



## **Open Radio equipment Interface (ORI); Requirements for Open Radio equipment Interface (ORI) (Release 3)**

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Reference

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Keywords

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# Contents

Intellectual Property Rights .....	4
Foreword.....	4
Introduction .....	4
1 Scope .....	5
2 References .....	5
2.1 Normative references .....	5
2.2 Informative references.....	6
2.3 Document structure of the ORI specifications.....	6
3 Definitions and abbreviations.....	6
3.1 Definitions.....	6
3.2 Abbreviations .....	7
4 ORI system requirements .....	8
4.1 Reference configurations.....	8
4.1.1 Topology.....	8
4.1.2 Specific ORI node requirements on ORI links and ORI ports .....	10
4.2 Supported radio standards .....	11
4.2.1 System requirements.....	11
4.2.2 Specific ORI node requirements .....	11
4.3 Protocol Requirements .....	12
4.3.1 Compliance with CPRI .....	12
4.3.1.1 System requirements .....	12
4.3.1.2 Specific ORI node requirements .....	12
4.3.2 C&M functionality.....	12
4.3.2.1 System requirements .....	12
4.3.2.2 Specific ORI node requirements .....	13
4.3.3 C&M signalling and transport .....	13
4.3.3.1 System requirements .....	13
4.3.3.2 Specific ORI node requirements .....	13
4.4 Redundancy .....	13
4.4.1 General.....	13
4.5 Interoperability .....	13
4.5.1 General.....	13
4.6 Forwards compatibility.....	14
4.6.1 General.....	14
History .....	15

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## Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Open Radio equipment Interface (ORI).

The contents of the present document are subject to continuing work within the ISG. Should the ISG modify the contents of the present document, it will be re-released by the ISG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit indicates the release number of ORI specification group starting from Release 1.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

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## Introduction

Mobile communication networks have evolved from 1<sup>st</sup> generation to 3<sup>rd</sup>, and now, many operators are preparing to introduce LTE. Economical and efficient deployment of base stations is one of key issues for the success of mobile services. Operators also consider ecological aspects when renewing a system.

In general mobile radio base stations consist of a BaseBand Unit (BBU) and a Radio Frequency Unit (RFU), which usually is a Remote Radio Head (RRH) in a distributed base station architecture.

Current interfaces between BBU and RRH are provided in a "semi proprietary" nature, although based on industry standards like CPRI or OBSAI. In order to gain flexibility operators are looking for distributed base station architectures with separate BBUs and RRHs. In order to gain interoperability, BBU and RRH are interconnected via an open BBU-RRH Interface (ORI) for flexible combination from different vendors.

ORI is about a digitized radio base station interface that establishes a connection between "Radio Equipment Control" (REC) and "Radio Equipment" (RE) enabling single-hop and multi-hop topologies. Different information flows (User Plane data, Control and Management Plane data, and Synchronization Plane data) are multiplexed over the interface. ORI covers OSI protocol layer 1, Layer 2 up to Layer 7.

The present document aims to define a set of system and link requirements that apply to the Open Radio equipment Interface (ORI).

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# 1 Scope

ETSI Group Specifications (GS) are deliverables produced by Industry Specification Groups (ISG). GSs are written with the style of a Technical Specification (TS), and represent the sole view of the ISG members.

The present document describes system-level requirements that apply to the Open Radio equipment Interface (ORI) and ORI nodes for Release 3.

NOTE: Requirements comply with CPRI specification of CPRI forum [1] and focuses on the following 3GPP radio access technologies namely UTRA-FDD [3], [4] and [5], E-UTRA-FDD [6], E-UTRA-TDD [6] and GSM [12]. Multiplexing between any combination of UTRA-FDD, E-UTRA-FDD and GSM on an ORI link is also considered.

---

# 2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

## 2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] "Common Public Radio Interface (CPRI); Interface Specification" V 5.0.

NOTE: Available at <http://www.cpri.info/spec.html>.

[2] ETSI GS ORI 002-1: "Open Radio equipment Interface (ORI); ORI Interface Specification; Part 1: Low Layers (Release 3)".

[3] ETSI TS 125 104: "Universal Mobile Telecommunications System (UMTS); Base Station (BS) radio transmission and reception (FDD) (3GPP TS 25.104)".

