

ECHONET Specification

Version 2.11

- English Version -



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Notes: In and after Version 2.00, the power line communication protocol has been compiled as Power Line Communication A.

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Definition of Terms

Note: For terms related to the lower-layer communications protocol, see “Definitions of Terms (Lower-Layer Communication Protocol)”.

ECHONET

ECHONET is an abbreviation for Energy Conservation & Homecare Network. This term also means a network for realizing energy conservation and home health care, as well as an answer to a call or a response, from the word “echo”.

ECHONET Address (EA)

An address permitting unique identification of an ECHONET Node in the domain. This address enables the ECHONET Communication Processing Block and the application software to disregard differences in the Lower-Layer Communication Software. This is a logical address that is defined separately from the MAC address native to Lower-Layer Communication Software; it consists of a Net ID and Node ID.

ECHONET Object (EOJ)

A model of information to be disclosed to the network from information owned by the ECHONET Communication Processing Block, or an access procedure model. The information or control target owned by each device is specified as a property, and the operating method (setting, browsing) for this is specified as a service. ECHONET Object is used when class or instance is not considered. It can be broadly classified into four types of objects: Device Object, Profile Object, Communication Definition Object, and Service Object.

ECHONET device

A home device, home electric product, or building/store device, such as lighting, air conditioning, refrigeration, power equipment, ordinary home appliances, sensors, actuators, etc. An ECHONET Node provided with a communication interface and system compatible function conforming to the ECHONET Standard. An ECHONET node provided with a controller function for the centralized control unit with functions to monitor, control, and operate them or an operating unit (remote control, etc.).

ECHONET device adapter

An adapter used to connect to an ECHONET device not provided with a communication interface for transmission media specified in ECHONET. Interface specifications between a device and an ECHONET device adapter conform to the Adapter Communication Interface Specification.

ECHONET Basic API

→ Basic API

ECHONET Basic Service Middleware

→ Basic Service Middleware

ECHONET Common Lower-Layer Communication Interface

→ Common Lower-Layer Communication Interface

ECHONET gateway

An ECHONET Node functioning to connect an ECHONET domain and an external system (including other ECHONET domains). Multiple ECHONET gateways may exist in the domain depending on differences in the external system(s) to be connected.

ECHONET Individual Lower-Layer Communication Interface

→ Individual Lower-Layer Communication Interface

ECHONET Service (ESV)

A function of the ECHONET Object. The services for property values are specified. There are three such services: “Request”, “Response” (processing response/"process not possible" response), and “Notice”.

ECHONET Service API

→ Service API

ECHONET Service Object

→ Service Object

ECHONET Service Middleware

→ Service Middleware

ECHONET Communication Processing Block

One processing block for the ECHONET Communication Middleware. This block performs communication protocol processing to facilitate remote device control/monitoring processing for application software, stores information for the above, and controls various information on the self-device as well as other device status.

ECHONET Communication Middleware

This middleware is arranged at a position between application software and Lower-Layer Communication Software and performs communication processing according to the ECHONET communication protocol. The major features of ECHONET are implemented by ECHONET Communication Middleware.

ECHONET domain

A range on the network within which information transmission is logically guaranteed by ECHONET. Generally, it is thought that property and security control, including homes and stores, use the same range as a domain, but the domain is not limited by any standard.

ECHONET Node

A communication node conforming to the ECHONET standard. In ECHONET, this is an ECHONET communication function to be uniquely identified by an ECHONET Address. There is no distinction between the application functions of nodes. The term node is used to describe the function of one communication terminal on ECHONET.

ECHONET Property (EPC)

An attribute of an ECHONET Object. It defines an attribute such as set value and status as property. For reading or writing, the ECHONET Service is used.

ECHONET router

An ECHONET Node used to connect ECHONET subnets. It connects the subnets of different lower-layer communication protocols (for different protocols, regardless of transmission media type) or divides the same protocol into subnets. The lower-layer communication protocol is connected seamlessly on the system using routing processing based on ECHONET Addresses as a function.

EMS (Energy Management Service/Energy Management System)

This service, designed to enable the efficient use of energy, efficiently operates and controls devices while maintaining a safe, comfortable living environment. It can also refer to a system using it as an application.

ET 2101

A home networking standard published by the Electronic Industries Association of Japan in September 1988.

