the field of communications systems, more particularly to communication modes in communication systems. (Ex. A at col. 1:6-8). The inventor’s recognized deficiencies of the prior art and developed an improved method of allowing devices to function in a communications network. (*Id*. at col. 2:20-30).

12. Cable television systems are now capable of providing many services in addition to analog broadcast video. (*Id.* at col 1:11-12). In implementing enhanced programming, set-top terminals or set-top boxes became important computing devices for accessing various video services. (*Id.* at col 1:12-15). These additional functions have also led to an increase in the number of two-way digital services, like video-on-demand. (*Id.* at col 1:15-19). These services require a set-top box that can communicate with the network and not impair the user experience. (*Id.* at col 1:20-48).

13. An advantage of the claimed subject matter “lies in reducing the overall data traffic, since the claimed retransmission is only needed in situations where any initial transmission cannot be successfully received by a receiver. The claimed subject matter employs retransmission and diversity combining only when the initial transmission is not received properly, whereas [the prior art] communications scheme always transmits identical data over three parallel paths for diversity combining by a receiver and does not retransmit data in accordance with a repeat request by a receiver.” (Ex. B at 17).

14. **<u>Direct Infringement.</u>** Upon information and belief, Defendant has been directly infringing at least claim 12 of the '982 patent in Delaware, and elsewhere in the United States, by performing actions comprising at least performing the claimed ARQ re-transmission method by performing the steps of the claimed invention using the Quidel Virena ("Accused Instrumentality") (*e.g.*, https://connectme.quidel.com/files/Virena%20Brochure%20March%202019.pdf).

15. The Accused Instrumentality practices a method for implementing a communication mode (*e.g.*, communication mode for selecting modulation schemes) for a communication terminal (*e.g.*, the Accused Instrumentality). The Accused Instrumentality supports Cellular LTE standard. It communicates with base station utilizing different modulation schemes (*e.g.*, communication mode).

How does Virena work?

Virena is a wireless cloud-based system that allows you to manage de-identified data, in near real-time, for improved operational efficiencies. Virena is simple, secure, HIPAA compliant, and available with Quidel automated testing platforms. Virena connects one or more Sofia, Sofia 2 and/or Solana instruments to the Quidel cloud via a secure, cellular 4G LTE network. As tests are run throughout the day, Virena transmits **de-identified data**, in near real-time, to the Quidel cloud where it is stored, processed and made available to your organization.

(*E.g.*, https://connectme.quidel.com/files/Virena%20Brochure%20March%202019.pdf).

LTE

LTE (both radio and core network evolution) is now on the market. Release 8 was frozen in December 2008 and this has been the basis for the first wave of LTE equipment. LTE specifications are very stable, with the added benefit of enhancements having been introduced in all subsequent 3GPP Releases.

The motivation for LTE

- Need to ensure the continuity of competitiveness of the 3G system for the future
- User demand for higher data rates and quality of service
- Packet Switch optimised system
- Continued demand for cost reduction (CAPEX and OPEX)
- Low complexity
- Avoid unnecessary fragmentation of technologies for paired and unpaired band operation

LTE Overview

Author: Magdalena Nohrborg, for 3GPP

LTE (Long Term Evolution) or the E-UTRAN (Evolved Universal Terrestrial Access Network), introduced in 3GPP R8, is the access part of the Evolved Packet System (EPS). The main requirements for the new access network are high spectral efficiency, high peak data rates, short round trip time as well as flexibility in frequency and bandwidth.

(*E.g.*, https://www.3gpp.org/technologies/keywords-acronyms/98-lte).