[4] ETSI TS 125 215: "Universal Mobile Telecommunications System (UMTS); Physical layer; Measurements (FDD) (3GPP TS 25.215)".

[5] ETSI TS 125 133: "Universal Mobile Telecommunications System (UMTS); Requirements for support of radio resource management (FDD) (3GPP TS 25.133)".

[6] ETSI TS 136 104: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception (3GPP TS 36.104)".

[7] ETSI GS ORI 002-2: "Open Radio equipment Interface (ORI); ORI Interface Specification; Part 2: Control and Management (Release 3)".

[8] ETSI TS 125 461 (V10.2.0): "Universal Mobile Telecommunications System (UMTS); UTRAN Iuant interface: Layer 1 (3GPP TS 25.461)".

[9] ETSI TS 125 462 (V10.1.0): "Universal Mobile Telecommunications System (UMTS); UTRAN Iuant interface: Signalling transport (3GPP TS 25.462)".

[10] ETSI TS 125 466 (V10.3.0): "Universal Mobile Telecommunications System (UMTS); UTRAN Iuant interface: Application part (3GPP TS 25.466)".

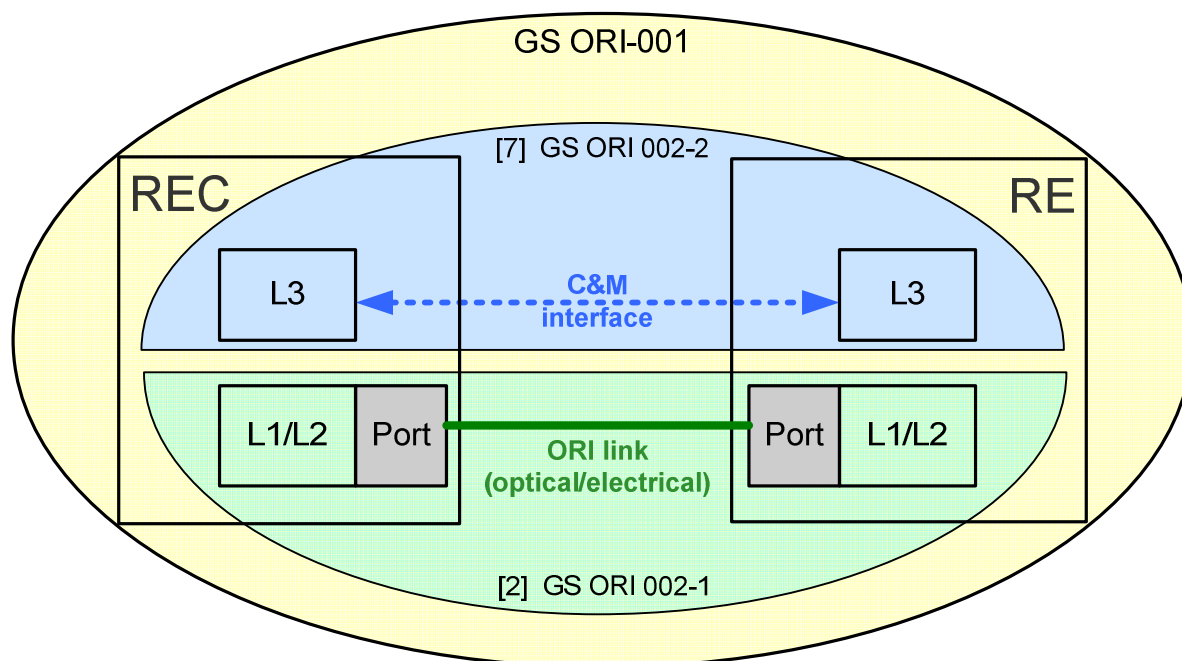
- [11] Antenna Interface Standards Group, Standard No. AISG v2.0, 13th June 2006: "Control interface for antenna line devices".
- [12] ETSI TS 145 005: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 45.005)".

## 2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

## 2.3 Document structure of the ORI specifications



**Figure 2.3.1: Document structure of the ORI specifications**

NOTE: The Low Layers specification [2] covers a single ORI link. The C&M specification [7] covers C&M communication between one REC and one RE. The present requirements specification covers a system configuration of multiple ORI links between one REC and one or multiple REs and optionally additional subsequent ORI links between those REs and other REs.

