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Edition 1.0 2017-09

# TECHNICAL REPORT

colour inside

## Transmitting equipment for radiocommunication – Radio-over-fibre technologies and their performance standard – Part 1: System applications of radio over fibre technology



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# TRANSMITTING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO-OVER-FIBRE TECHNOLOGIES AND THEIR PERFORMANCE STANDARD –

## Part 1: System applications of radio over fibre technology

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IEC TR 63098-1, which is a Technical Report, has been prepared by IEC technical committee 103: Transmitting equipment for radiocommunication.

The text of this technical report is based on the following documents:

| Enquiry draft | Report on voting |
|---|---|
| 103/153/DTR | 103/168/RVDTR |

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 63098 series, published under the general title *Transmitting equipment for radiocommunication*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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# INTRODUCTION

Using radio-over-fibre technology, RF modulated optical carriers and signals can be transmitted in optical fibre with very low loss. Fundamentally, radio-over-fibre (RoF) is an analogue transmission system that allows radio frequency signals to be transmitted and processed without being digitized. Remote antenna systems including distributed antenna system (DAS) which use RoF technology in terrestrial broadcasting and mobile communications have also become established infrastructures.

In terrestrial broadcasting, the conventional microwave links for studio-transmitter links (STLs), transmitter-studio links (TSLs), transmitter-transmitter links (TTLs) and field pickup units (FPUs) have been replaced by RoF systems, particularly in Japan.

RoF technology is a promising technology for broadband access networks combined with the mobility and the flexibility of wireless access. An advantage of RoF technology is multiplexing of RF signals. Multiple RF signals can be converged on the physical layer and they are transmitted to the remote site transparently. RoF technology can also be used for multiplexed transmission that supports CATV (cable television) trunk line systems, cellular phone systems, etc. for blind spots, such as inside buildings, underground areas and subways. RoF systems are also used in digital signage systems and rapid and agile deployment of broadcasting and communication services.

This document provides information on the current and latest applications of radio-over-fibre technology, which are already implemented or will be in the near future. This document will also be beneficial to system developers and system users in the fields of mobile communications and optical fibre technologies.

An example of the technical specification of a radio over fibre (RoF) link in accordance with the spectral emission standard for digital terrestrial television broadcasting in Japan is given in Annex A.

# TRANSMITTING EQUIPMENT FOR RADIOCOMMUNICATION – RADIO-OVER-FIBRE TECHNOLOGIES AND THEIR PERFORMANCE STANDARD –

## Part 1: System applications of radio over fibre technology

## 1 Scope

The purpose of this document is to provide information on the current and latest applications of radio-over-fibre technology. Wireless communication, broadcasting, and airport multilateration systems, which are already implemented or will be in the near future, are introduced. This document includes the basic concept, a brief outline and related standards of the applications of RoF technology.

## 2 Normative references

There are no normative references in this document.

## 3 Terms, definitions and abbreviated terms

### 3.1 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

### 3.2 Abbreviated terms

| | |
|---|---|
| AGC | automatic gain control |
| CATV | cable television |
| DAS | distributed antenna system |
| FPU | field pickup unit, equivalent to microwave link |
| STL | studio-transmitter link |
| TSL | transmitter-studio link |
| TTL | transmitter-transmitter link |
| TIA | transimpedance amplifier |
| LNA | low noise amplifier |

| | |
|---|---|
| NF | noise figure |
| MZ | Mach-Zehnder |
| BTS | base transceiver station |
| E/O | electric to optical |
| O/E | optical to electric |
| W-CDMA | wideband code division multiple access |
| LTE | long term evolution |
| C-RAN | centralized-radio access network |
| MOF | multi drop optical feeder |
| DSP | digital signal processing |
| SCM | sub-carrier multiplexing |
| RoF | radio over fibre |
| DRoF | digital radio over fibre |
| TX | transmitter |
| RX | receiver |
| DTTB | digital terrestrial television broadcasting |

## 4 Advantages and disadvantages of RoF

Advantages of RoF are:

- low attenuation,
- low complexity,
- lower cost.

RoF is an analogue transmission system that allows radio frequency signals to be transmitted and processed without being digitized. RF modulated optical carriers and signals can be transmitted in optical fibre with very low propagation loss. By modulating and demodulating the optical signals at the sending and receiving ends of the optical fibre, the optical fibre operates as a low-loss, high-frequency analogue RF transmission medium. RoF technology is more efficient, less complex, and less costly than conventional electronic systems, especially at high microwave and millimetre wave frequencies.

Disadvantages of RoF are:

- dynamic range,
- intermodulation distortion,