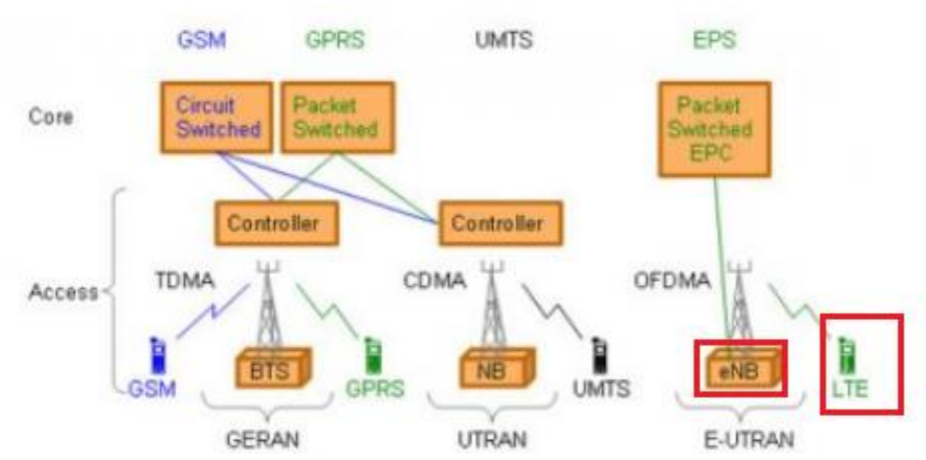


Figure 1 Network Solutions from GSM to LTE

(*E.g.*, https://www.3gpp.org/technologies/keywords-acronyms/98-lte).

4.2.2 Physical channels and modulation

The physical channels defined in the downlink are:

- the Physical Downlink Shared Channel (PDSCH),
- the Physical Multicast Channel (PMCH),
- the Physical Downlink Control Channel (PDCCH),
- the Physical Broadcast Channel (PBCH),
- the Physical Control Format Indicator Channel (PCFICH)
- and the Physical Hybrid ARQ Indicator Channel (PHICH).

The physical channels defined in the uplink are:

- the Physical Random Access Channel (PRACH),
- the Physical Uplink Shared Channel (PUSCH),
- and the Physical Uplink Control Channel (PUCCH).

In addition, signals are defined as reference signals, primary and secondary synchronization signals.

The modulation schemes supported in the downlink and uplink are QPSK, 16QAM and 64QAM.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/08.03.00_60/ts_136201v080300p.pdf).

16. Upon information and belief, the Accused Instrumentality practices receiving a message (*e.g.*, an operating mode change indication) from a remotely located network control system (*e.g.*, LTE base station). The Accused Instrumentality receives message signals from an associated LTE base station. The base station sends a downlink control message with DCI value over PDCCH channel. The DCI value suggests modulation scheme to communicate with the base station.

4.2.2 Physical channels and modulation

The physical channels defined in the downlink are:

- the Physical Downlink Shared Channel (PDSCH),
- the Physical Multicast Channel (PMCH),
- the Physical Downlink Control Channel (PDCCH),
- the Physical Broadcast Channel (PBCH),
- the Physical Control Format Indicator Channel (PCFICH)
- and the Physical Hybrid ARQ Indicator Channel (PHICH).

The physical channels defined in the uplink are:

- the Physical Random Access Channel (PRACH),
- the Physical Uplink Shared Channel (PUSCH),
- and the Physical Uplink Control Channel (PUCCH).

In addition, signals are defined as reference signals, primary and secondary synchronization signals.

The modulation schemes supported in the downlink and uplink are QPSK, 16QAM and 64QAM.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136201/08.03.00_60/ts_136201v080300p.pdf).

4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

Table 4.2-1

TrCH	Physical Channel
DL-SCH	PDSCH
BCH	PBCH
PCH	PDSCH
MCH	PMCH

Table 4.2-2

Control information	Physical Channel
CFI	PCFICH
HI	PHICH
DCI	PDCCH

5.3.3 Downlink control information

A DCI transports downlink or uplink scheduling information, or uplink power control commands for one RNTI. The RNTI is implicitly encoded in the CRC.

Figure 5.3.3-1 shows the processing structure for the DCI. The following coding steps can be identified:

- Information element multiplexing
- CRC attachment
- Channel coding
- Rate matching

The coding steps for DCI are shown in the figure below.

5.3.3.1 DCI formats

The fields defined in the DCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, including the zero-padding bit(s), if any, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0.

Note: DCI formats 0, 1A, 3, and 3A shall have the same payload size.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \rceil$ bits
- For PUSCH hopping:
  - N_{UL_hop} MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]
  - $\left(\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \rceil - N_{\mathrm{UL\_hop}}\right)$ bits provide the resource allocation of the first slot in the UL subframe
- For non-hopping PUSCH:
  - $\left(\lceil \log_2(N_{\mathrm{RB}}^{\mathrm{UL}}(N_{\mathrm{RB}}^{\mathrm{UL}}+1)/2) \rceil\right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit
- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

Format 1A is used for random access procedure initiated by a PDCCH order only if format 1A CRC is scrambled with C-RNTI and all the remaining fields are set as follows:

