The OCA Object Model

Features and mechanisms of Open Control Architecture version 1.4, standardized in the AES70-2018 standards suite.

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This presentation may be viewed sequentially, or random-accessed by clicking on topics in the contents list. In any section, click on the home icon ( ) to return to this page.

Contents

Basics

OCA's mission is to provide full-function device control and monitoring for:

- Professional applications
- Multivendor systems
- Mission-critical or noncritical applications
- Media networking applications of all sizes - 2 to 10,000 nodes or more
- Secure or insecure implementations
- Multicontroller systems
- Controllerless (peer to peer) systems
- Audio devices (now), video devices (future), and possibly related equipment (farther future)
- Devices of all sizes - wall panel to mixing desk, possibly with tiny processors
- Dynamically-reconfigurable devices
- Products with proprietary features

using:

- Networks of all speeds, from kBits/sec upward
- Multiple media transport architectures
- Heterogeneous networks - LAN, WAN, IP, non-IP, etc.

and supporting:

- Sharing and reuse of designs, within and among manufacturers, trade associations, and standards bodies.
- Orderly application evolution and expansion over many years, if not decades.

What's the OCA Object Model?

- An object-oriented framework for media device network control interfaces
- A rich and extensible repertoire of **control class** definitions that represent the signal processing, control logic, and network connection functions of media devices
- A set of **datatype class** definitions that specify data elements used by the control classes
- A standardized **device model** for controllable devices

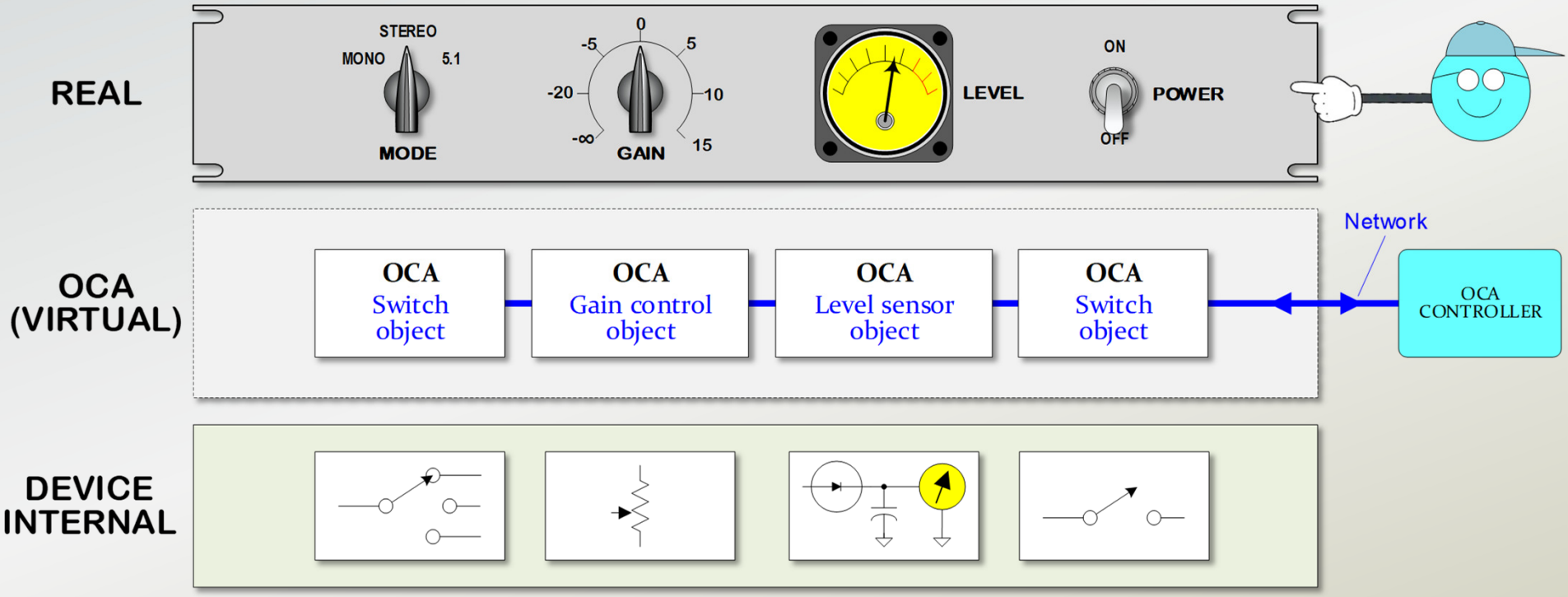
What **isn't** the OCA Object Model?

- A control protocol definition - although it does *lead* to control protocol definitions.
- A media transport protocol definition
- A programming model for devices
- A user interface model for controllers

What's the difference between the OCA object model and AES70?

- The OCA model is a way of modeling media device network control interfaces. By itself, it is not a protocol standard.
- AES70 is a control architecture and protocol standard based on the OCA model.

