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# OsmoPCU Gb Protocol Specification

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DRAFT

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The Asciidoc source code of this manual can be found at http://git.osmocom.org/osmo-gsm-manuals/

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# 1 Introduction

This document describes the Gb interface of **OsmoPCU**. Based on 3GPP TS 48.016 and 48.018, this document indicates which of the 3GPP specified Gb messages and IEs are implemented according to 3GPP specifications, which of these are not or not fully implemented, as well as OsmoPCU-specific extensions to the Gb interface not specified by 3GPP.

Extensions to the Gb interface specific to OsmoPCU are detailed in this document. For details on the messages and IEs that comply with above-mentioned 3GPP specifications, please refer to those documents.

Table 1: 3GPP document versions referred to by this document

| | |
|---|---|
| 3GPP TS 08.56 | version 8.0.1 Release 1999 |
| 3GPP TS 08.58 | version 8.6.0 Release 1999 |
| 3GPP TS 08.60 | version 8.2.1 Release 1999 |
| 3GPP TS 12.21 | version 8.0.0 Release 1999 |
| 3GPP TS 48.016 | version 15.0.0 Release 15 |
| 3GPP TS 48.018 | version 15.0.0 Release 15 |

Table 2: IETF documents referred to by his document

| | |
|---|---|
| IETF RFC 768 | User Datagram Protocol |
| IETF RFC 791 | Internet Protocol |

# 2 Overview

The OsmoPCU Gb interface consists of the NS (Network Services) and BSSGP (Base Station Subsystem Gateway Protocol), encapsulated in UDP (User Datagram Protocol) and IP (Internet Protocol) version 4. Use of other underlying protocols (e. g. Frame Relay) is not supported.

Table 3: UDP port numbers used by OsmoPCU Gb/IP

| **TCP Port Number** | **Usage** |
|---|---|
| 23000 | NS over UDP (default port) |

The NS-over-UDP link is established in the PCU → SGSN direction, i.e. the PCU is running as client while the SGSN is running as server.

Establishment of the NS-over-UDP link is only possible after OsmoPCU has been configured via the **PCU socket** interface from OsmoBTS.

OsmoBTS in turn receives relevant configuration parameters from OsmoBSC or the BSC component inside OsmoNITB.

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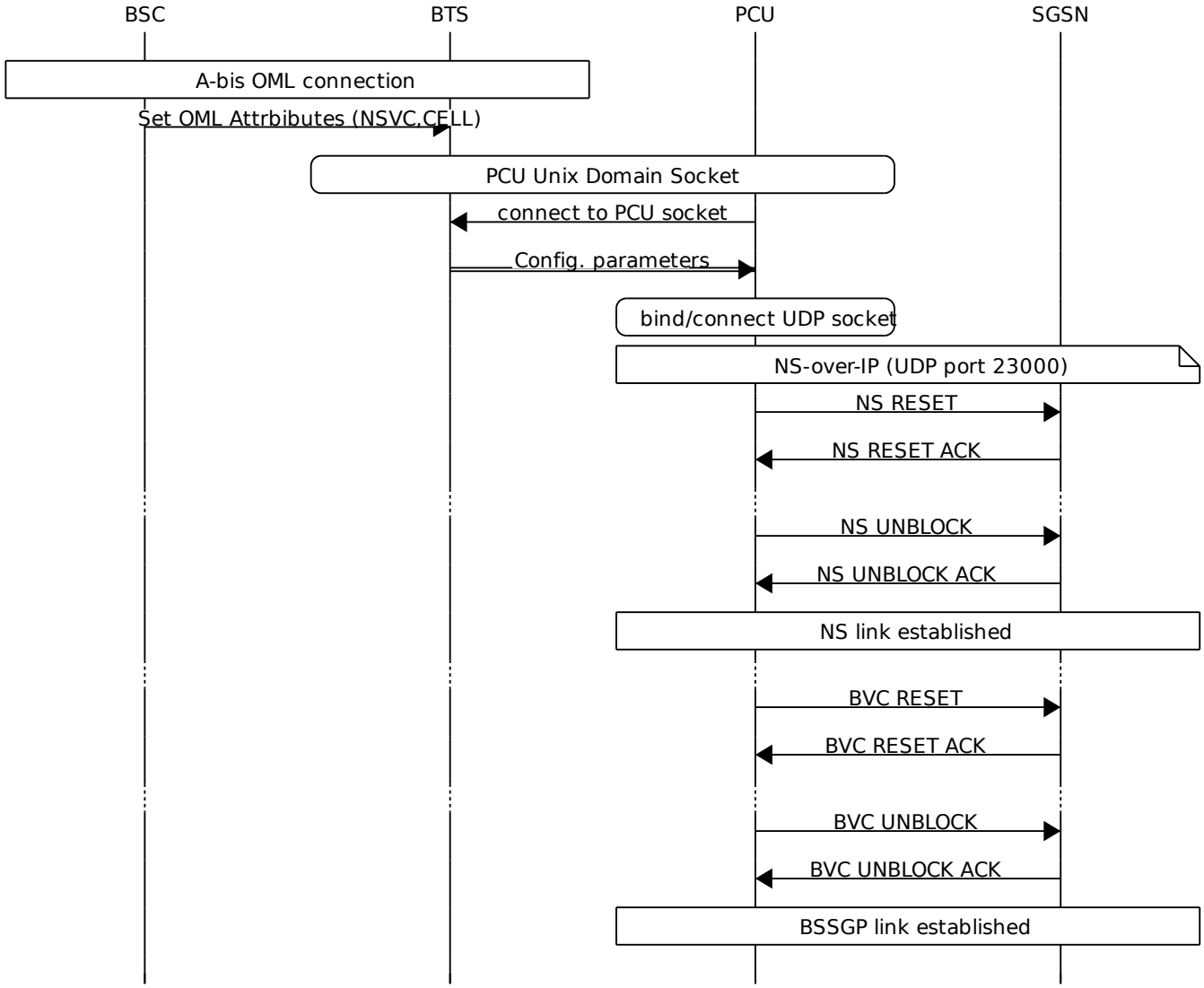



Figure 1: Overview of Gb link establishment

## 2.1 Identities

The Gb interface identities of the PCU are configured via BSC → OsmoBTS → PCU Socket. They consist of

**NSEI**
NS Equipment Identifier

**NSVCI**
NS Virtual Connection Identifier

**BVCI**
BSSGP Virtual Connection Identifier

For an explanation of those identifiers and their use in the NS and BSSGP protocols, please see the relevant 3GPP specifications for NS (TS 48.016) and BSSGP (TS 48.018).

In most cases, all above identities belong to different namespaces and must be unique within their respective namespace and within the SGSN they connect to.

This means that typically each OsmoPCU has one unique set of NSEI, NSVCI and BVCI in your network.

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# 3 Network Service (NS)

## 3.1 List of Messages

The following tables list the NS messages used by osmo-pcu and osmo-gbproxy, grouped by their level of compliance with 3GPP TS 48.016.