- Localized/Distributed VRB assignment flag – 1 bit is set to '0'
- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits, where all bits shall be set to 1
- Preamble Index – 6 bits
- PRACH Mask Index – 4 bits, [5]
- All the remaining bits in format 1A for compact scheduling assignment of one PDSCH codeword are set to zeroes

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]
- HARQ process number – 3 bits (FDD) , 4 bits (TDD)
- New data indicator – 1 bit
  - If the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI:
    - If $N_{RB}^{DL} \geq 50$ and Localized/Distributed VRB assignment flag is set to 1
      - the new data indicator bit indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$.
    - Else the new data indicator bit is reserved.
  - Else
    - The new data indicator bit as defined in [5]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

7.1.7 Modulation order and transport block size determination

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field (I_{MCS}) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - set the Table 7.1.7.2.1-1 column indicator N_{PRB} to N_{PRB}^{1A} from Section 5.3.3.1.3 in [4]
- for DCI format 1C:
  - use Table 7.1.7.2.3-1 for determining its transport block size.

else

- set the Table 7.1.7.2.1-1 column indicator N'_{PRB} to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\{\lfloor N'_{PRB} \times 0.75 \rfloor, 1\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

17. Upon information and belief, the Accused Instrumentality practices response to the message specifying a first communication mode (*e.g.*, communication mode with QPSK modulation scheme), implementing the first communication mode (*e.g.*, communication mode with QPSK modulation scheme) including communication with the network control system using a first type of modulation scheme, wherein the first type of modulation scheme is quadrature phase shift keying (QPSK), and wherein implementing the first communication mode includes receiving broadcast data and transmitting and receiving unicast data using the first type of modulation scheme. The Accused Instrumentality receives a message with DCI value. The DCI value suggests modulation scheme to communicate with the base station. When DCI value indicates QPSK modulation scheme, the Accused Instrumentality communicates with the base station utilizing

QPSK modulation scheme. The Accused Instrumentality communicates broadcast and unicast messages utilizing QPSK modulation. As shown below, when the Accused Instrumentality determines modulation order is 2 based on DCI value or DCI CRC scrambling interpretation. Additionally, the Accused Instrumentality utilizes QPSK modulation for communication with base station. Further, the Accused Instrumentality utilizes QPSK modulation scheme for uplink and downlink communication.

5.3.3 Downlink control information

A DCI transports downlink or uplink scheduling information, or uplink power control commands for one RNTI. The RNTI is implicitly encoded in the CRC.

Figure 5.3.3-1 shows the processing structure for the DCI. The following coding steps can be identified:

- Information element multiplexing
- CRC attachment
- Channel coding
- Rate matching

The coding steps for DCI are shown in the figure below.

5.3.3.1 DCI formats

The fields defined in the DCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, including the zero-padding bit(s), if any, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0.

Note: DCI formats 0, 1A, 3, and 3A shall have the same payload size.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

Format 1A is used for random access procedure initiated by a PDCCH order only if format 1A CRC is scrambled with C-RNTI and all the remaining fields are set as follows:

- Localized/Distributed VRB assignment flag – 1 bit is set to '0'

- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits, where all bits shall be set to 1

- Preamble Index – 6 bits

- PRACH Mask Index – 4 bits, [5]

- All the remaining bits in format 1A for compact scheduling assignment of one PDSCH codeword are set to zeroes

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

- HARQ process number – 3 bits (FDD) , 4 bits (TDD)

- New data indicator – 1 bit

- If the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI:

- If $N_{RB}^{DL} \geq 50$ and Localized/Distributed VRB assignment flag is set to 1

- the new data indicator bit indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$.

- Else the new data indicator bit is reserved.

- Else

- The new data indicator bit as defined in [5]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

- Hopping flag – 1 bit as defined in section 8.4 of [3]

- Resource block assignment and hopping resource allocation – $\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil$ bits

- For PUSCH hopping:

  - N_{UL_hop} MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]

  - $\left(\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil - N_{UL\_hop} \right)$ bits provide the resource allocation of the first slot in the UL subframe

- For non-hopping PUSCH:

  - $\left(\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil \right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]

- New data indicator – 1 bit

- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

7.1.7 Modulation order and transport block size determination

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field (I_{MCS}) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
  - set the Table 7.1.7.2.1-1 column indicator N_{PRB} to N_{PRB}^{1A} from Section 5.3.3.1.3 in [4]
- for DCI format 1C:
  - use Table 7.1.7.2.3-1 for determining its transport block size.

else

- set the Table 7.1.7.2.1-1 column indicator N'_{PRB} to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\{\lfloor N'_{PRB} \times 0.75 \rfloor, \ 1\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

7.1.7.1 Modulation order determination

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use I_{MCS} and Table 7.1.7.1-1 to determine the modulation order (Q_m) used in the physical downlink shared channel.

