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MULTIMEDIA SIGNALS

Cable modems and home networking

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**Functional requirements for second generation  
HiNoC**

Recommendation ITU-T J.196.1

ITU-T





# Recommendation ITU-T J.196.1

## Functional requirements for second generation HiNoC

### Summary

Recommendation ITU-T J.196.1 specifies requirements for second generation high performance network over coax (HiNoC) that provides 1 Gbit/s data transmission over coaxial networks in the cable industry. Recommendation ITU-T J.196.1 contains descriptions for functional requirements of the general system, physical (PHY) layer and media access control (MAC) layer function over coaxial networks connected with fibre to the building (FTTB).

### History

Edition	Recommendation	Approval	Study Group	Unique ID*
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# Recommendation ITU-T J.196.1

## Functional requirements for second generation HiNoC

### 1 Scope

This Recommendation specifies requirements for second generation high performance network over coax (HiNoC) that provides 1 Gbit/s data transmission over a premises coaxial network connected with fibre to the building (FTTB).

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T J.195.1] Recommendation ITU-T J.195.1 (2016), *Functional requirements for high speed transmission over coaxial networks connected with fiber to the building.*

[ITU-T J.195.2] Recommendation ITU-T J.195.2 (2014), *Physical layer specification for high speed transmission over coaxial networks.*

[ITU-T J.195.3] Recommendation ITU-T J.195.3 (2014), *Medium Access Control layer specification for high speed transmission over coaxial networks.*

### 3 Definitions

#### 3.1 Terms defined elsewhere

None.

#### 3.2 Terms defined in this Recommendation

None.

### 4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3DTV	three Dimensional Television
ARQ	Automatic Repeat request
CPS	Common Part Sublayer
CS	Convergence Sublayer
DBA	Dynamic Bandwidth Allocation
FEC	Forward Error Correction
FTTB	Fibre To The Building
HD	High Definition
HiNoC	High performance Network over Coax

IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LDPC	Low Density Parity Check
MAC	Media Access Control
OAM	Operation, Administration and Maintenance
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency-Division Multiple Access
PHY	Physical
PON	Passive Optical Network
QoS	Quality of Service
SD	Standard Definition
SS	Security Sublayer
TV	Television
UHDTV	Ultra High Definition Television
VoIP	Voice over Internet Protocol

## 5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In the body of this document and its annexes, the words *shall*, *shall not*, *should* and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required to*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

The keywords "HiNoC 1.0" indicate the HiNoC system defined by [ITU-T J.195.1], [ITU-T J.195.2] and [ITU-T J.195.3].

The keywords "HiNoC 2.0" indicate the second generation HiNoC.

## 6 Architecture

The logic architecture model and protocol stack of HiNoC 2.0 refers to clause 6 of [ITU-T J.195.1].

## **7 Requirement**

### **7.1 Functional requirement**

[HiNoC 2.0-Gen-1] HiNoC 2.0 is required to be applied to the passive coaxial access network in a premises network.

[HiNoC 2.0-Gen-2] HiNoC 2.0 is required to support any IP-based services, such as standard definition (SD) or high definition (HD) television (TV), three dimensional TV (3DTV), ultrahigh definition TV (UHDTV), interactive services, voice over Internet protocol (VoIP) and Internet access.

[HiNoC 2.0-Gen-3] HiNoC 2.0 is required not to affect the adjacent channels that provide services and deployments such as analogue broadcasting, digital broadcasting and data services.

[HiNoC 2.0-Gen-4] HiNoC 2.0 is required to support a tree distribution structure and centralized distribution structure of a coaxial cable access network.

[HiNoC 2.0-Gen-5] HiNoC 2.0 is recommended to be applicable below the 1.2 GHz frequency band on a coaxial network.

[HiNoC 2.0-Gen-6] HiNoC 2.0 is required to be robust enough to resist the interference and micro-reflection in a short-range coaxial environment.