### 3.1.1 Messages Compliant With 3GPP TS 48.016

The NS protocol is implemented inside libosmogb so none of the messages below are sent by OsmoPCU explicitly. Instead corresponding functions from libosmogb are called which send and receive messages as necessary. See Section 3.5 for details on establishing NS connection.

Table 4: Messages compliant with 3GPP TS 48.016

| TS 48.016 § | type code (hex) | This document § | Message | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|---|
| 9.2.1 | 0x0a | Section 3.2.9 | NS-ALIVE | ←/→ | Received/Sent |
| 9.2.2 | 0x0b | Section 3.2.10 | NS-ALIVE-ACK | ←/→ | Received/Sent |
| 9.2.3 | 0x04 | Section 3.2.4 | NS-BLOCK | ←/→ | Received/Sent |
| 9.2.4 | 0x05 | Section 3.2.5 | NS-BLOCK-ACK | ←/→ | Received/Sent |
| 9.2.5 | 0x02 | Section 3.2.2 | NS-RESET | ←/→ | Received/Sent |
| 9.2.6 | 0x03 | Section 3.2.3 | NS-RESET-ACK | ←/→ | Received/Sent |
| 9.2.7 | 0x08 | Section 3.2.8 | NS-STATUS | ←/→ | Received/Sent |
| 9.2.8 | 0x06 | Section 3.2.6 | NS-UNBLOCK | ←/→ | Received/Sent |
| 9.2.9 | 0x07 | Section 3.2.7 | NS-UNBLOCK-ACK | ←/→ | Received/Sent |
| 9.2.10 | 0x00 | Section 3.2.1 | NS-UNITDATA | ←/→ | Received/Sent |
| 9.3.1 | 0x0c | Section 3.2.11 | SNS-ACK | ←/→ | Received/Sent |
| 9.3.2 | 0x0d | Section 3.2.12 | SNS-ADD | ←/→ | Received/Sent |
| 9.3.3 | 0x0e | Section 3.2.13 | SNS-CHANGEWEIGHT | ←/→ | Received/Sent |
| 9.3.4 | 0x0f | Section 3.2.14 | SNS-CONFIG | ←/→ | Received/Sent |
| 9.3.5 | 0x10 | Section 3.2.15 | SNS-CONFIG | ←/→ | Received/Sent |
| 9.3.6 | 0x11 | Section 3.2.16 | SNS-DELETE | ←/→ | Received/Sent |
| 9.3.7 | 0x12 | [?] | SNS-SIZE | ←/→ | Received/Sent |
| 9.3.8 | 0x13 | Section 3.2.18 | SNS-SIZE-ACK | ←/→ | Received/Sent |

### 3.1.2 Messages Specific to OsmoPCU

There are no OsmoPCU specific NS messages.

### 3.1.3 Messages Not Implemented by OsmoPCU

All the NS protocol messages from 3GPP TS 48.016 are implemented in OsmoPCU.

## 3.2 Details on Compliant NS Messages

### 3.2.1 NS-UNITDATA

This PDU transfers one NS SDU (specified in 3GPP TS 08.18) between OsmoPCU and SGSN. Upon receiving it OsmoPCU passes it to BSSGP implementation to handle. It is also sent by BSSGP as necessary - see Section 4 for details.

It contains BVCI (Section 3.4.5) and NS SDU (Section 3.4.4) IEs.

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#### 3.2.2 NS-RESET

This message is send by OsmoPCU in order to initiate reset procedure described in 3GPP TS 48.016 § 7.3. The expected reply is NS-RESET-ACK (Section 3.2.3) message. If no expected reply is received in 3 seconds than the sending is retried up to 3 times. When this message is received it is replied with NS-RESET-ACK (Section 3.2.3). It might be ignored under conditions described in 3GPP TS 48.016 § 7.3.1.

The message conforms to 3GPP TS 48.016 § 9.2.5 specification.

It contains Cause (Section 3.4.1), NSVCI (Section 3.4.2) and NSEI (Section 3.4.6) IEs.

#### 3.2.3 NS-RESET-ACK

This message is sent as a response to proper NS-RESET (Section 3.2.2) message initiating reset procedure.

The message conforms to 3GPP TS 48.016 § 9.2.6 specification.

It contains NSVCI (Section 3.4.2) and NSEI (Section 3.4.6) IEs.

#### 3.2.4 NS-BLOCK

Upon receiving this message corresponding NS-VC is marked as blocked by OsmoPCU and NS-BLOCK-ACK (Section 3.2.5) reply is transmitted. When this message is sent by OsmoPCU corresponding NS-BLOCK-ACK (Section 3.2.5) reply is expected before NS-VC is actually marked as blocked. This behavior follows the blocking procedure described in 3GPP TS 48.016 § 7.2.

The message conforms to 3GPP TS 48.016 § 9.2.3 specification.

It contains Cause (Section 3.4.1) and NSVCI (Section 3.4.2) IEs.

#### 3.2.5 NS-BLOCK-ACK

This message is sent by OsmoPCU automatically upon reception of correct NS-BLOCK (Section 3.2.4) message. It is expected as a reply for NS-BLOCK (Section 3.2.4) message sent by OsmoPCU.

The message conforms to 3GPP TS 48.016 § 9.2.4 specification.

It contains NSVCI (Section 3.4.2) IE.

#### 3.2.6 NS-UNBLOCK

Upon receiving this message corresponding NS-VC is unblocked by OsmoPCU and NS-UNBLOCK-ACK (Section 3.2.7) reply is sent. When this message is sent by OsmoPCU corresponding NS-UNBLOCK-ACK (Section 3.2.7) reply is expected before NS-VC is actually marked as unblocked. This behavior follows the blocking procedure described in 3GPP TS 48.016 § 7.2.

The message conforms to 3GPP TS 48.016 § 9.2.8 specification.

#### 3.2.7 NS-UNBLOCK-ACK

Receiving this message notifies OsmoPCU that NS-VC unblocking request is confirmed and thus NS-VC is marked as unblocked. This message is also sent as a reply to NS-UNBLOCK (Section 3.2.6) message.

The message conforms to 3GPP TS 48.016 § 9.2.9 specification.

#### 3.2.8 NS-STATUS

This message is sent to inform other party about error conditions as a response to various unexpected PDUs or PDUs with unexpected/missing data. If this message is received for unknown NS-VC it is ignored in accordance with 3GPP TS 48.016 § 7.5.1, otherwise the error cause is logged if present in NS-STATUS.

The message conforms to 3GPP TS 48.016 § 9.2.7 specification.

It contains Cause (Section 3.4.1) and might (depending on actual error) contain NSVCI (Section 3.4.2), NS PDU (Section 3.4.3) and BVCI (Section 3.4.5) IEs.

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#### 3.2.9 NS-ALIVE

This message is sent periodically to test connectivity according to 3GPP TS 48.016 § 4.5.3. The expected response is NS-ALIVE-ACK (Section 3.2.10). If no such response arrives within given amount of time (3 seconds) than another NS-ALIVE message is sent and failed test attempt is recorded. After 10 failed attempts NS connection is considered dead and OsmoPCU tries to reconnect.

The message conforms to 3GPP TS 48.016 § 9.2.1 specification.