At a glance: OCA is a kit for defining **virtual control panels.**



Control classes

- An OCA control class is the definition of a network control API for a particular kind of device function - switch, gain control, level monitor, etcetera.
- OCA control classes are defined for both control and monitoring functions.
- Each OCA class has a name beginning with "Oca". For example, the switch control class is called OcaSwitch.
- Control classes are instantiated into control ***objects***. For example, a device with two switch functions would have two OcaSwitch objects.
- OCA objects define control APIs but not internal implementation.
- A device's OCA control API is simply the union of all its individual object APIs.

Proprietary control classes

- Proprietary features may require special control classes. OCA provides a way for manufacturers to define these in a way that coexists harmoniously with standard OCA classes.
- Devices can hide the existence of proprietary objects, if necessary.
- **OCA's virtual control panel objects do not expose proprietary elements any more than physical control panel knobs and switches would.**

Control Class APIs

- Control class APIs are normal object-oriented interfaces with:
  - **Properties** variables that define the state of the object
  - **Methods** functions that change property values or do other things
  - **Events** predefined conditions that arise in the object and cause notifications to be returned to controllers

Datatype Classes

- Datatype classes ("datatypes" for short) have no APIs, they simply define data formats that are exchanged by controllers and control objects. Thus, they only have:
  - **Properties** variables ("fields") that define the data content
- An OCA datatype may be a simple element, e.g.
  - **OcaDB** a value in decibels; maps directly into float32.

  or a more complex structure, e.g.
  - **OcaTimePTP** a value of time in PTP format; contains the following:
    - **Negative** boolean that is TRUE if time value is negative
    - **Seconds** 48 bit unsigned integer value of seconds
    - **Nanoseconds** 32 bit unsigned integer value of nanoseconds

Excluded: Protocols

- The OCA model does not specify a particular network protocol.
- AES70 defines a binary RPC protocol and will soon include a JSON version as well.
- Other protocols are completely feasible, as long as they allow controllers to call **Methods** and receive notifications of **Events**, and have reasonably flexible abilities to transfer parameter data of various types.

Excluded: Device implementation

- OCA doesn't define how a device is implemented. OCA classes only define the device's network API, not its internal structure.
- An OCA device is free to define whatever control objects it needs to surface its control model. Which functions it surfaces is a product decision.
- OCA defines control interfaces for device functions, but doesn't specify how those functions work. For example, OCA defines filters and filter parameters, but doesn't specify the resulting filter transfer functions.

Excluded: Controllers

- The current OCA object model doesn't include controllers.
- At present, OCA says nothing about what's beyond a device's network interface.
- We could define OCA classes for controllers and their UI elements, if we wanted to.

Features

OCA Features

- **Basic application functionality**
  - Signal processing & routing control
  - Full signal & state monitoring
  - Reconfigurable device support
  - Internal signal path control
- **Security features**
  - Key management
- **Device structuring**
  - Element groups and hierarchies
  - Arrays and matrices of control elements
- **Connection management**
  - Media streams
  - Non-media streams
- **Time and clocking management**
  - Multiple time reference support
  - Multiple media clock support
- **Codec support**
  - Multiple codec support
- **Datasets (data block storage & retrieval)** (*in next release*)
- **Media file storage & playout** (*in next release*)
- **Physical location features**
  - Location awareness
  - Object-based audio support
- **Control management**
  - Control aggregation (grouping, mastering, etc.)
  - Event and subscription mechanisms
  - Device enumeration support
  - Multiple controller support
  - Command batching (*in next release)*
  - Realtime command execution (*in next release*)
  - Prescheduled, prestored control tasks.
- **Prestored configuration store & recall**
  - Entire device
  - Subsets
- **Power supply management**
  - Multiple power sources
  - Batteries
  - Failover features
- **Reusability features**
  - Reusable component support
  - Shareable custom designs
- **Extensibility support**
  - Proprietary extension mechanism with inheritance
  - Ability to evolve gracefully
  - Upward, downward, & lateral compatibility

Control objects

instances of control classes

How control objects (or just "objects") Work

- **Object number**
  - Every object is an instance of an OCA control class.
  - Every object has an object number ("ONo") that is unique within the device.
  - An ONo is a 32-bit unsigned integer
  - ONo values may be freely chosen, except that the range 0..4095 is reserved.
- **Properties and Methods**
  - Objects have properties, properties have values.
  - Objects have Get(...) and Set(...) methods for retrieving and changing property values.
  - Some objects have action-oriented methods, too, e.g. Start(...).
- **Events**
  - Objects have Events that cause Notifications to be emitted when the events are triggered.
  - Notifications are messages to Subscribers.
  - Subscribers are controllers that have created Subscriptions via the Subscription Manager object.
- **The PropertyChanged event**
  - The most important kind of event
  - Defined for all OCA objects
  - Triggered when a property value changes
  - Notable use: allows multiple controllers to stay in sync without polling.

Control Classes

Class example

Used to control a device parameter with a fixed number of predefined states.