Table 7.1.7.1-1: Modulation and TBS index table for PDSCH

MCS Index I_{MCS}	Modulation Order Q_m	TBS Index I_{TBS}
0	2	0
1	2	1
2	2	2
3	2	3
4	2	4
5	2	5
6	2	6
7	2	7
8	2	8
9	2	9
10	4	9
11	4	10
12	4	11
13	4	12
14	4	13
15	4	14
16	4	15
17	6	15
18	6	16
19	6	17
20	6	18
21	6	19
22	6	20
23	6	21
24	6	22
25	6	23
26	6	24
27	6	25
28	6	26
29	2	reserved
30	4	
31	6	

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

8.6 Modulation order, redundancy version and transport block size determination

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme and redundancy version" field (I_{MCS}) in the DCI, and
- check the "CQI request" bit in DCI, and
- compute the total number of allocated PRBs (N_{PRB}) based on the procedure defined in Section 8.1, and
- compute the number of coded symbols for control information..

8.6.1 Modulation order and redundancy version determination

For $0 \le I_{MCS} \le 28$, the modulation order (Q_m) is determined as follows:

- If the UE is capable of supporting 64QAM in PUSCH and has not been configured by higher layers to transmit only QPSK and 16QAM, the modulation order is given by Q'_m in Table 8.6.1-1.
- If the UE is not capable of supporting 64QAM in PUSCH or has been configured by higher layers to transmit only QPSK and 16QAM, Q'_m is first read from Table 8.6.1-1. The modulation order is set to $Q_m = \min(4, Q'_m)$.
- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the resource allocation size is restricted to $N_{PRB} \le 3$ and the modulation order is set to $Q_m = 2$.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	1	0
2	2	2	0
3	2	3	0
4	2	4	0
5	2	5	0
6	2	6	0
7	2	7	0
8	2	8	0
9	2	9	0
10	2	10	0
11	4	10	0
12	4	11	0
13	4	12	0
14	4	13	0
15	4	14	0
16	4	15	0
17	4	16	0
18	4	17	0
19	4	18	0
20	4	19	0
21	6	19	0
22	6	20	0
23	6	21	0
24	6	22	0
25	6	23	0
26	6	24	0
27	6	25	0
28	6	26	0
29	reserved		1
30			2
31			3

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

MCS and Modulation Order

You may know that MCS (Modulation Coding Scheme) is related to Modulation Order (Modulation Depth, e.g, QPSK, 16 QAM, 64 QAM, 256 QAM). This modulation order is defined as a Parameter called Qm in 3GPP and the relationship between MCS value and Qm is defined in a little bit differently for PDSCH and PUSCH in the three tables : Table 7.1.7.1-1, 7.1.7.1-1A and Table 8.6.1-1 in 36.213.

The mapping between Qm and Modulation Method is defined as follows (Following is for downlink).

Qm	Modulation Method
2	QPSK
4	16 QAM
6	64 QAM
8	256 QAM

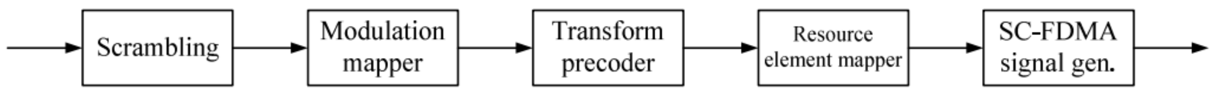
NOTE : If Uplink case, the meaning of Qm 6 varies a little depending UE capability. Qm 6 in UL is interpreted as 16 QAM if UE does not support 64QAM and it is interpreted as 64QAM if UE support 64QAM.

(*E.g.*, https://www.sharetechnote.com/html/Handbook_LTE_MCS_ModulationOrder.html).