IrDA Control router

An ECHONET router that connects a subnet using IrDA Control with an adjacent subnet. For routing processing, requirements for a general ECHONET router and requirements native to IrDA Control must both be satisfied. In other words, ECHONET router functions must be implemented on the IrDA Control host. When it serves as a router, the IrDA host should absorb restrictions on the communication functions of IrDA Control.

JEM-1439

A home networking standard (dealing with equipment systems in particular) published by the Electronic Industries Association of Japan in August 1988.

MAC address

An address to implement layer 2 communication in the transmission medium. In ECHONET, this does not signify an Ethernet MAC address.

Net ID

A subnet identifier. This is also a component of an ECHONET Address.

Net ID server

An ECHONET Node that assigns a Net ID to each subnet or distributes a Net ID to the ECHONET router, or performs a similar function when the domain consists of multiple subnets. When the domain consists of multiple subnets, a unique Net ID server is required in the domain.

Node ID

An identifier used to identify an ECHONET Node uniquely within the subnet. This is a logical address converted from the MAC address native to the Lower-Layer Communication Software. This is also a component of an ECHONET Address.

Access rule (AR)

A group of ECHONET Services executable for ECHONET properties.

Adapter Communication Interface

An interface between an ECHONET device adapter and a device.

Adapter Communication Interface protocol (ACIP)

A protocol between adapter communication interfaces. In the Adapter Communication Software, an Adapter Communication Software protocol is converted into an Adapter Communication Interface protocol or vice versa.

Adapter Communication Software

Software that executes a service to be exchanged through the Common Lower-Layer Communication Interface after converting it into an Adapter Communication Interface protocol. As an intermediate conversion step, it also handles an Adapter Communication Software protocol. This software must be mounted on both device adapter and device.

Adapter Communication Software protocol (ACSP)

A protocol that is positioned in the intermediate step of conversion between a service to be exchanged through the Common Lower-Layer Communication Interface (or service specified by the adapter vendor) and an Adapter Communication Interface protocol. This protocol is handled by the Adapter Communication Software.

Application software

Software that remotely controls devices connected to the system in the controller, or software that implements device functions themselves in individual devices such as air conditioners or refrigerators.

Instance

An entity when ECHONET Objects exist. When multiple objects of the same class exist in a single node, multiple instances should exist. In ECHONET, Instance Codes are used for instance identification.

Instance Code

A code that represents an instance. However, code 0x00 is used to signify a simultaneous broadcast to all instances.

Warm start

A method of starting the ECHONET Node by starting initial setting processing while keeping previous ECHONET Addresses and initial setting information.

Lower-Layer Communication Software

Software to perform communication protocol processing native to each transmission medium. This software mainly performs communication processing equivalent to layer 1 or 2 of the OSI reference model.

In ECHONET, at present, the power line communication protocol for power lines, low-power wireless communication protocol for low-power wireless, IrDA Control for infrared, extended HBS communication protocol for twisted pair cable, and LonTalk protocol for low-power wireless are defined as Lower-Layer Communication Software.

Device adapter

→ ECHONET Device adapter

Device Object

A logical model of the information held by equipment devices or home electrical appliances such as sensors, air conditioners and refrigerators, or of control items that can be remotely controlled. The interface form for remote control is standardized. The information and control target of each device is specified as property, and the operating method (setting and browsing) is specified as a service.

Device Object super class

A specified property configuration common to all Device Object classes (class group code 0x00 to 0x05).

Basic API

An interface between application software or Service Middleware and the ECHONET Communication Processing Block. It is designed to use the basic functions of ECHONET. Processing requests are mainly made for ECHONET communication operations (start, stop, etc.) and transmitting and receiving functions.

Basic Service Middleware

Service Middleware handling basic functions that can be shared.

Common lower-layer Communication Interface

An interface between the ECHONET Communication Processing Block and the Protocol Difference Absorption Processing Block. Viewed from the ECHONET Communication Middleware, this interface appears to have common specifications regardless of the type of Lower-Layer Communication Software.

Class

A definition of an ECHONET Object. In ECHONET, each class is uniquely identified by a combination of Class Group Code and Class Code.

Class Group

A group of classes. In ECHONET, each group is uniquely identified by a combination of Class Group Code and Class Code.