#### 3.2.10 NS-ALIVE-ACK

This message is sent automatically in reply to NS-ALIVE (Section 3.2.9) message.

The message conforms to 3GPP TS 48.016 § 9.2.2 specification.

#### 3.2.11 SNS-ACK

#### 3.2.12 SNS-ADD

#### 3.2.13 SNS-CHANGEWEIGHT

#### 3.2.14 SNS-CONFIG

#### 3.2.15 SNS-CONFIG-ACK

#### 3.2.16 SNS-DELETE

#### 3.2.17 SNS-SIZE

#### 3.2.18 SNS-SIZE-ACK

### 3.3 Information Elements Overview

All of the IEs handled by OsmoPCU are listed below, with limitations and additions to 3GPP TS 48.016 specified in more detail.

#### 3.3.1 IEs Conforming to 3GPP TS 48.016

The following Information Elements are accepted by OsmoPCU.

Table 5: IEs conforming to 3GPP TS 48.016

| tag (hex) | TS 48.016 § | IE name | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|
| 0x03 | 10.3.1 | BVCI | ←/→ | Received/Sent |
| 0x00 | 10.3.2 | Cause | ←/→ | Received/Sent |
| - | 10.3.2a | End Flag | ←/→ | Received/Sent |
| 0x0b | 10.3.2b | IP Address | ←/→ | Received/Sent |
| 0x05 | 10.3.2c | List of IP4 Elements | ←/→ | Received/Sent |
| 0x06 | 10.3.2d | List of IP6 Elements | ←/→ | Received/Sent |
| 0x07 | 10.3.2e | Maximum Number of NS-VCs | ←/→ | Received/Sent |
| 0x08 | 10.3.2f | Number of IP4 Endpoints | ←/→ | Received/Sent |
| 0x09 | 10.3.2g | Number of IP6 Endpoints | ←/→ | Received/Sent |
| 0x02 | 10.3.3 | NS PDU | ←/→ | Received/Sent |
| 0x01 | 10.3.5 | NSVCI | ←/→ | Received/Sent |
| 0x04 | 10.3.6 | NSEI | ←/→ | Received/Sent |

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Table 5: (continued)

| tag (hex) | TS 48.016 § | IE name | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|
| - | 10.3.7 | PDU Type | ←/→ | Received/Sent |
| 0x0a | 10.3.7a | Reset Flag | ←/→ | Received/Sent |
| - | 10.3.8 | Spare Octet | ←/→ | Received/Sent |
| - | 10.3.10 | Transaction ID | ←/→ | Received/Sent |

#### 3.3.2 IEs Not Conforming to 3GPP TS 48.016

Table 6: IEs conforming to 3GPP TS 48.016

| tag (hex) | TS 48.016 § | IE name | ←/→ | Notice |
|---|---|---|---|---|
| - | 10.3.9 | NS-SDU Control Bits | ←/→ | Not implemented yet |

All other IEs defined in 3GPP TS 48.016 § 10.3 are supported by OsmoPCU.

#### 3.3.3 Additional Attributes and Parameters

There are no OsmoPCU specific additional Attributes and Parameters.

### 3.4 Details on IEs

#### 3.4.1 Cause

This IE contains reason for a procedure or error as described in 3GPP TS 48.016 § 10.3.2.

#### 3.4.2 NSVCI

This IE represents NSVCI identity described in Section 2.1 and 3GPP TS 48.016 § 10.3.5.

#### 3.4.3 NS PDU

This IE contains PDU (possibly truncated) which cause error described in NS-STATUS message (Section 3.2.8) as described in 3GPP TS 48.016 § 10.3.3.

#### 3.4.4 NS SDU

This IE contains BSSGP data - see Section 4 for details.

#### 3.4.5 BVCI

This IE represents BSSGP identity described in Section 2.1 and 3GPP TS 48.016 § 10.3.1.

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#### 3.4.6 NSEI

This IE represents NSEI identity described in Section 2.1 and 3GPP TS 48.016 § 10.3.6.

### 3.5 Gb NS Initialization / PCU bring-up

OsmoPCU binds and connects an UDP socket for NS using port numbers and IP information given by OsmoBTS via the PCU socket. OsmoBTS in turn receives this information from the BSC vi A-bis OML.

Following successful initialization of the UDP socket, the reset procedure is initiated as described in Section 3.2.2.

## 4 BSS GPRS Protocol (BSSGP)

### 4.1 List of Messages

The following tables list the BSSGP messages used by OsmoPCU, grouped by their level of compliance with 3GPP TS 48.018.

#### 4.1.1 Messages Compliant With TS 48.018

Table 7: Messages compliant with TS 48.018

| TS 48.018 § | type code (hex) | This document § | Message | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|---|
| **RL and BSSGP SAP Messages:** | | | | | |
| 10.2.1 | 0x00 | Section 4.2.1 | DL-UNITDATA | ← | Received |
| 10.2.2 | 0x01 | Section 4.2.2 | UL-UNITDATA | → | Sent |
| 10.2.3 | 0x02 | Section 4.2.3 | RA-CAPABILITY | ← | Received |
| **GMM SAP Messages:** | | | | | |
| 10.3.1 | 0x06 | Section 4.2.4 | PAGING PS | ← | Received |
| 10.3.2 | 0x07 | Section 4.2.5 | PAGING CS | ← | Received |
| 10.3.7 | 0x0c | Section 4.2.6 | SUSPEND-ACK | ← | Received |
| 10.3.8 | 0x0d | Section 4.2.7 | SUSPEND-NACK | ← | Received |
| 10.3.10 | 0x0f | Section 4.2.8 | RESUME-ACK | ← | Received |
| 10.3.11 | 0x10 | Section 4.2.9 | RESUME-NACK | ← | Received |
| **NM SAP Messages:** | | | | | |
| 10.4.9 | 0x21 | Section 4.2.10 | BVC-BLOCK-ACK | ← | Received |
| 10.4.12 | 0x22 | Section 4.2.11 | BVC-RESET | ←/→ | Received/Sent |
| 10.4.13 | 0x23 | Section 4.2.12 | BVC-RESET-ACK | ← | Received |
| 10.4.10 | 0x24 | Section 4.2.14 | BVC-UNBLOCK | → | Sent |
| 10.4.11 | 0x25 | Section 4.2.13 | BVC-UNBLOCK-ACK | ← | Received |
| 10.4.4 | 0x26 | Section 4.2.17 | FLOW-CONTROL-BVC | → | Sent |
| 10.4.5 | 0x27 | Section 4.2.16 | FLOW-CONTROL-BVC-ACK | ← | Received |
| 10.4.7 | 0x29 | Section 4.2.15 | FLOW-CONTROL-MS-ACK | ← | Received |
| 10.4.1 | 0x2a | Section 4.2.18 | FLUSH-LL | ← | Received |
| 10.4.15 | 0x40 | Section 4.2.19 | SGSN-INVOKE-TRACE | ← | Received |
| 10.4.14 | 0x41 | Section 4.2.20 | STATUS | ←/→ | Received/Sent |

#### 4.1.2 Messages Specific to OsmoPCU

There are no OsmoPCU specific BSSGP messages.