5.3 Physical uplink shared channel

The baseband signal representing the physical uplink shared channel is defined in terms of the following steps:

- scrambling
- modulation of scrambled bits to generate complex-valued symbols
- transform precoding to generate complex-valued symbols
- mapping of complex-valued symbols to resource elements
- generation of complex-valued time-domain SC-FDMA signal for each antenna port

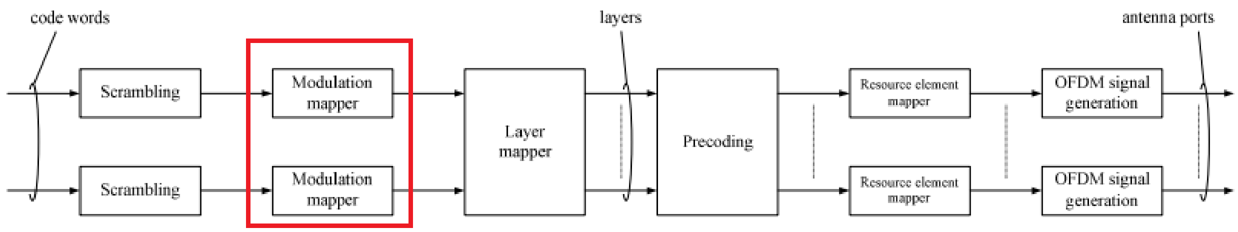


6.3 General structure for downlink physical channels

This section describes a general structure, applicable to more than one physical channel.

The baseband signal representing a downlink physical channel is defined in terms of the following steps:

- scrambling of coded bits in each of the code words to be transmitted on a physical channel
- modulation of scrambled bits to generate complex-valued modulation symbols
- mapping of the complex-valued modulation symbols onto one or several transmission layers
- precoding of the complex-valued modulation symbols on each layer for transmission on the antenna ports
- mapping of complex-valued modulation symbols for each antenna port to resource elements
- generation of complex-valued time-domain OFDM signal for each antenna port



(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.09.00_60/ts_136211v080900p.pdf).

6.6 Physical broadcast channel

6.6.1 Scrambling

The block of bits $b(0),...,b(M_{\text{bit}}-1)$, where M_{bit}, the number of bits transmitted on the physical broadcast channel, equals 1920 for normal cyclic prefix and 1728 for extended cyclic prefix, shall be scrambled with a cell-specific sequence prior to modulation, resulting in a block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{\text{bit}}-1)$ according to

$$\tilde{b}(i) = (b(i) + c(i)) \bmod 2$$

where the scrambling sequence $c(i)$ is given by Section 7.2. The scrambling sequence shall be initialised with $c_{\text{init}} = N_{\text{ID}}^{\text{cell}}$ in each radio frame fulfilling $n_{\text{f}} \bmod 4 = 0$.

6.6.2 Modulation

The block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{\text{bit}}-1)$ shall be modulated as described in Section 7.1, resulting in a block of complex-valued modulation symbols $d(0),...,d(M_{\text{symb}}-1)$. Table 6.6.2-1 specifies the modulation mappings applicable for the physical broadcast channel.

Table 6.6.2-1: PBCH modulation schemes

Physical channel	Modulation schemes
PBCH	QPSK

5.3.2 Modulation

The block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{\text{bit}}-1)$ shall be modulated as described in Section 7.1, resulting in a block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$. Table 5.3.2-1 specifies the modulation mappings applicable for the physical uplink shared channel.

Table 5.3.2-1: Uplink modulation schemes

Physical channel	Modulation schemes
PUSCH	QPSK, 16QAM, 64QAM

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.09.00_60/ts_136211v080900p.pdf).

18. Upon information and belief, the Accused Instrumentality practices responsive to the message specifying a second communication mode (*e.g.*, communication mode with QAM modulation scheme), implementing the second communication mode *e.g.*, communication mode with QAM modulation scheme) including communicating with the network control system using a second type of modulation scheme, wherein the second type of modulation scheme is quadrature

amplitude modulation (QAM). When the received DCI value indicates QAM modulation scheme, the Accused Instrumentality communicates with the base station utilizing QAM modulation scheme. Additionally, when the Accused Instrumentality determines modulation order is other than 2 based on DCI value or DCI CRC scrambling interpretation. Further, the Accused Instrumentality utilizes QAM modulation for communication with base station. The Accused Instrumentality utilizes QAM modulation scheme for uplink and downlink communication.

5.3.3 Downlink control information

A DCI transports downlink or uplink scheduling information, or uplink power control commands for one RNTI. The RNTI is implicitly encoded in the CRC.

Figure 5.3.3-1 shows the processing structure for the DCI. The following coding steps can be identified:

- Information element multiplexing
- CRC attachment
- Channel coding
- Rate matching

The coding steps for DCI are shown in the figure below.

