**IEEE P802.15**

**Wireless Personal Area Networks**

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| Title | Proposed modification of TG3d Applications Requirements Document (ARD) |
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| Abstract | The aim of this contribution is to propose the modified texts in the Application Requirement Document (ARD). |
| Purpose | Proposing modified texts in section 6 of Application Requirement Document (ARD). |
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# Fronthaul

There are a lot of studies to transmit high-speed data signals around 10 Gbps to user terminals for future mobile services such as IMT 2020 and beyond (5G) which requiresa huge number of base transceiver stations (BTSs) and small-cell networks[1]. The centralized radio access network (C-RAN) separates the function of the BTS to a baseband unit (BBU) and a remote radio head (RRH). The connection between the BBU and RRH is called “fronthaul”, and currently, ITU-T SG15 defines mobile fronthaul including Radio over Fiber (RoF) [2]. Mobile fronthaul is defined as a connection between one and the other of separated radio transceiver functions within a base station. The transmission capacity of fronhaul must be much higher than 10 Gbps to meet requirements of IMT 2020 and beyond.

## Description of the operational environment

Figure 6.1 indicates mobile fronthaul (MHF) links using 300-GHz frequency. This link utilizes 300-GHz carrier frequencies to feed 5G signals to the user terminals in a small cell.



Figure 6.1 Mobile fronthaul using 300-GHz link.

Figure 6.2 shows the detailed block diagram of the fronthaul. In this figure, a modulation and demodulation unit represents one partial BTS located in the network side (BBU) and a radio antenna unit represents the other partial BTS located in the antenna side (RRH). Taking the above situation into account, mobile fronthaul should be defined as the connection between one and the other of separated radio transceiver functions within the BTS. In addition, mobile fronthaul link (MHF) should be also defined as a link to establish a mobile fronthaul. IEEE802.15.3d devices interface BBU with 300-GHz link, and RRH with 300-GHz link.



Figure 6.2 Definition of mobile fronthaul using 300-GHz link [2].

Figure 6.3 shows the hybrid cell structure which utilizes 300-GHz fronthaul links to feed 5G signals to the user terminals. The propagation distance of 300-GHz link is limited due to attenuation characteristics [3]. c.



Figure 6.3 Hybrid cell structure for IMT 2020 and beyond using 300-GHz link.

## Definition of a typical transmission range

The typical transmission distance of 300-GHz link mainly depends on propagation attenuation of carrier frequencies whose values have been already published by Recommendation ITU-R P.676, P.838, P.840, and the output power and antenna gain of BBUand the receiver noise figure of RRH, and vice versa. The typical transmission range of the 300-GHz link is around 300 meters which may be improved by the technology progress of RF components. .

Additional important parameters which define a typical transmission range are frequency interference and transmission latency. Frequency interference causes reduction of the capacity and connectivity between BBU and RRHAU. 300-GHzlinks can avoid the frequency interference between links due to their high antenna directivities. The transmission latency of 300-GHz link isdertermined from IMT 2020 and byond specifications and the concrete number is TBD at this moment. However, the maximum absolute round trip delay time per link excluding transmission length is specified to 5ms according to the current CPRI specifications [4].

##  Description of the conditions to achive the Target data rate

The modulated spectrum bandwidth of the waveform is determined by the modulation speed and the modulation scheme such as multi-level Quadrature Amplitude Modulation. The limiting factors of transmission bandwidth of 300-GHz link are up and down conversion frequency responses.

The specification of base transceiver stations is known as a Common Public Radio Interface (CPRI) [4] which specifies the key internal interface of base transceiver stations between the Radio Equipment Control (REC) and the Radio Equipment (RE). REC and RE defined by CPRI correspond to BBU and RRH, respectively. The current specified maximum bit rate of CPRI is limited to 10 Gbps, however, IMT 2020 and beyond mobile systems will offer higher data rates greater than 10 Gbps to the mobile terminals [1]. The capacity of the mobile fronthaul link has to be increased to satisfy with the technical requirements of such mobile systems. The new CPRI for IMT 2020 and beyond is not yet specified , but the target data rate at this stage is 100 Gbps in the condition of BER of 10-12 [4].

## Specific issues with respect to regulation

Suitable frequency range and contiguouis bandwidth was proposed by considering gaseous attenuation characteristics in the frequency range from 100 GHz to 1000 GHz [5]. There are the specific resonant attenuation by oxygen and water vapour. The contiguous band is simply estimated by avoiding the resonance attenuation lines. Table 1 below summarizes the suitable frequency range and the contiguous bandwidth. In the frequency range from 200 GHz to 320 GHz, it is difficult to have contiguous bands for mobile services below 252 GHz, because many frequency bands are not allocated for the fixed services [6]. However, the frequency bands between 252 GHz and 275 GHz have been already allocated for fixed services. If the frequency band from 275 GHz to 320 GHz can be allocated or identified for fixed services, a contiguous band of 68 GHz can be utilized for point-to-point type fixed srvices for not only the mobile fronthaul link, but also the wireless data center link, as shown in Figure 6.4. In order to allocate or identify the frequency band from 275 GHz to 320 GHz for the fixed service, the Table of Frequency Allocations in the Radio Regulatios have to be revicsed at the future World Radiocommunication Conference.

Table 1 Suitable frequency range and contiguous bandwidth.





Figure 6.4 Possible operational frequency band for IEEE 802.15.3d devices.

## Specific requirements with respect to the MAC

MAC supports the following information such as IQ data, synchronization, L1 inband protocol, C&M data, vender specific information specified by CPRI specifications [4]. However these information may be amended according to the specification of IMT 2020 and beyond.

## Other issues

##  References

[1] Mobile Communications Systems for 2020 and beyond, *ARIB 2020 and Beyond Ad Hoc Group White Paper, Version 1.0.0, October 2014.*

[2] Draft Supplement to ITU-T G-series Recommendations (G.Suppl.RoF), “Radio-over-fiber (RoF) technologies and their applications”.

 [3] Recommendation ITU-R P.676-9, “Attenuation by atmospheric gases”.

[4] Common Public Radio Interface (CPRI); Interface Specification, *CPRI Specification V6.0 (2013-08-30).*

 [5] IEEE P802.15-14-0613-01-003d, “Proposed suitable frequency ranges in section 5 of a preliminary draft new Report ITU-R SM.[THZ.TREND]”.

[6] Radio Regulations, Edition 2012.