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

**active link:** ORI link that supports at least one C&M signalling channel

**antenna line device:** See [11].

**downlink:** direction from REC to RE for a logical connection

**hop:** aggregation of all ORI links directly connecting two ORI nodes

**logical connection:** interconnection between a particular SAP belonging to a port of the REC and the corresponding peer SAP belonging to a port of one particular RE and builds upon a single hop, or a multi-hop connection, between the REC and that particular RE

NOTE: Logical connections for C&M data, user plane data and synchronization can be distinguished.

**master port and slave port:** See section 2.1 in [1].

**multi-hop connection:** set of continuously connected hops starting from the REC and ending at a particular RE including REs in between

**networking RE:** RE with at least one ORI Port in master role

**ORI link:** bidirectional interface in between two directly-connected ORI ports, on two ORI nodes

NOTE: A working link consists of a master port and a slave port.

**ORI node:** subsystems REC and RE are also called ORI nodes, when either an REC or an RE is meant

**ORI port:** master port or slave port on an REC or an RE

**passive link:** ORI link that does not support any C&M channel

**protocol data planes:** the following data flows are discerned:

- **Control and Management (C&M) Plane:** Control data flow used for call processing while the management data flow is for the operation, administration and maintenance of the ORI link and the nodes. The control plane and management plane are mapped to a Service Access Point SAP.
- **User Plane:** Data that has to be transferred from the radio base station to the mobile station and vice versa. These data are transferred in the form of IQ data. Several IQ data flows are sent via one physical ORI link. Each IQ data flow reflects the data of one antenna for one carrier.
- **Synchronization:** Data flow which transfers synchronization and timing information between nodes.

**Service Access Points (SAP):** See section 2.1 in [1].

**subsystems:** radio base station system is composed of two basic subsystems, the radio equipment control and the radio equipment

**uplink:** direction from RE to REC for a logical connection

NOTE: For any terms used in the present document that are not defined either here or directly in the section in which they are used, refer to [1].

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3 <sup>rd</sup> Generation Partnership Project
AISG	Antenna Interface Standards Group
BBU	BaseBand Unit
C&M	Control and Management
CPRI	Common Public Radio Interface
E-UTRA	Evolved UMTS Terrestrial Radio Access
FDD	Frequency Division Duplex
GSM	Global System for Mobile communications (Groupe Spécial Mobile)
IQ	In-phase data and Quadrature data
O&M	Operation and Maintenance
OBSAI	Open Base Station Architecture Initiative
ORI	Open Radio equipment Interface
OSI	Open Systems Interconnection
RE	Radio Equipment
REC	Radio Equipment Control

RFU	Radio Frequency Unit
RRH	Remote Radio Head
SAP	Service Access Point
TDD	Time Division Duplex
UTRA	UMTS Terrestrial Radio Access

## 4 ORI system requirements

### 4.1 Reference configurations

#### 4.1.1 Topology

The following networking topologies shall be supported by the present release of the ORI interface:

For single-REC single hop:

- Single point-to-point link between one REC and one RE (figure 4.1.1).
- Multiple point-to-point links between one REC and one RE (figure 4.1.2).
- Multiple point-to-point links between one REC and several REs (Star topology) (figure 4.1.3).

For single-REC multi-hop:

- Chain (figure 4.1.4).
- Tree (figure 4.1.5).
- Ring (figure 4.1.6).

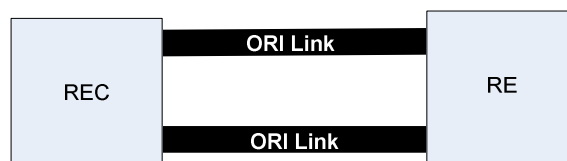
For single-REC multi-hop topologies, the specification shall be designed to support the following:

- both the "simple solution" and "general solution" for networking, as described in section 6.3 of [1], including:
  - the capability for the line bit rate used on ORI links to be different across different hops;
  - the capability for data to be transported via AxCs mapped to M slave ports to be able to be switched by the networking RE to/from N master ports, where  $M \neq N$ .

The capability for the REC to configure an RE that is connected to the REC via a networking RE without affecting radio interface transmission on the networking RE, and vice versa.