5.3.3.1 DCI formats

The fields defined in the DCI formats below are mapped to the information bits a_0 to a_{A-1} as follows.

Each field is mapped in the order in which it appears in the description, including the zero-padding bit(s), if any, with the first field mapped to the lowest order information bit a_0 and each successive field mapped to higher order information bits. The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to a_0.

Note: DCI formats 0, 1A, 3, and 3A shall have the same payload size.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.1 Format 0

DCI format 0 is used for the scheduling of PUSCH.

The following information is transmitted by means of the DCI format 0:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A
- Hopping flag – 1 bit as defined in section 8.4 of [3]
- Resource block assignment and hopping resource allocation – $\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil$ bits
- For PUSCH hopping:
  - N_{UL_hop} MSB bits are used to obtain the value of $\tilde{n}_{PRB}(i)$ as indicated in subclause [8.4] of [3]
  - $\left(\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil - N_{UL\_hop} \right)$ bits provide the resource allocation of the first slot in the UL subframe
- For non-hopping PUSCH:
  - $\left(\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL}+1)/2) \rceil \right)$ bits provide the resource allocation in the UL subframe as defined in section 8.1 of [3]

- Modulation and coding scheme and redundancy version – 5 bits as defined in section 8.6 of [3]
- New data indicator – 1 bit
- TPC command for scheduled PUSCH – 2 bits as defined in section 5.1.1.1 of [3]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

5.3.3.1.3 Format 1A

DCI format 1A is used for the compact scheduling of one PDSCH codeword and random access procedure initiated by a PDCCH order.

The following information is transmitted by means of the DCI format 1A:

- Flag for format0/format1A differentiation – 1 bit, where value 0 indicates format 0 and value 1 indicates format 1A

Format 1A is used for random access procedure initiated by a PDCCH order only if format 1A CRC is scrambled with C-RNTI and all the remaining fields are set as follows:

- Localized/Distributed VRB assignment flag – 1 bit is set to '0'

- Resource block assignment – $\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL}+1)/2) \rceil$ bits, where all bits shall be set to 1

- Preamble Index – 6 bits

- PRACH Mask Index – 4 bits, [5]

- All the remaining bits in format 1A for compact scheduling assignment of one PDSCH codeword are set to zeroes

- Modulation and coding scheme – 5bits as defined in section 7.1.7 of [3]

- HARQ process number – 3 bits (FDD) , 4 bits (TDD)

- New data indicator – 1 bit

- If the format 1A CRC is scrambled by RA-RNTI, P-RNTI, or SI-RNTI:

- If $N_{RB}^{DL} \geq 50$ and Localized/Distributed VRB assignment flag is set to 1

- the new data indicator bit indicates the gap value, where value 0 indicates $N_{gap} = N_{gap,1}$ and value 1 indicates $N_{gap} = N_{gap,2}$.

- Else the new data indicator bit is reserved.

- Else

- The new data indicator bit as defined in [5]

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136212/08.08.00_60/ts_136212v080800p.pdf).

7.1.7 Modulation order and transport block size determination

To determine the modulation order and transport block size(s) in the physical downlink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme" field (I_{MCS}) in the DCI

and second if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI then

- for DCI format 1A:
    - set the Table 7.1.7.2.1-1 column indicator N_{PRB} to N_{PRB}^{1A} from Section 5.3.3.1.3 in [4]
- for DCI format 1C:
    - use Table 7.1.7.2.3-1 for determining its transport block size.

else

- set the Table 7.1.7.2.1-1 column indicator N'_{PRB} to the total number of allocated PRBs based on the procedure defined in Section 7.1.6.

  if the transport block is transmitted in DwPTS of the special subframe in frame structure type 2, then

  set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = \max\{\lfloor N'_{PRB} \times 0.75 \rfloor, \quad 1\}$,

  else, set the Table 7.1.7.2.1-1 column indicator $N_{PRB} = N'_{PRB}$.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/08.08.00_60/ts_136213v080800p.pdf).

7.1.7.1 Modulation order determination

The UE shall use $Q_m = 2$ if the DCI CRC is scrambled by P-RNTI, RA-RNTI, or SI-RNTI, otherwise, the UE shall use I_{MCS} and Table 7.1.7.1-1 to determine the modulation order (Q_m) used in the physical downlink shared channel.