Class Group Code

A code that represents a Class Group. In ECHONET, each class is uniquely identified by a combination of Class Group Code and Class Code.

Class Code

A code that represents a class. This is specified in units of Class Group. In ECHONET, each class is uniquely identified by a combination of Class Group Code and Class Code.

Gateway

→ ECHONET gateway

Gateway Basic Block

A block to perform processing dependent on the ECHONET domain from the software of the ECHONET gateway Service Middleware.

Gateway Individual Block

A block to perform processing dependent on an external system from the software of ECHONET gateway Service Middleware.

Individual identification information

Unique information for an application to identify each device. The ECHONET Address may be changed by a connecting position to the network, but the individual identification information is never changed.

Individual Lower-Layer Communication Interface

An interface between the Protocol Difference Absorption Processing Block and the Lower-Layer Communication Software.

Cold start

A method for starting the ECHONET node by starting initial setting processing while abandoning previous information related to ECHONET Addresses.

Cold start (1)

An ECHONET node startup method for starting an initial setup process while discarding the house code information, MAC address information, and ECHONET address information that were used for the last startup.

(Versions 2.10 and later)

Cold start (2)

An ECHONET node startup method for starting an initial setup process while retaining the house code information used for the last startup but discarding the previous MAC address information and ECHONET address information. Equivalent to the cold startup method provided by Versions 2.01 and earlier.

(Versions 2.10 and later)

Cold start (3)

An ECHONET node startup method for starting an initial setup process while retaining the previous house code information and MAC address information but discarding the ECHONET address information.

(Versions 2.10 and later)

Service API

An interface designed to access Service Middleware from the application software.

Service Object

A modeled function to be disclosed to the network based on Service Middleware functions. Class specifications such as property are defined as ECHONET Objects.

Service Middleware

Software that mounts the standard and common functions required for implementation of an application. This software is classified into two types: Basic Service Middleware, which handles basic functions that may be shared; and Service Middleware, which is designed for a specific application.

Subnet

A group of nodes using the same Lower-Layer Communication protocol. Each subnet has a Net ID. Different subnets can be connected by an ECHONET router.

Participation

A status in which ECHONET Nodes are connected to the ECHONET, enabling communication. In other words, this status permits access to a Node Profile Object.

Self-device

General term for a group of Self-device Objects.

Self-device Object

An ECHONET Object for disclosing self-node functions to others or receiving control from others.

Self-node

Node in which the self is mounted, as viewed from application software and middleware.

System

An application with a specific objective; consists of two or more devices or controllers that are organically operated in a linked form by information exchange.

System architecture

A configuration of various controllers or devices and a structure for function/role sharing between them in a system consisting of multiple devices or controllers.

Other-device

General term for a group of Other-device Objects.

Other-device Object

An ECHONET Object that controls other node functions or obtains their status.

Other-node

A node other than the Self-node. This node is accessed through the network.

Communication Definition Object

A model of controls and setting items for the communication operations of Device Objects and Profile Objects. This object is specified for each Device Object or Profile Object.

Communication conversion device adapter

A device adapter that permits connecting the Full ECHONET device to the ECHONET system by another different lower-layer communications protocol.

Communication Middleware

→ ECHONET Communication Middleware

Default router

A router that is always transmitted directly from the transmission source when the subnet of the destination is different from the subnet of the source. Data received by the default router is put into routing processing and then transmitted to the destination or a proper router. If the routing processing specification in a node other than the router is a simplified processing type, all data to other subnets is delivered to the default router.

Transmission Medium

Physical medium for communication. At present, power lines, low-power wireless, infrared, and twisted pair cables are specified as transmission media in ECHONET.

Transmission medium addition device adapter

A device adapter that permits connecting to the ECHONET system through the addition of Lower-Layer Communication Software to the Flex ECHONET device.

Registration

Storing and holding of the application information of the corresponding ECHONET Node in the system, together with an ECHONET Address. The information is generated as linkage information or as an instance list in any ECHONET Node. It has no relation to the physical status of participation or non-participation.

Topology

A physical multi-point network configuration. Connection of different transmission media is included.

Domain

→ ECHONET domain

Node

→ ECHONET Node

Full ECHONET device (Full_Device)

A device that has a communications interface standardized by ECHONET and can be connected to the ECHONET system by itself.