**Figure 4.1.1: Single point-to-point link between one REC and one RE**



**Figure 4.1.2: Multiple point-to-point links between one REC and one RE**



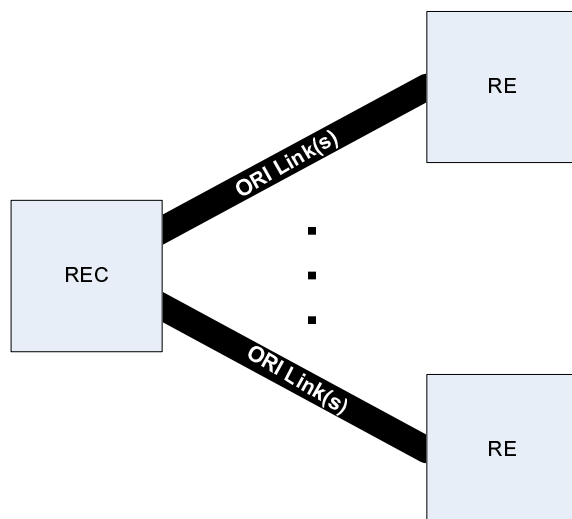


Figure 4.1.3: Multiple point-to-point links between one REC and several REs (star topology)

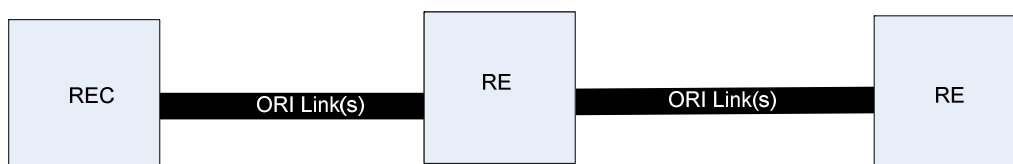


Figure 4.1.4: Chain topology

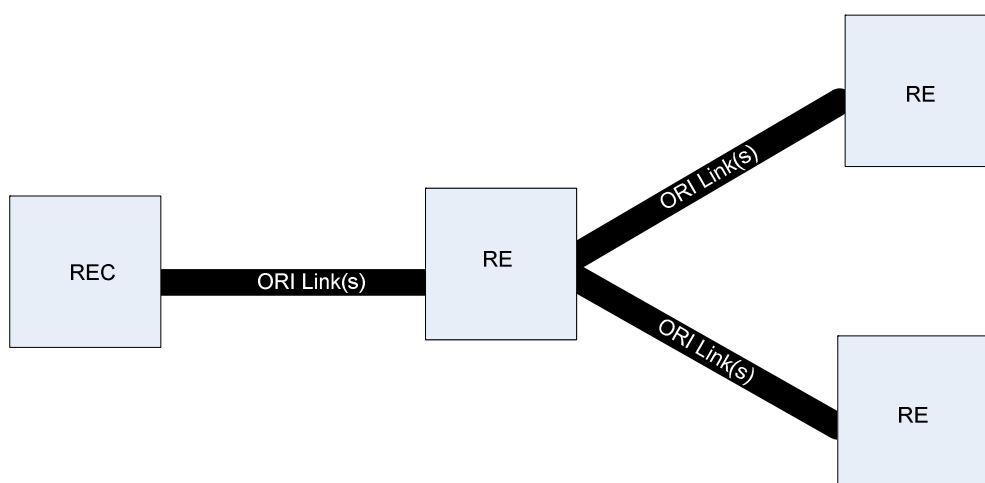


Figure 4.1.5: Tree topology

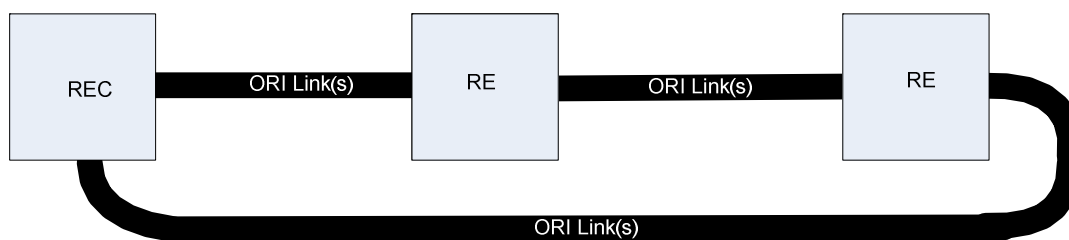


Figure 4.1.6: Ring topology

## 4.1.2 Specific ORI node requirements on ORI links and ORI ports

In support of the topology options as specified for the present release of ORI, the following is required of the RE and REC:

- A hop shall support at least one active link.