[HiNoC 2.0-Gen-7] HiNoC 2.0 is required to allocate downstream and upstream bandwidth flexibly (symmetrical/asymmetrical scenario).

[HiNoC 2.0-Gen-8] HiNoC 2.0 is required to support 128 MHz bandwidth per channel.

[HiNoC 2.0-Gen-9] HiNoC 2.0 is required to support channel bonding to provide a higher transmission rate.

[HiNoC 2.0-Gen-10] HiNoC 2.0 is required to be able to schedule the time-slot for the master-node and client-node to send or receive.

[HiNoC 2.0-Gen-11] HiNoC 2.0 is required to support end-to-end operation, administration and maintenance (OAM) integration with a passive optical network (PON).

[HiNoC 2.0-Gen-12] HiNoC 2.0 is required to avoid spectrum overlap with existing cable services.

[HiNoC 2.0-Gen-13] HiNoC 2.0 is required to be compatible with HiNoC 1.0.

[HiNoC 2.0-Gen-14] The screening attenuation of the coaxial cable to connect the HiNoC 2.0 system is required to be higher than 60 dB.

### **7.2 Requirements of PHY layer**

[HiNoC 2.0-PHY-1] HiNoC 2.0 is required to be based on orthogonal frequency division multiplexing (OFDM) modulation.

[HiNoC 2.0-PHY-2] HiNoC 2.0 physical (PHY) layer is required to support adaptive constellation mapping function for each OFDM subcarrier in accordance with the channel conditions in the coaxial network.

[HiNoC 2.0-PHY-3] HiNoC 2.0 PHY is required to support a flexible forward error correction (FEC) encoding rate in accordance with channel conditions in the coaxial network.

[HiNoC 2.0-PHY-4] HiNoC 2.0 PHY is required to satisfy out-of-band attenuation to reduce the adjacent channel interference in the coaxial network.

[HiNoC 2.0-PHY-5] HiNoC 2.0 PHY is required to perform channel estimation in the connections between master-node and client-node.

### **7.3 Requirements of MAC layer**

#### **7.3.1 System requirements of the convergence sublayer (CS) layer**

[HiNoC 2.0-MAC-1] HiNoC 2.0 media access control (MAC) layer is required to support an address learning function.

[HiNoC 2.0-MAC-2] HiNoC 2.0 MAC is required to support a packing and unpacking of data frames function.

[HiNoC 2.0-MAC-3] HiNoC 2.0 MAC is required to support Internet protocol version 4 (IPv4) and Internet protocol version 6 (IPv6).

[HiNoC 2.0-MAC-4] HiNoC 2.0 MAC is required to support a dynamic bandwidth allocation (DBA) function.

[HiNoC 2.0-MAC-5] HiNoC 2.0 MAC is required to support a service priority mapping function.

[HiNoC 2.0-MAC-6] HiNoC 2.0 MAC is required to support a stream classification function.

[HiNoC 2.0-MAC-7] HiNoC 2.0 MAC is required to support a quality of service (QoS) control function.

[HiNoC 2.0-MAC-8] HiNoC 2.0 MAC is recommended to support a multicast services management and packet filter function.

#### **7.3.2 System requirements of the common part sublayer (CPS)**

[HiNoC 2.0-MAC-9] HiNoC 2.0 MAC is required to support a channel allocation function.

[HiNoC 2.0-MAC-10] HiNoC 2.0 MAC is required to support a node quitting and deletion function.

[HiNoC 2.0-MAC-11] HiNoC 2.0 MAC is required to support a link maintenance function.

[HiNoC 2.0-MAC-12] HiNoC 2.0 MAC is required to support an automatic repeat request (ARQ).

#### **7.3.3 System requirements of the security sublayer (SS) layer**

[HiNoC 2.0-MAC-13] HiNoC 2.0 MAC is required to support an identity function.

[HiNoC 2.0-MAC-14] HiNoC 2.0 MAC is required to support an authentication function.