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#### 4.1.3 Messages Not Implemented by OsmoPCU

Table 8: 3GPP TS 48.018 messages not implemented by OsmoPCU

| TS 48.018 § | type code (hex) | Message |
|---|---|---|
| **RL (relay) and BSSGP SAP Messages:** | | |
| 10.2.4 | 0x03 | PTM-UNITDATA |
| **GMM (GPRS mobility management) SAP Messages:** | | |
| 10.3.3 | 0x08 | RA-CAPABILITY-UPDATE |
| 10.3.4 | 0x09 | RA-CAPABILITY-UPDATE-ACK |
| 10.3.5 | 0x0a | RADIO-STATUS |
| 10.3.6 | 0x0b | SUSPEND |
| 10.3.9 | 0x0e | RESUME |
| **NM (network management) SAP Messages:** | | |
| 10.4.8 | 0x20 | BVC-BLOCK |
| 10.4.6 | 0x28 | FLOW-CONTROL-MS |
| 10.4.2 | 0x2b | FLUSH-LL-ACK |
| 10.4.3 | 0x2c | LLC-DISCARDED |
| **PFM (packet flow management) SAP Messages:** | | |
| 10.4.16 | 0x50 | DOWNLOAD-BSS-PFC |
| 10.4.17 | 0x51 | CREATE-BSS-PFC |
| 10.4.18 | 0x52 | CREATE-BSS-PFC-ACK |
| 10.4.19 | 0x53 | CREATE-BSS-PFC-NACK |
| 10.4.20 | 0x54 | MODIFY-BSS-PFC |
| 10.4.21 | 0x55 | MODIFY-BSS-PFC-ACK |
| 10.4.22 | 0x56 | DELETE-BSS-PFC |
| 10.4.23 | 0x57 | DELETE-BSS-PFC-ACK |

### 4.2 Details on Compliant BSSGP Messages

#### 4.2.1 DL-UNITDATA

This message conforms to 3GPP TS 48.018 § 10.2.1, with the following limitations:

- OsmoPCU does not support QoS
- all optional IEs except for IMSI and old TLLI are ignored.

Table 9: *DL-UNITDATA* IE limitations

| TS 48.018 § | IE Name | Handling |
|---|---|---|
| 11.3.28 | QoS Profile | *ignored* |
| 11.3.22 | MS Radio Access Capability | *ignored* |
| 11.3.27 | Priority | *ignored* |
| 11.3.11 | DRX Parameters | *ignored* |
| 1.3.42 | PFI | *ignored* |
| 11.3.19 | LSA Information | *ignored* |
| 11.3.47 | Service UTRAN CCO | *ignored* |

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#### 4.2.2 UL-UNITDATA

This message conforms to 3GPP TS 48.018 § 10.2.2, with the following limitations:

- OsmoPCU does not send optional IEs - PFI (§ 12.3.42) and LSA Identifier List (§ 11.3.18).
- QoS Profile (§ 11.3.28) IE is always set to 0x04.

#### 4.2.3 RA-CAPABILITY

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.4 PAGING PS

This message conforms to 3GPP TS 48.018 § 10.3.1, with the following limitations:

- only IMSI and P-TMSI are parsed by OsmoPCU.

Table 10: *DL-UNITDATA* IE limitations

| **TS 48.018 §** | **IE Name** | **Handling** |
|---|---|---|
| 11.3.11 | DRX Parameters | *ignored* |
| 11.3.6 | BVCI | *ignored* |
| 11.3.17 | Location Are | *ignored* |
| 11.3.31 | Routeing Area | *ignored* |
| 11.3.3 | BSS Area Indication | *ignored* |
| 11.3.42 | PFI | *ignored* |
| 11.3.43 | ABQP | *ignored* |
| 11.3.28 | QoS Profile | *ignored* |
| 11.3.36 | P-TMSI | treated as mandatory (in case of absence paging with 0-length P-TMSI will be sent) |

#### 4.2.5 PAGING CS

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.6 SUSPEND-ACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.7 SUSPEND-NACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.8 RESUME-ACK

This message is received and logged but ignored by OsmoPCU at the moment.

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#### 4.2.9 RESUME-NACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.10 BVC-BLOCK-ACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.11 BVC-RESET

OsmoPCU never transmits optional Feature bitmap (3GPP TS 48.018 § 11.3.40) IE.

Receiving BVC RESET will cause OsmoPCU to respond with "Unknown BVCI" status message.

#### 4.2.12 BVC-RESET-ACK

This message conforms to 3GPP TS 48.018 § 10.4.13.

After receiving it OsmoPCU completes the RESET procedure for BVC according to 3GPP TS 48.018 § 8.4.

#### 4.2.13 BVC-UNBLOCK-ACK

This message conforms to 3GPP TS 48.018 § 10.4.11.

After receiving it OsmoPCU completes the RESET procedure for BVC according to 3GPP TS 48.018 § 8.3.

#### 4.2.14 BVC-UNBLOCK

This message conforms to 3GPP TS 48.018 § 10.4.10 and is send by OsmoPCU as part of UNBLOCK procedure described in 3GPP TS 48.018 § 8.3.

#### 4.2.15 FLOW-CONTROL-MS-ACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.16 FLOW-CONTROL-BVC-ACK

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.17 FLOW-CONTROL-BVC

This message conforms to 3GPP TS 48.018 § 10.4.4, with the following limitations:

- OsmoPCU does not support Current Bucket Level (CBL) feature so Bucket_Full Ratio (TS 48.018 § 11.3.46) IE is not transmitted as part of this message.

#### 4.2.18 FLUSH-LL

This message is received and logged but ignored by OsmoPCU at the moment.

#### 4.2.19 SGSN-INVOKE-TRACE

This message is received and logged but ignored by OsmoPCU at the moment.

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#### 4.2.20 STATUS

This message conforms to 3GPP TS 48.018 § 10.4.14.

## 4.3 Information Elements Overview

All of the IEs handled by OsmoPCU are listed below, with limitations and additions to 3GPP TS 48.018 specified in more detail.

### 4.3.1 IEs Conforming to 3GPP TS 48.018

The following Information Elements are accepted by OsmoPCU. Not all IEs are actually evaluated.