Table 7.1.7.1-1: Modulation and TBS index table for PDSCH

MCS Index I_{MCS}	Modulation Order Q_m	TBS Index I_{TBS}
0	2	0
1	2	1
2	2	2
3	2	3
4	2	4
5	2	5
6	2	6
7	2	7
8	2	8
9	2	9
10	4	9
11	4	10
12	4	11
13	4	12
14	4	13
15	4	14
16	4	15
17	6	15
18	6	16
19	6	17
20	6	18
21	6	19
22	6	20
23	6	21
24	6	22
25	6	23
26	6	24
27	6	25
28	6	26
29	2	reserved
30	4	
31	6	

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/08.08.00_60/ts_136213v080800p.pdf).

8.6 Modulation order, redundancy version and transport block size determination

To determine the modulation order, redundancy version and transport block size for the physical uplink shared channel, the UE shall first

- read the 5-bit "modulation and coding scheme and redundancy version" field (I_{MCS}) in the DCI, and
- check the "CQI request" bit in DCI, and
- compute the total number of allocated PRBs (N_{PRB}) based on the procedure defined in Section 8.1, and
- compute the number of coded symbols for control information..

8.6.1 Modulation order and redundancy version determination

For $0 \le I_{MCS} \le 28$, the modulation order (Q_m) is determined as follows:

- If the UE is capable of supporting 64QAM in PUSCH and has not been configured by higher layers to transmit only QPSK and 16QAM, the modulation order is given by Q_m' in Table 8.6.1-1.
- If the UE is not capable of supporting 64QAM in PUSCH or has been configured by higher layers to transmit only QPSK and 16QAM, Q_m' is first read from Table 8.6.1-1. The modulation order is set to $Q_m = \min(4, Q_m')$.
- If the parameter *ttiBundling* provided by higher layers is set to *TRUE*, then the resource allocation size is restricted to $N_{PRB} \le 3$ and the modulation order is set to $Q_m = 2$.

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/08.08.00_60/ts_136213v080800p.pdf).

Table 8.6.1-1: Modulation, TBS index and redundancy version table for PUSCH

MCS Index I_{MCS}	Modulation Order Q'_m	TBS Index I_{TBS}	Redundancy Version rv_{idx}
0	2	0	0
1	2	1	0
2	2	2	0
3	2	3	0
4	2	4	0
5	2	5	0
6	2	6	0
7	2	7	0
8	2	8	0
9	2	9	0
10	2	10	0
11	4	10	0
12	4	11	0
13	4	12	0
14	4	13	0
15	4	14	0
16	4	15	0
17	4	16	0
18	4	17	0
19	4	18	0
20	4	19	0
21	6	19	0
22	6	20	0
23	6	21	0
24	6	22	0
25	6	23	0
26	6	24	0
27	6	25	0
28	6	26	0
29	reserved		1
30			2
31			3

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136213/08.08.00_60/ts_136213v080800p.pdf).

MCS and Modulation Order

You may know that MCS (Modulation Coding Scheme) is related to Modulation Order (Modulation Depth, e.g, QPSK, 16 QAM, 64 QAM, 256 QAM). This modulation order is defined as a Parameter called Qm in 3GPP and the relationship between MCS value and Qm is defined in a little bit differently for PDSCH and PUSCH in the three tables : Table 7.1.7.1-1, 7.1.7.1-1A and Table 8.6.1-1 in 36.213.

The mapping between Qm and Modulation Method is defined as follows (Following is for downlink).

Qm	Modulation Method
2	QPSK
4	16 QAM
6	64 QAM
8	256 QAM

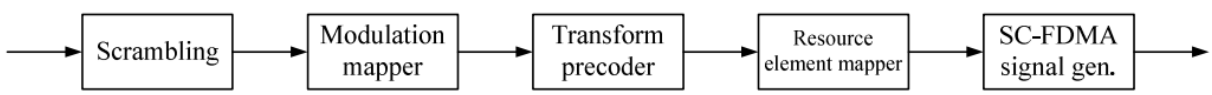
NOTE : If Uplink case, the meaning of Qm 6 varies a little depending UE capability. Qm 6 in UL is interpreted as 16 QAM if UE does not support 64QAM and it is interpreted as 64QAM if UE support 64QAM.

(*E.g.*, https://www.sharetechnote.com/html/Handbook_LTE_MCS_ModulationOrder.html).