[HiNoC 2.0-MAC-15] HiNoC 2.0 MAC is required to support a data encryption function.

[HiNoC 2.0-MAC-16] HiNoC 2.0 MAC is required to support a key management function.

## Appendix I

### HiNoC 2.0 and 1.0 brief comparison

(This appendix does not form an integral part of this Recommendation.)

HiNoC 2.0 is the second generation HiNoC. HiNoC 1.0 refers to the HiNoC system defined by [ITU-T J.195.1], [ITU-T J.195.2] and [ITU-T J.195.3].

Considering the operators facing rapid increasing bandwidth pressure, HiNoC 2.0 primarily aims at enhancing the data transmission speed of the HiNoC system up to 1 Gbit/s. A new channel coding is defined in HiNoC 2.0 to improve the robustness of the HiNoC system. HiNoC 2.0 can provide smaller DBA granularity and lower latency transmission.

HiNoC 2.0 is compatible with HiNoC 1.0; HiNoC 1.0 HiNoC modem (HM) can register with HiNoC 2.0 HiNoC bridge (HB).

A brief comparison of HiNoC 2.0 and HiNoC 1.0 is shown as Table I.1.

**Table I.1 – HiNoC 2.0 and 1.0 brief comparison**

Key parameters	HiNoC 2.0	HiNoC 1.0
Working frequency	Below 1.2 GHz	Below 1.2 GHz
Transmission speed	Up to 1 Gbit/s	Up to 100 Mbit/s
Spectrum bandwidth	128 MHz/channel (supporting channel bundle)	16 MHz/channel (supporting channel bundle)
Modulation	OFDM, adaptive subcarrier modulation	OFDM, adaptive subcarrier modulation
Constellation	DQPSK, QPSK/8QAM/16QAM/32QAM/ 64QAM/128QAM/256QAM/ 512QAM/1024QAM/2048QAM/ 4096QAM	DQPSK, QPSK/8QAM/16QAM/32QAM/ 64QAM/128QAM/256QAM/ 512QAM/1024QAM
Carrier number	2048 (1982 effective)	256 (210 effective)
Channel coding	BCH, low density parity check (LDPC)	BCH
Duplex/multi-access mode	TDD/TDMA, orthogonal frequency-division multiple access (OFDMA) (optional)	TDD/TDMA

## **Appendix II**

### **Operational notes**

(This appendix does not form an integral part of this Recommendation.)

Possible interference from or to the wireless signal or radiocommunication services, such as terrestrial broadcast, global system for mobile communications (GSM), 3G/4G, Wi-Fi and aeronautical navigation, might degrade the signal or service quality both in coaxial cable and in air, and can even be risky to flight safety in the worst-case scenario. Therefore, any multiple systems operator (MSO) which plans to deploy HiNoC 2.0/1.0 should be cautious about the spectrum allocation, coaxial cable mounting and maintenance, and equipment screening to minimize the risk from and to any other possible signal outside the coaxial cable. Specifically, any deployment of HiNoC 2.0 should not be within 1 km range of any airport.

Frequency planning, safety and EMC requirements are a national matter and are not covered by this Recommendation. Compliance remains the operators' responsibility, and any operator who needs to calculate or estimate the EMC conditions of their network should refer to [b-ITU-R P.525], [b-ITU-R P.528] and [b-ITU-R P.1238-7].

## Bibliography

- [b-ITU-R P.525] Recommendation ITU-R P.525 (1994), *Calculation of free-space attenuation.*
- [b-ITU-R P.528] Recommendation ITU-R P.528 (2012), *Propagation curves for aeronautical mobile and radionavigation services using the VHF, UHF and SHF bands.*
- [b-ITU-R P.1238-7] Recommendation ITU-R P.1238-7 (2012), *Propagation data and prediction methods for the planning of indoor radiocommunication systems and radio local area networks in the frequency range 900 MHz to 100 GHz.*





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