Table 11: IEs conforming to 3GPP TS 48.018

| tag (hex) | TS 48.018 § | IE name | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|
| 0x00 | 11.3.1 | Alignment Octets | ←/→ | Received/Sent |
| 0x01 | 11.3.2 | Bmax default MS | → | Sent |
| 0x02 | 11.3.3 | BSS Area Indication | ← | Received |
| 0x03 | 11.3.4 | Bucket Leak Rate | → | Sent |
| 0x04 | 11.3.6 | BVCI | ←/→ | Received/Sent |
| 0x05 | 11.3.5 | BVC Bucket Size | → | Sent |
| 0x06 | 11.3.7 | BVC Measurement | → | Sent |
| 0x07 | 11.3.8 | Cause | ←/→ | Received/Sent |
| 0x08 | 11.3.9 | Cell Identifier | → | Sent |
| 0x09 | 11.3.10 | Channel needed | ← | Received |
| 0x0a | 11.3.11 | DRX Parameters | ← | Received |
| 0x0b | 11.3.12 | eMLPP-Priority | ← | Received |
| 0x0c | 11.3.13 | Flush Action | ← | Received |
| 0x0d | 11.3.14 | IMSI | ←/→ | Received/Sent |
| 0x0e | 11.3.15 | LLC-PDU | ←/→ | Received/Sent |
| 0x0f | 11.3.16 | LLC Frames Discarded | → | Sent |
| 0x10 | 11.3.17 | Location Area | ← | Received |
| 0x11 | 11.3.20 | Mobile Id | ← | Received |
| 0x12 | 11.3.21 | MS Bucket Size | → | Sent |
| 0x13 | 11.3.22 | MS Radio Access Capability | ← | Received |
| 0x14 | 11.3.23 | OMC Id | ← | Received |
| 0x15 | 11.3.24 | PDU In Error | ←/→ | Received/Sent |
| 0x16 | 11.3.25 | PDU Lifetime | ← | Received |
| 0x17 | 11.3.27 | Priority | ← | Received |
| 0x19 | 11.3.29 | Radio Cause | → | Sent |
| 0x1a | 11.3.30 | RA-Cap-UPD-Cause | → | Sent |
| 0x1b | 11.3.31 | Routeing Area | ←/→ | Received/Sent |
| 0x1c | 11.3.32 | R_default_MS | → | Sent |
| 0x1d | 11.3.33 | Suspend Reference Number | ←/→ | Received/Sent |
| 0x1e | 11.3.34 | Tag | ←/→ | Received/Sent |
| 0x1f | 11.3.35 | TLLI | ←/→ | Received/Sent |
| 0x20 | 11.3.36 | TMSI | ←/→ | Received/Sent |
| 0x21 | 11.3.37 | Trace Reference | ← | Received |
| 0x22 | 11.3.38 | Trace Type | ← | Received |
| 0x23 | 11.3.39 | TransactionId | ← | Received |
| 0x24 | 11.3.40 | Trigger Id | ← | Received |
| 0x25 | 11.3.41 | Number of octets affected | → | Sent |
| 0x26 | 11.3.18 | LSA Identifier List | → | Sent |
| 0x27 | 11.3.19 | LSA Information | ← | Received |

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Table 11: (continued)

| tag (hex) | TS 48.018 § | IE name | ←/→ | Received/Sent by OsmoPCU |
|---|---|---|---|---|
| 0x28 | 11.3.42 | Packet Flow Identifier | ←/→ | Received/Sent |
| 0x3a | 11.3.43 | Aggregate BSS QoS Profile (ABQP) | ←/→ | Received/Sent |
| 0x3b | 11.3.45 | Feature Bitmap | ←/→ | Received/Sent |
| 0x3c | 11.3.46 | Bucket_Full Ratio | → | Sent |
| 0x3d | 11.3.47 | Service UTRAN CCO (Cell Change Order) | ← | Received |

#### 4.3.2 IEs Not Conforming to 3GPP TS 48.018

Table 12: IEs not conforming to 3GPP TS 48.018

| tag (hex) | TS 48.018 § | IE name | Description |
|---|---|---|---|
| 0x18 | 11.3.28 | QoS Profile | Received value is ignored. Sent value is hard-coded to 0x4 (3 octets). |

#### 4.3.3 Additional Attributes and Parameters

There are no OsmoPCU specific additional Attributes and Parameters.

### 4.4 Details on IEs

#### 4.4.1 BSS Area Indication

This IE is ignored by OsmoPCU.

#### 4.4.2 Bucket Leak Rate

The value used by OsmoPCU for this IE can be set through configuration file or vty via "flow-control force-ms-leak-rate <1-6553500>" command.

#### 4.4.3 BVC Bucket Size

The value used by OsmoPCU for this IE can be set through configuration file or vty via "flow-control force-bvc-bucket-size <1-6553500>" command.

#### 4.4.4 Channel needed

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.5 for details.

#### 4.4.5 DRX Parameters

This IE is ignored by OsmoPCU.

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#### 4.4.6 eMLPP-Priority

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.5 for details.

#### 4.4.7 Flush Action

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.18 for details.

#### 4.4.8 LLC Frames Discarded

This IE is not available because entire message which contains it (LLC-DISCARDED) is not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.9 Location Area

This IE is ignored by OsmoPCU.

#### 4.4.10 Mobile Id

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.11 MS Bucket Size

The value used by OsmoPCU for this IE can be set through configuration file or vty via "flow-control force-ms-bucket-size <1-6553500>" command.

#### 4.4.12 MS Radio Access Capability

This IE is ignored by OsmoPCU.

#### 4.4.13 OMC Id

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.14 Priority

This IE is ignored by OsmoPCU.

#### 4.4.15 QoS Profile

No QoS is supported by OsmoPCU so this IE is ignored or safe default used when mandatory.

#### 4.4.16 Radio Cause

This IE is not available because entire message which contains it (RADIO-STATUS) is not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.17 RA-Cap-UPD-Cause

This IE is not available because entire message which contains it (RA-CAPABILITY-UPDATE-ACK) is not implemented by OsmoPCU - see for Section 4.1.3 details.

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#### 4.4.18 Routeing Area

This IE is ignored by OsmoPCU upon receiving.

The messages which might require this IE to be send are not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.19 Suspend Reference Number

This IE is ignored by OsmoPCU upon receiving.

The messages which might require this IE to be send are not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.20 Tag

This IE currently only used by OsmoPCU for Flow Control procedure (TS 48.018 § 8.2). In other cases it's either ignored or unavailable.

#### 4.4.21 Trace Reference

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.22 Trace Type

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.23 TransactionId

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.24 Trigger Id

This IE is ignored because entire message which contains it is ignored by OsmoPCU - see Section 4.2.19 for details.

#### 4.4.25 Number of octets affected

This IE is not available because the messages which contains it (FLUSH-LL-ACK and LLC-DISCARDE) are not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.26 LSA Information

This IE is ignored by OsmoPCU.

#### 4.4.27 LSA Identifier List

This IE is not implemented by OsmoPCU.

#### 4.4.28 Packet Flow Identifier

This IE is ignored by OsmoPCU upon receiving.

The messages which might require this IE to be send are not implemented by OsmoPCU - see for Section 4.1.3 details.

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#### 4.4.29 Aggregate BSS QoS Profile (ABQP)

This IE is ignored by OsmoPCU upon receiving.

The messages which might require this IE to be send are not implemented by OsmoPCU - see for Section 4.1.3 details.

#### 4.4.30 Feature Bitmap

This IE is not implemented by OsmoPCU.

This IE is ignored by OsmoPCU when received.

Absence of Feature Bitmap automatically disables optional features for Network Service Entity (NSE) communicating with OsmoPCU.

#### 4.4.31 Bucket_Full Ratio

This IE is not implemented by OsmoPCU.

#### 4.4.32 Service UTRAN CCO (Cell Change Order)

This IE is ignored by OsmoPCU.