Flex ECHONET device (Flex_Device)

A device having ECHONET Communication Middleware (ECHONET Communication Processing Block) and application software higher than the Common Lower-Layer Communication Interface. When the Flex ECHONET device is connected to an ECHONET device adapter (transmission media addition device adapter) for communication processing lower than the Common Lower-Layer Communication Interface, it can be connected to the ECHONET system.

Protocol Difference Absorption Processing Block

One processing block of the ECHONET Communication Middleware. This block is intended to absorb differences of multiple protocols, including power lines and low-power wireless, to configure a single network. The block performs address translation, communication type conversion, data division, and data assembly.

Property

→ ECHONET Property

Property map

Contents of property support for each instance. This is intended to identify mounted functions.

Profile Object

A model of profile information and controls and setting items as an ECHONET Node, such as ECHONET Node operation status, manufacturer information, and Device Object list.

Deletion

Deletion of corresponding ECHONET Node information and ECHONET Address from the system. The information is deleted from the linkage information of all ECHONET Nodes and instance lists. This has no relation to participation or non-participation.

Master router

When two or more routers exist within a subnet, one router exists in the path to their parent router and is given router information by the parent router prior to the other routers within the same subnet. This router is called the "master router" in the subnet and differentiated from the other routers in the same subnet. For master router identification, the "Master Router Information" properties of "Router Profile Object" are used. (Versions 2.10 and later)

Secession

Status in which an ECHONET Node secedes from the ECHONET network (including Power Off), disabling communications. In other words, the Node Profile Object cannot be accessed.

Router

→ ECHONET router

Linkage

An operation status change of the other ECHONET device as the operation status or measured value of one of the ECHONET device changes. In other words, the property value of the other specific instance changes with the property value of one specific instance.

Abbreviations

Note: For abbreviations related to the lower-layer communications protocol, see “Definitions of Abbreviations (Lower-Layer Communication Protocol)”.

ACIP

Adapter Communication Interface Protocol

ACSP

Adapter Communication Software Protocol

API

Application Programming Interface

AR

Access Rule

DEA

Destination ECHONET Address

DEOJ

Destination ECHONET Object

EA

ECHONET Address

EBC

ECHONET Byte Counter

EDATA

ECHONET Data

EDC

ECHONET Data Counter

EDT

ECHONET Property Value Data

EHD

ECHONET Header

EOJ

ECHONET Object

EPC

ECHONET Property

ESV

ECHONET Service

Flex_Device

Flex ECHONET Device

Full_Device

Full ECHONET Device

HBS

Home Bus System

OHD

Object Data Header

SEA

Source ECHONET Address

SEOJ

Source ECHONET Object

Definition of Terms (Lower-Layer Communication Protocol)

Note: For terms other than those regarding lower-layer communications protocol, see “Definition of Terms”.

[Definitions of Power Line Protocol A System Terms]

Primary modulation

Modulation performed before execution of a spectrum spread for an information signal.

ARQ

Automatic Repeat Request.

When information with an error detection code is transmitted, the receiver makes a request to resend if an error is detected.

BER

Bit Error Rate.

CSMA

Carrier Sense Multiple Access.

Implementation of multi-access by carrier signal detection.

DS-SS system

Direct Sequence Spread Spectrum.

A system for transmitting a signal by multiplying an information signal by a spread signal for a wider spectrum.

FEC

Forward Error Correction.

Signal is transmitted together with an error correction code included in the information, and receiving side performs self-correction.

SUBBAND delay detection system

A system in which the DS-SS signal is divided into bands on the receiver side, and a delay is detected for each band and then integrated.

Blocking filter

A filter that blocks the leakage of a high-frequency signal from one high-frequency device to another.

[Definitions of Power Line Communication Protocol B System Terms]

Primary modulation

Modulation to be performed for a transmit signal in the multi-carrier system.

AMP

Amplifier.

BER

Bit Error Rate.

CSMA

Carrier Sense Multiple Access.

DBPSK

Differential Binary Phase Shift Keying.

DQPSK

Differential Quadrature Phase Shift Keying.

D8PSK

Differential 8 Phase Shift Keying.

HPF

High-Pass Filter.