As per the single-hop topologies defined in clause 4.1.1 it is assumed REC ports are only master ports and RE ports are only slave ports.

As per the single-REC multi-hop topologies defined in clause 4.1.1, it is assumed that REC ports are only master ports and each RE port may take a master port role or a slave port role within the constraints defined below. The REC shall manage which ORI ports act as a master port in the RE (within the RE's ORI port role capabilities).

The following requirements shall then apply:

- The RE without the capability to be a networking RE shall support 1 to 255 ORI ports.
- The RE with the capability to be a networking RE shall support 2 to 255 ORI ports, and shall support the simultaneous configuration of at least one ORI port as a master port and at least one other ORI port as a slave port.
- The REC shall support 1 to 255 ORI ports.

All ORI Links terminated by an ORI port in slave role at the RE shall have their timing generated by the same timing source.

NOTE: Further restrictions may be needed for multi-REC topologies in the future.

In order to support single-REC multi-hop topologies, the RE acting as a networking RE is expected to support the following:

- At least the simplified solution for networking, described in section 6.3 of [1].
- The forwarding of all the SAPs defined in [1] through the unit between relevant master and slave ports, The networking RE shall not forward SAPs defined in [1] from one slave port to another slave port, e.g. in ring topology.
- The forwarding of the contents of the control words defined within the "ORI reserved field", the "vendor-specific area" between the relevant master and slave ports.

Given that the RE is only required to terminate one active link at any one time, in the ring topology a break in the ring affecting the routing of the active link would cause one or more REs to require C&M re-establishment. See figure 4.1.7.

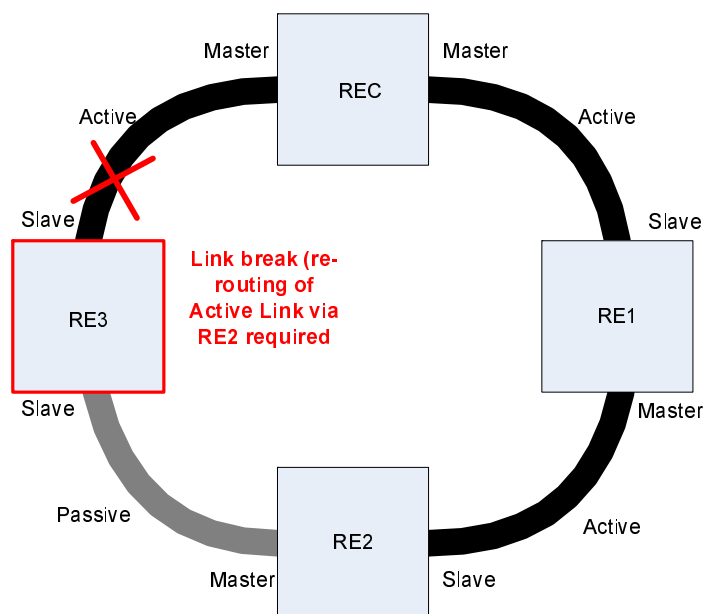


Figure 4.1.7: Example of need for C&M re-establishment following link break in ring topology

## 4.2 Supported radio standards

### 4.2.1 System requirements

The following technologies shall be supported by the present release of the ORI interface:

- UTRA-FDD [3], [4] and [5];
- E-UTRA-FDD [6];
- E-UTRA-TDD [6];
- GSM [12].

3GPP releases and versions relevant to the above radio standards are specified in [1], section 3.1.

Multiplexing between any combination of UTRA-FDD, E-UTRA-FDD, and GSM on an ORI link shall also be supported.

### 4.2.2 Specific ORI node requirements

In support of the technology options as specified for the present release of ORI, the following is required of the RE and REC:

- The RE/REC shall support at least one of UTRA-FDD, E-UTRA-FDD, E-UTRA-TDD, or GSM, and may optionally support multiplexing between any combination of UTRA-FDD, E-UTRA-FDD, and GSM on the ORI Link.
- The REC and RE shall support the functional separation of radio functionality as described in:
  - Table 1 in [1] for support of UTRA.
  - Table 1A in [1] in support of E-UTRA.
  - Table 1AA in [1] in support of GSM.