### 4.5 Gb BSSGP Initialization / PCU bring-up

The BSSGP initialization directly follows NS connection establishment described in Section 3.5.

OsmoPCU allocates a BVC context for the BVCI given by OsmoBTS, which in turn receives it from OsmoBSC or OsmoNITB via OML procedures.

In addition to the BVCI identifying the OsmoPCU side of BSSGP connection, there is also special BVCI which is accepted by OsmoPCU in accordance with 3GPP TS 48.018 § 5.4.1: BVCI = 0 represents signaling data between SGSN and PCU in contrast to PTP (Peer-To-Peer) user's data.

The mapping between BSSGP PDUs and signaling or PTP BVCIs is available in 3GPP TS 48.018 Table 5.4.

## 5 Glossary

**2FF**
: 2nd Generation Form Factor; the so-called plug-in SIM form factor

**3FF**
: 3rd Generation Form Factor; the so-called microSIM form factor

**3GPP**
: 3rd Generation Partnership Project

**4FF**
: 4th Generation Form Factor; the so-called nanoSIM form factor

**A Interface**
: Interface between BTS and BSC, traditionally over E1 (*3GPP TS 48.008* [?])

**A3/A8**
: Algorithm 3 and 8; Authentication and key generation algorithm in GSM and GPRS, typically COMP128v1/v2/v3 or MILENAGE are typically used

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**A5**
Algorithm 5; Air-interface encryption of GSM; currently only A5/0 (no encryption), A5/1 and A5/3 are in use

**Abis Interface**
Interface between BTS and BSC, traditionally over E1 (*3GPP TS 48.058* [?] and *3GPP TS 52.021* [?])

**ACC**
Access Control Class; every BTS broadcasts a bit-mask of permitted ACC, and only subscribers with a SIM of matching ACC are permitted to use that BTS

**AGCH**
Access Grant Channel on Um interface; used to assign a dedicated channel in response to RACH request

**AGPL**
GNU Affero General Public License, a copyleft-style Free Software License

**AQPSK**
Adaptive QPSK, a modulation scheme used by VAMOS channels on Downlink

**ARFCN**
Absolute Radio Frequency Channel Number; specifies a tuple of uplink and downlink frequencies

**AUC**
Authentication Center; central database of authentication key material for each subscriber

**BCCH**
Broadcast Control Channel on Um interface; used to broadcast information about Cell and its neighbors

**BCC**
Base Station Color Code; short identifier of BTS, lower part of BSIC

**BTS**
Base Transceiver Station

**BSC**
Base Station Controller

**BSIC**
Base Station Identity Code; 16bit identifier of BTS within location area

**BSSGP**
Base Station Subsystem Gateway Protocol (*3GPP TS 48.018* [?])

**BVCI**
BSSGP Virtual Circuit Identifier

**CBC**
Cell Broadcast Centre; central entity of Cell Broadcast service

**CBCH**
Cell Broadcast Channel; used to transmit Cell Broadcast SMS (SMS-CB)

**CBS**
Cell Broadcast Service

**CBSP**
Cell Broadcast Service Protocol (*3GPP TS 48.049* [?])

**CC**
Call Control; Part of the GSM Layer 3 Protocol

**CCCH**
Common Control Channel on Um interface; consists of RACH (uplink), BCCH, PCH, AGCH (all downlink)

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**Cell**
A cell in a cellular network, served by a BTS

**CEPT**
Conférence européenne des administrations des postes et des télécommunications; European Conference of Postal and Telecommunications Administrations.

**CGI**
Cell Global Identifier comprised of MCC, MNC, LAC and BSIC

**CSFB**
Circiut-Switched Fall Back; Mechanism for switching from LTE/EUTRAN to UTRAN/GERAN when circuit-switched services such as voice telephony are required.

**dB**
deci-Bel; relative logarithmic unit

**dBm**
deci-Bel (milliwatt); unit of measurement for signal strength of radio signals

**DHCP**
Dynamic Host Configuration Protocol (*IETF RFC 2131* [?])

**downlink**
Direction of messages / signals from the network core towards the mobile phone

**DSCP**
Differentiated Services Code Point (*IETF RFC 2474* [?])

**DSP**
Digital Signal Processor

**dvnixload**
Tool to program UBL and the Bootloader on a sysmoBTS

**EDGE**
Enhanced Data rates for GPRS Evolution; Higher-speed improvement of GPRS; introduces 8PSK

**EGPRS**
Enhanced GPRS; the part of EDGE relating to GPRS services

**EIR**
Equipment Identity Register; core network element that stores and manages IMEI numbers

**ESME**
External SMS Entity; an external application interfacing with a SMSC over SMPP

**ETSI**
European Telecommunications Standardization Institute

**FPGA**
Field Programmable Gate Array; programmable digital logic hardware

**Gb**
Interface between PCU and SGSN in GPRS/EDGE network; uses NS, BSSGP, LLC

**GERAN**
GPRS/EDGE Radio Access Network

**GFDL**
GNU Free Documentation License; a copyleft-style Documentation License

**GGSN**
GPRS Gateway Support Node; gateway between GPRS and external (IP) network

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**GMSK**
Gaussian Minimum Shift Keying; modulation used for GSM and GPRS

**GPL**
GNU General Public License, a copyleft-style Free Software License

**Gp**
Gp interface between SGSN and GGSN; uses GTP protocol

**GPRS**
General Packet Radio Service; the packet switched 2G technology

**GPS**
Global Positioning System; provides a highly accurate clock reference besides the global position

**GSM**
Global System for Mobile Communications. ETSI/3GPP Standard of a 2G digital cellular network

**GSMTAP**
GSM tap; pseudo standard for encapsulating GSM protocol layers over UDP/IP for analysis

**GSUP**
Generic Subscriber Update Protocol. Osmocom-specific alternative to TCAP/MAP

**GT**
Global Title; an address in SCCP

**GTP**
GPRS Tunnel Protocol; used between SGSN and GGSN

**HLR**
Home Location Register; central subscriber database of a GSM network

**HNB-GW**
Home NodeB Gateway. Entity between femtocells (Home NodeB) and CN in 3G/UMTS.

**HPLMN**
Home PLMN; the network that has issued the subscriber SIM and has his record in HLR

**IE**
Information Element

**IMEI**
International Mobile Equipment Identity; unique 14-digit decimal number to globally identify a mobile device, optionally with a 15th checksum digit

**IMEISV**
IMEI software version; unique 14-digit decimal number to globally identify a mobile device (same as IMEI) plus two software version digits (total digits: 16)

**IMSI**
International Mobile Subscriber Identity; 15-digit unique identifier for the subscriber/SIM; starts with MCC/MNC of issuing operator

**IP**
Internet Protocol (*IETF RFC 791* [?])

**IPA**
*ip.access GSM over IP* protocol; used to multiplex a single TCP connection

**Iu**
Interface in 3G/UMTS between RAN and CN

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**IuCS**
Iu interface for circuit-switched domain. Used in 3G/UMTS between RAN and MSC

**IuPS**
Iu interface for packet-switched domain. Used in 3G/UMTS between RAN and SGSN

**LAC**
Location Area Code; 16bit identifier of Location Area within network

**LAPD**
Link Access Protocol, D-Channel (*ITU-T Q.921* [?])

**LAPDm**
Link Access Protocol Mobile (*3GPP TS 44.006* [?])

**LLC**
Logical Link Control; GPRS protocol between MS and SGSN (*3GPP TS 44.064* [?])

**Location Area**
Location Area; a geographic area containing multiple BTS

**LU**
Location Updating; can be of type IMSI-Attach or Periodic. Procedure that indicates a subscriber's physical presence in a given radio cell.