LPF

Low-Pass Filter.

Coupling system

A coupling system between an output from the modem or a signal on the power line, and the power line when said signal is input to the modem.

Carrier sense

Monitors transmit signals of other terminals at transmission.

tone

A single modulation signal to be arranged at a spacing of 4.3125 kHz for a multi-carrier transmit signal.

House code

A code to be attached to the special carrier system digital transmitter to avoid radio interference with another special carrier type digital transmitter.

House code information

Information about the power line or LonTalk® house code or the information about the specific low-power radio system identification code.

Multi-carrier

A signal system that performs communication by putting a modulation signal on multiple tones spread at equal frequency spacing.

Modem

Modulator and demodulator unit using the modulation/demodulation system specified in the Power Line Communication System in Part 3.

[Low-power Radio Communication Protocol]

31-bit M series code

One of the pseudo-random codes.

ARIB Standard

The Standard of Association of Radio Industries and Businesses that includes the contents of laws, ministerial ordinances, and MITI notifications.

BCH code

Bose-Chaudhuri-Hocquenghem code. One of the error detection/correction codes.

CSMA

Carrier Sense Multiple Access.

F1D

A symbol to indicate radio type

F: Frequency modulation

1: No use of sub-carrier wave for modulation

D: Data transmission, tele-metering, or remote command transmission information.

FSK

Frequency Shift Keying.

A modulation system for changing carrier frequency based on transmission data.

NRZ code

Non return-to-zero code

RCR STD-16,30

Standards No.16 and 30 of the Research & Development Center for Radio Systems, the precursor to the Association of Radio Industries & Businesses.

Device identification code

A unique identification code (MAC address) for each device comprising a radio system. At low-power radio communication, this code is used for transmitter identification or receiver identification.

One-way system

A communication system designed to perform transmission only to a single destination.

Simplex system

A communication system that transmits in opposite directions between two communicating parties.

Broadcast communication system

A communication system designed only to simultaneously transmit the same contents to two or more specific destinations.

Radio system identification code

A unique identification code for each radio system. With low-power radio communication, communication is disabled between systems having different system identification codes.

Link connection, establishment, and disconnection

To perform data communications continuously and more than once, a link is established between the calling office and the called office to increase communication efficiency. Link connection fixes the destination and shortens the reception wait cycle prior to data communication. Link disconnection clears the fixed status of the destination and returns the reception wait cycle to the original status after completion of data communication.

[Definitions of IrDA Control Terms]

AGC (Automatic Gain Control)

An infrared receiver sensitivity adjustment signal.

CRC (Cyclic Redundancy Check)

An error detection signal.

HADD (Host Address)

MAC (physical) address of the host (8 bits).

LLC layer (Logical Link Control layer)

This layer is provided mainly with functions such as packet loss detection and re-transmission.

MAC layer (Media Access Control layer)

This layer is provided with functions such as property information exchange between host and peripherals, connection, scheduling for 1:N communication, destination device identification, and error detection.

PADD (Peripheral Address)

A temporary MAC address (4 bits) to be given to a peripheral at bind execution.

PHY (Physical Layer)

A physical layer. This layer consists of AGC, PRE, STA, MAC frame, CRC, and STO.

PRE (IrDA Control Preamble Field)

A signal to be used for clock synchronization.

STA (IrDA Control Start Flag)

Start flag. This is synchronized with the symbol.

STO (IrDA Control Start Flag)

Stop flag. This indicates the end of packet.

Address control table

A table to control PADD, peripheral ID, virtual MAC address, etc.

Intensity

Power for unit solid angle. (mw/steradian)

Enumeration

A procedure for exchanging information between the host and peripherals.

Virtual MAC address

The logical MAC address of a uniquely defined peripheral.

Sub-carrier

IR pulse group whose modulation is used as a signal for data transmission.

Sub-carrier duty

Ratio of continuous IR radiation time in one sub-carrier cycle to the total time of one sub-carrier cycle.

Packet

Period from the start of an AGC area to the end of an STO area during IrDA Control transmission.

Binding

A procedure used by the host to poll a peripheral.

Peak wavelength

Wavelength when optical output intensity is maximized. (### m)

Peripheral

A device to be polled by the IrDA Control host, to which IrDA Control is applicable.