5.3 Physical uplink shared channel

The baseband signal representing the physical uplink shared channel is defined in terms of the following steps:

- scrambling
- modulation of scrambled bits to generate complex-valued symbols
- transform precoding to generate complex-valued symbols
- mapping of complex-valued symbols to resource elements
- generation of complex-valued time-domain SC-FDMA signal for each antenna port



5.3.2 Modulation

The block of scrambled bits $\tilde{b}(0),...,\tilde{b}(M_{\text{bit}}-1)$ shall be modulated as described in Section 7.1, resulting in a block of complex-valued symbols $d(0),...,d(M_{\text{symb}}-1)$. Table 5.3.2-1 specifies the modulation mappings applicable for the physical uplink shared channel.

Table 5.3.2-1: Uplink modulation schemes

Physical channel	Modulation schemes
PUSCH	QPSK, 16QAM, 64QAM

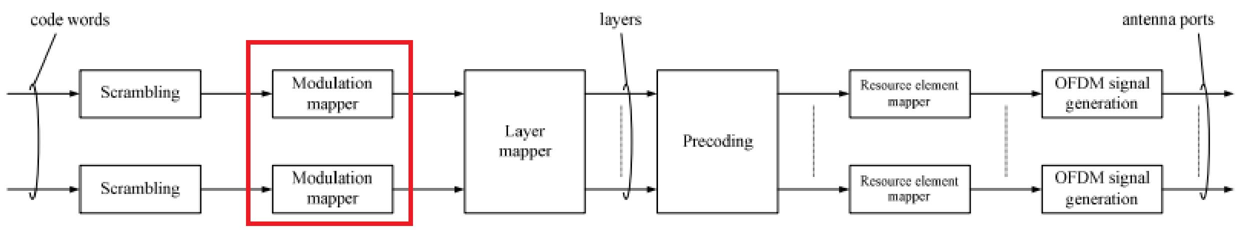
(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.09.00_60/ts_136211v080900p.pdf).

6.3 General structure for downlink physical channels

This section describes a general structure, applicable to more than one physical channel.

The baseband signal representing a downlink physical channel is defined in terms of the following steps:

- scrambling of coded bits in each of the code words to be transmitted on a physical channel
- modulation of scrambled bits to generate complex-valued modulation symbols
- mapping of the complex-valued modulation symbols onto one or several transmission layers
- precoding of the complex-valued modulation symbols on each layer for transmission on the antenna ports
- mapping of complex-valued modulation symbols for each antenna port to resource elements
- generation of complex-valued time-domain OFDM signal for each antenna port



6.3.2 Modulation

For each code word q, the block of scrambled bits $\tilde{b}^{(q)}(0),...,\tilde{b}^{(q)}(M_{\text{bit}}^{(q)}-1)$ shall be modulated as described in Section 7.1 using one of the modulation schemes in Table 6.3.2-1, resulting in a block of complex-valued modulation symbols $d^{(q)}(0),...,d^{(q)}(M_{\text{symb}}^{(q)}-1)$.

Table 6.3.2-1: Modulation schemes

Physical channel	Modulation schemes
PDSCH	QPSK, 16QAM, 64QAM
PMCH	QPSK, 16QAM, 64QAM

(*E.g.*, https://www.etsi.org/deliver/etsi_ts/136200_136299/136211/08.09.00_60/ts_136211v080900p.pdf).

19. Plaintiff has been damaged as a result of Defendant's infringing conduct. Defendant is thus liable to Plaintiff for damages in an amount that adequately compensates Plaintiff for such Defendant's infringement of the '982 Patent, *i.e.*, in an amount that by law cannot be less than would constitute a reasonable royalty for the use of the patented technology, together

with interest and costs as fixed by this Court under 35 U.S.C. § 284.

20. On information and belief, Defendant has had at least constructive notice of the '982 Patent by operation of law and marking requirements have been complied with.

IV. JURY DEMAND

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

V. PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that the Court find in its favor and against Defendant, and that the Court grant Plaintiff the following relief:

a. Judgment that one or more claims of United States Patent No. 7,423,982 have been infringed, either literally and/or under the doctrine of equivalents, by Defendant;

b. Judgment that Defendant account for and pay to Plaintiff all damages to and costs incurred by Plaintiff because of Defendant's infringing activities and other conduct complained of herein;

c. That Plaintiff be granted pre-judgment and post-judgment interest on the damages caused by Defendant's infringing activities and other conduct complained of herein;

d. That Plaintiff be granted such other and further relief as the Court may deem just and proper under the circumstances.

June 27, 2022

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