**M2PA**
MTP2 Peer-to-Peer Adaptation; a SIGTRAN Variant (*RFC 4165* [?])

**M2UA**
MTP2 User Adaptation; a SIGTRAN Variant (*RFC 3331* [?])

**M3UA**
MTP3 User Adaptation; a SIGTRAN Variant (*RFC 4666* [?])

**MCC**
Mobile Country Code; unique identifier of a country, e.g. 262 for Germany

**MFF**
Machine-to-Machine Form Factor; a SIM chip package that is soldered permanently onto M2M device circuit boards.

**MGW**
Media Gateway

**MM**
Mobility Management; part of the GSM Layer 3 Protocol

**MNC**
Mobile Network Code; identifies network within a country; assigned by national regulator

**MNCC**
Mobile Network Call Control; Unix domain socket based Interface between MSC and external call control entity like osmo-sip-connector

**MNO**
Mobile Network Operator; operator with physical radio network under his MCC/MNC

**MO**
Mobile Originated. Direction from Mobile (MS/UE) to Network

**MS**
Mobile Station; a mobile phone / GSM Modem

**MSC**
Mobile Switching Center; network element in the circuit-switched core network

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**MSC pool**
A number of redundant MSCs serving the same core network, which a BSC / RNC distributes load across; see also the "MSC Pooling" chapter in OsmoBSC's user manual [?] and *3GPP TS 23.236* [?]

**MSISDN**
Mobile Subscriber ISDN Number; telephone number of the subscriber

**MT**
Mobile Terminated. Direction from Network to Mobile (MS/UE)

**MTP**
Message Transfer Part; SS7 signaling protocol (*ITU-T Q.701* [?])

**MVNO**
Mobile Virtual Network Operator; Operator without physical radio network

**NCC**
Network Color Code; assigned by national regulator

**NITB**
Network In The Box; combines functionality traditionally provided by BSC, MSC, VLR, HLR, SMSC functions; see OsmoNITB

**NRI**
Network Resource Indicator, typically 10 bits of a TMSI indicating which MSC of an MSC pool attached the subscriber; see also the "MSC Pooling" chapter in OsmoBSC's user manual [?] and *3GPP TS 23.236* [?]

**NSEI**
NS Entity Identifier

**NVCI**
NS Virtual Circuit Identifier

**NWL**
Network Listen; ability of some BTS to receive downlink from other BTSs

**NS**
Network Service; protocol on Gb interface (*3GPP TS 48.016* [?])

**OCXO**
Oven Controlled Crystal Oscillator; very high precision oscillator, superior to a VCTCXO

**OML**
Operation & Maintenance Link (ETSI/*3GPP TS 52.021* [?])

**OpenBSC**
Open Source implementation of GSM network elements, specifically OsmoBSC, OsmoNITB, OsmoSGSN

**OpenGGSN**
Open Source implementation of a GPRS Packet Control Unit

**OpenVPN**
Open-Source Virtual Private Network; software employed to establish encrypted private networks over untrusted public networks

**Osmocom**
Open Source MObile COMmunications; collaborative community for implementing communications protocols and systems, including GSM, GPRS, TETRA, DECT, GMR and others

**OsmoBSC**
Open Source implementation of a GSM Base Station Controller

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**OsmoNITB**
Open Source implementation of a GSM Network In The Box, combines functionality traditionally provided by BSC, MSC, VLR, HLR, AUC, SMSC

**OsmoSGSN**
Open Source implementation of a Serving GPRS Support Node

**OsmoPCU**
Open Source implementation of a GPRS Packet Control Unit

**OTA**
Over-The-Air; Capability of operators to remotely reconfigure/reprogram ISM/USIM cards

**PC**
Point Code; an address in MTP

**PCH**
Paging Channel on downlink Um interface; used by network to page an MS

**PCP**
Priority Code Point (*IEEE 802.1Q* [?])

**PCU**
Packet Control Unit; used to manage Layer 2 of the GPRS radio interface

**PDCH**
Packet Data Channel on Um interface; used for GPRS/EDGE signalling + user data

**PIN**
Personal Identification Number; a number by which the user authenticates to a SIM/USIM or other smart card

**PLMN**
Public Land Mobile Network; specification language for a single GSM network

**PUK**
PIN Unblocking Code; used to unblock a blocked PIN (after too many wrong PIN attempts)

**RAC**
Routing Area Code; 16bit identifier for a Routing Area within a Location Area

**RACH**
Random Access Channel on uplink Um interface; used by MS to request establishment of a dedicated channel

**RAM**
Remote Application Management; Ability to remotely manage (install, remove) Java Applications on SIM/USIM Card

**RF**
Radio Frequency

**RFM**
Remote File Management; Ability to remotely manage (write, read) files on a SIM/USIM card

**Roaming**
Procedure in which a subscriber of one network is using the radio network of another network, often in different countries; in some countries national roaming exists

**Routing Area**
Routing Area; GPRS specific sub-division of Location Area

**RR**
Radio Resources; Part of the GSM Layer 3 Protocol

**RSL**
Radio Signalling Link (*3GPP TS 48.058* [?])

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**RTP**
Real-Time Transport Protocol (*IETF RFC 3550* [?]); Used to transport audio/video streams over UDP/IP

**SACCH**
Slow Associate Control Channel on Um interface; bundled to a TCH or SDCCH, used for signalling in parallel to active dedicated channel

**SCCP**
Signaling Connection Control Part; SS7 signaling protocol (*ITU-T Q.711* [?])

**SDCCH**
Slow Dedicated Control Channel on Um interface; used for signalling and SMS transport in GSM

**SDK**
Software Development Kit

**SGs**
Interface between MSC (GSM/UMTS) and MME (LTE/EPC) to facilitate CSFB and SMS.

**SGSN**
Serving GPRS Support Node; Core network element for packet-switched services in GSM and UMTS.

**SIGTRAN**
Signaling Transport over IP (*IETF RFC 2719* [?])

**SIM**
Subscriber Identity Module; small chip card storing subscriber identity

**Site**
A site is a location where one or more BTSs are installed, typically three BTSs for three sectors

**SMPP**
Short Message Peer-to-Peer; TCP based protocol to interface external entities with an SMSC

**SMSC**
Short Message Service Center; store-and-forward relay for short messages

**SS7**
Signaling System No. 7; Classic digital telephony signaling system

**SS**
Supplementary Services; query and set various service parameters between subscriber and core network (e.g. USSD, 3rd-party calls, hold/retrieve, advice-of-charge, call deflection)

**SSH**
Secure Shell; *IETF RFC 4250* [?] to 4254

**SSN**
Sub-System Number; identifies a given SCCP Service such as MSC, HLR

**STP**
Signaling Transfer Point; A Router in SS7 Networks

**SUA**
SCCP User Adaptation; a SIGTRAN Variant (*RFC 3868* [?])

**syslog**
System logging service of UNIX-like operating systems

**System Information**
A set of downlink messages on the BCCH and SACCH of the Um interface describing properties of the cell and network

**TCH**
Traffic Channel; used for circuit-switched user traffic (mostly voice) in GSM

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**TCP**
Transmission Control Protocol; (*IETF RFC 793* [?])