Peripheral ID

A 32-bit peripheral device ID set at the factory.

Irradiance

Power per unit area ($\mu\text{w}/\text{cm}^2$)

Host

A device that permits polling IrDA Control peripheral groups, and to which IrDA Control is applicable.

[Definitions of LonTalk Protocol Terms]

APP

APPLICATION

BUSY signal

A send disable signal output from the RF microcomputer to the Neuron chip. The collision detection signal is notified to the NET-CPU of the Neuron chip, while the BUSY signal is notified to the APP-CPU of the Neuron chip.

LON

Local Operating Network.

A distributed intelligent control network system developed by Echelon Corporation of the U.S.

MAC

MEDIA ACCESS CONTROL.

NET

NETWORK.

Neuron chip

A VLSI device that is the nucleus of the LON. TMPN3150, TMPN3120xx.

RF

Radio Frequency. Used to mean radio or radio signal.

RF microcomputer

A control circuit that acts as an intermediary between the Neuron chip and the RF module. This need not be limited to microcomputers.

RF module

A module in which a radio modulator/demodulator circuit, amplifier, PLL circuit, etc. are integrated. Data input/output, PLL data input, or input/output selection are generally used as an external interface. The input/output waveform shaping circuit may exist outside the module. Here, "RF module" is used as a generic term for all of these.

RxSW

A switch for opening/closing transfer of RF demodulation output (receive data) from the RF microcomputer to the Neuron chip.

TxSW

A switch for selecting between data transmission from the Neuron chip and data transmission from the RF microcomputer.

Communication port

A communication port for the network in the Neuron chip.

Differential Manchester coding system

This system supervises state transition at the beginning of each bit period with the object of clock synchronization on the receiver side. This is called clock transition. The data of 0/1 is indicated depending on whether another transition (data transition) exists between the current clock transition and the next clock transition. When such a transition does exist, the data is set to 0. Otherwise it is set to 1.

Detection collision signal

The Neuron chip inputs this signal at Active-Low from communication port CP4. During transmission, if the signal remains low over the system clock period (200 ns at 10 MHz clock), it is notified that "Collision" took place or is taking place. The LON judges "the necessity for message re-transmission". In this status, re-access is attempted.

Send enable signal

A trigger signal that the Neuron chip outputs prior to data transmission. In the single-end mode, this signal is output at Active-Low from communication port CP2.

* Echelon, LON, LonTalk, Neuron, 3150, and 3120 are registered trademarks of Echelon Corporation of the U.S.

Abbreviations (Lower-Layer Communication Protocol)

Note: For abbreviations other than those of the lower-layer communications protocol, see “Definitions of Abbreviations”.

[Definitions of IrDA Control Abbreviations]

AGC

Automatic Gain Control

BER

Bit Error Rate or Bit Error Ratio

BIOS

Basic Input/Output System

bps

Bits per second

CL

Critical Latency

CRC

Cyclic Redundancy Check

CRC-16

16bit CRC based on the polynomial $x^{16} + x^{15} + x^2 + 1$

CRC-8

8 bit CRC based on the polynomial $x^8 + x^7 + x^2 + 1$

DBS

Data Bit Set

HADD

Host Address

IR

Infrared

IRB-TM

Infrared Bus Transceiver Module

IrDA

Infrared Data Association

IRED

Infrared Emitting Diode

IrLAP

Infrared Link Access Protocol

Kbps

Kilo bits per second

LLC

Logical Link Control

LSB

Least Significant Bit

MAC

Media Access Control layer

MSB

Most Significant Bit

NCL

Non-Critical Latency

NRZ

Non Return to Zero code

PADD

Peripheral Address

PDA

Personal Digital Assistant

PFID

Peripheral physical Identifier

PHY

Physical layer

Pin-PD

Pin PhotoDiode

PRE

IrDA Control Preamble field

PSM

Pulse Sequence Modulation

SEPC

Sub-carrier Emission Pulse Chip

SEPD

Sub-carrier Emission pulse Duration

SIR

IrDA Serial Infrared standard, 115.2kbit/s (1.0)

STA

IrDA Control Start flag

STL

IrDA Control Start flag (Long Packet)

STO

IrDA Control Stop flag

STS

IrDA Control Start flag (Short Packet)

USB

Universal Serial Bus