## 4.3 Protocol Requirements

### 4.3.1 Compliance with CPRI

#### 4.3.1.1 System requirements

The CPRI specification as specified in [1] shall be the baseline for the ORI Low Layers specification [2]. In line with that, the ORI shall be compliant with all of the requirements in [1] for the applicable topologies and radio standards as specified for the present release of ORI. Furthermore, in order to make the ORI specification fully inter-operable, it may be necessary to restrict the number of options defined in [1] for usage within ORI. Such restrictions shall be described in the ORI specifications.

#### 4.3.1.2 Specific ORI node requirements

The RE/REC compliant to the ORI specifications shall:

- be fully compliant to CPRI, as defined in section 5.2 of [1];
- support mandatory requirements defined within ORI that are defined as options within CPRI;
- support mandatory requirements defined within ORI on all layers (specified in the present document, as well as [2] and [7]) that do not refer to functionality in CPRI specifications.

### 4.3.2 C&M functionality

#### 4.3.2.1 System requirements

The following aspects shall be supported by the interface:

- C&M plane protocol stack.
- RE Resource Management.
- RE Fault management: Full fault concept and states as well as the stable fault types.
- C&M protocol encoding and rules.

The following C&M procedures shall be supported by the interface:

- Device Management:
  - Device Management shall be the procedures required to manage the RE as a device, including: Establishment of a C&M layer, Maintaining communication, Reset of the device and Setting the Time of Day in the RE.
- Software Management:
  - Software Management shall be the procedures required to determine the version of software currently available on the RE and the procedure to update and activate the software on the RE.
- Configuration Management:
  - Configuration Management shall be the procedures enable the REC to configure the RE to perform cell transmission and reception over the radio interface, via data provided over the ORI link.
- Resource State Management:
  - Resource State Management shall be the procedures required to change the operating mode of the RE resources and report the current operating state.

- Fault Management:
  - Fault Management shall be the procedures required to report fault conditions within the RE and transfer of additional information about events that have occurred within the RE (log files).
- Performance Management:
  - Performance Management shall be the procedures required determine the operating performance of the RE.
- AISG support:
  - Support the communication towards Antenna Line Devices which have a physical connection to the RE, in line with the 3GPP Iuant interface defined in [8], [9], [10] and AISG specification [11].

#### 4.3.2.2 Specific ORI node requirements

See clause 4.3.1.2.

### 4.3.3 C&M signalling and transport

#### 4.3.3.1 System requirements

Any necessary additions to [1] shall be made in the ORI specification to provide transport for any C&M signalling required to fulfil the C&M functionality requirements.

CPRI defined "Fast C&M signalling channel based on Ethernet" shall be supported by the present release of the ORI interface.

#### 4.3.3.2 Specific ORI node requirements

Requirements on RE/REC for signalling transport are defined in [2].

## 4.4 Redundancy

### 4.4.1 General

Optimizations to redundancy-switching is deferred to future releases.

## 4.5 Interoperability

### 4.5.1 General

The interface shall enable interoperability between products of different vendors. Any restrictions to the requirements in [1] or any other existing protocols used by ORI to enable interoperability shall be described in the ORI specifications.

Any knowledge of ORI support in the RE (and any subsequent RE connected to the RE connected directly to the REC) prior to C&M link establishment needs to be provisioned in the REC via O&M.

NOTE: The concurrent operation of compliant and non-compliant ORI nodes is not specified in the ORI specifications.

## 4.6 Forwards compatibility

### 4.6.1 General

The release 1 of the ORI specification targets basic deployment and related interoperability. The release 2 of the ORI specification adds the support of chain, tree, and ring topologies as well as an additional line rate. The release 2 of the ORI specification shall also attempt to enable hardware-compatibility towards future Releases of the ORI specification, for such functionality where extensions are foreseen as needed. The release 3 of the ORI specification adds support of the GSM radio standard.

Foreseen future topologies include multi-REC topologies.

Foreseen future functionalities include optimizations to redundancy-switching, especially considering optimizations for switching between two active links terminated by slave ports on the same RE.

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## History

<b>Document history</b>		
V1.1.1	October 2011	Publication
V1.2.1	August 2012	Publication
V2.1.1	May 2013	Publication
V3.1.1	March 2014	Publication