**TFTP**
Trivial File Transfer Protocol; (*IETF RFC 1350* [?])

**TOS**
Type Of Service; bit-field in IPv4 header, now re-used as DSCP (*IETF RFC 791* [?])

**TRX**
Transceiver; element of a BTS serving a single carrier

**TS**
Technical Specification

**u-Boot**
Boot loader used in various embedded systems

**UBI**
An MTD wear leveling system to deal with NAND flash in Linux

**UBL**
Initial bootloader loaded by the TI Davinci SoC

**UDP**
User Datagram Protocol (*IETF RFC 768* [?])

**UICC**
Universal Integrated Chip Card; A smart card according to *ETSI TR 102 216* [?]

**Um interface**
U mobile; Radio interface between MS and BTS

**uplink**
Direction of messages: Signals from the mobile phone towards the network

**USIM**
Universal Subscriber Identity Module; application running on a UICC to provide subscriber identity for UMTS and GSM networks

**USSD**
Unstructured Supplementary Service Data; textual dialog between subscriber and core network, e.g. **100 → Your extension is 1234*

**VAMOS**
Voice services over Adaptive Multi-user channels on One Slot; an optional extension for GSM specified in Release 9 of 3GPP GERAN specifications (*3GPP TS 48.018* [?]) allowing two independent UEs to transmit and receive simultaneously on traffic channels

**VCTCXO**
Voltage Controlled, Temperature Compensated Crystal Oscillator; a precision oscillator, superior to a classic crystal oscillator, but inferior to an OCXO

**VLAN**
Virtual LAN in the context of Ethernet (*IEEE 802.1Q* [?])

**VLR**
Visitor Location Register; volatile storage of attached subscribers in the MSC

**VPLMN**
Visited PLMN; the network in which the subscriber is currently registered; may differ from HPLMN when on roaming

**VTY**
Virtual TeletYpe; a textual command-line interface for configuration and introspection, e.g. the OsmoBSC configuration file as well as its telnet link on port 4242

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# A Osmocom TCP/UDP Port Numbers

The Osmocom GSM system utilizes a variety of TCP/IP based protocols. The table below provides a reference as to which port numbers are used by which protocol / interface.

Table 13: TCP/UDP port numbers

| L4 Protocol | Port Number | Purpose | Software |
|---|---|---|---|
| UDP | 1984 | Osmux | osmo-mgw, osmo-bts |
| UDP | 2427 | MGCP GW | osmo-bsc_mgcp, osmo-mgw |
| TCP | 2775 | SMPP (SMS interface for external programs) | osmo-nitb |
| TCP | 3002 | A-bis/IP OML | osmo-bts, osmo-bsc, osmo-nitb |
| TCP | 3003 | A-bis/IP RSL | osmo-bts, osmo-bsc, osmo-nitb |
| TCP | 4227 | telnet (VTY) | osmo-pcap-client |
| TCP | 4228 | telnet (VTY) | osmo-pcap-server |
| TCP | 4236 | Control Interface | osmo-trx |
| TCP | 4237 | telnet (VTY) | osmo-trx |
| TCP | 4238 | Control Interface | osmo-bts |
| TCP | 4239 | telnet (VTY) | osmo-stp |
| TCP | 4240 | telnet (VTY) | osmo-pcu |
| TCP | 4241 | telnet (VTY) | osmo-bts |
| TCP | 4242 | telnet (VTY) | osmo-nitb, osmo-bsc, cellmgr-ng |
| TCP | 4243 | telnet (VTY) | osmo-bsc_mgcp, osmo-mgw |
| TCP | 4244 | telnet (VTY) | osmo-bsc_nat |
| TCP | 4245 | telnet (VTY) | osmo-sgsn |
| TCP | 4246 | telnet (VTY) | osmo-gbproxy |
| TCP | 4247 | telnet (VTY) | OsmocomBB |
| TCP | 4249 | Control Interface | osmo-nitb, osmo-bsc |
| TCP | 4250 | Control Interface | osmo-bsc_nat |
| TCP | 4251 | Control Interface | osmo-sgsn |
| TCP | 4252 | telnet (VTY) | sysmobts-mgr |
| TCP | 4253 | telnet (VTY) | osmo-gtphub |
| TCP | 4254 | telnet (VTY) | osmo-msc |
| TCP | 4255 | Control Interface | osmo-msc |
| TCP | 4256 | telnet (VTY) | osmo-sip-connector |
| TCP | 4257 | Control Interface | osmo-ggsn, ggsn (OpenGGSN) |
| TCP | 4258 | telnet (VTY) | osmo-hlr |
| TCP | 4259 | Control Interface | osmo-hlr |
| TCP | 4260 | telnet (VTY) | osmo-ggsn |
| TCP | 4261 | telnet (VTY) | osmo-hnbgw |
| TCP | 4262 | Control Interface | osmo-hnbgw |
| TCP | 4263 | Control Interface | osmo-gbproxy |
| TCP | 4264 | telnet (VTY) | osmo-cbc |
| TCP | 4265 | Control Interface | osmo-cbc |
| TCP | 4266 | D-GSM MS Lookup: mDNS serve | osmo-hlr |
| TCP | 4267 | Control Interface | osmo-mgw |
| TCP | 4268 | telnet (VTY) | osmo-uecups |
| SCTP | 4268 | UECUPS | osmo-uecups |
| TCP | 4269 | telnet (VTY) | osmo-e1d |
| TCP | 4270 | telnet (VTY) | osmo-isdntap |
| TCP | 4271 | telnet (VTY) | osmo-smlc |
| TCP | 4272 | Control Interface | osmo-smlc |
| TCP | 4273 | telnet (VTY) | osmo-hnodeb |
| TCP | 4274 | Control Interface | osmo-hnodeb |
| TCP | 4275 | telnet (VTY) | osmo-upf |

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Table 13: (continued)

| L4 Protocol | Port Number | Purpose | Software |
|---|---|---|---|
| TCP | 4276 | Control Interface | osmo-upf |
| TCP | 4277 | telnet (VTY) | osmo-pfcp-tool |
| TCP | 4278 | Control Interface | osmo-pfcp-tool |
| UDP | 4729 | GSMTAP | Almost every osmocom project |
| TCP | 5000 | A/IP | osmo-bsc, osmo-bsc_nat |
| UDP | 23000 | GPRS-NS over IP default port | osmo-pcu, osmo-sgsn, osmo-gbproxy |
| TCP | 48049 | BSC-CBC (CBSP) default port | osmo-bsc, osmo-cbc |

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