Examples of such states:

- *on/off*
- *high/medium/low*
- *left/center/right*
- *etcetera*

The controller can select the desired state by specifying its index. Optionally, the states may have names and/or be selectively enabled.

```
class OcaSwitch                          /* OCA class for n-position switch */
{
      int Position                       /* current switch position */
      list<string> PositionNames         /* names of switch positions */
      list<bool>PositionEnable           /* flags to enable positions */

      GetPosition(...)                   /* Get current position  */
      SetPosition(...)                   /* Set new position */
      GetPositionNames(...)              /* Get list of position names */
      SetPositionNames(...)              /* Set list of position names */
      GetPositionEnable(...)             /* Get list of position-enable switches */
      SetPositionEnable(...)             /* Set list of position-enable switches */
}
```

To change the switch's position, the controller invokes **SetPosition(...)** .

To discover the switch's position, the controller invokes **GetPosition(...)** .

To configure the switch's position names, the controller invokes **SetPositionNames(...)** .

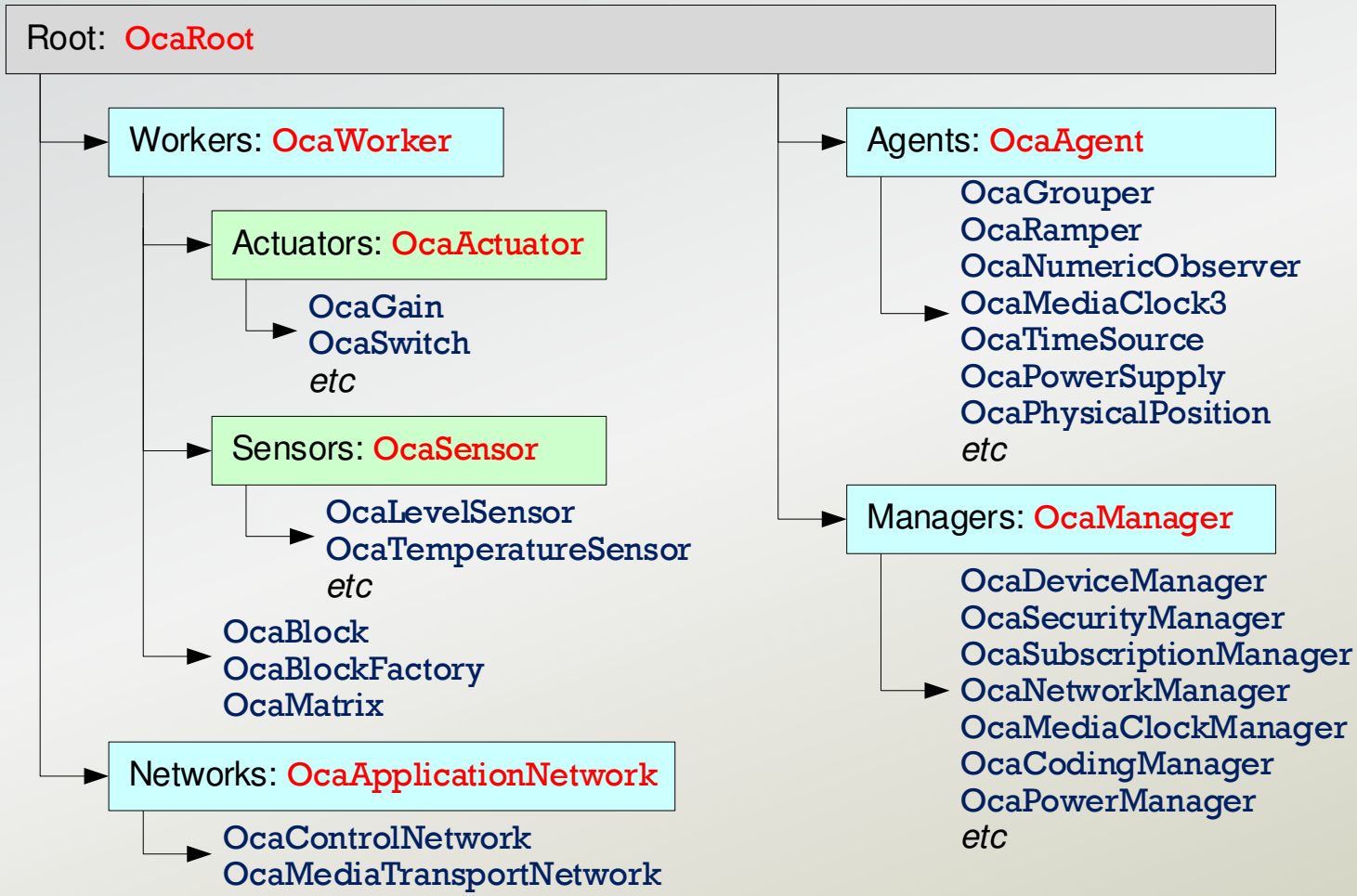
... and so on

Categories of Classes

Workers	*Classes that deal with audio processing*
Actuators	*Classes that control audio processing*
Sensors	*Classes that monitor the device*
Blocks and Matrices	*Classes that collect objects into organized groups*
Agents	*Classes that affect the flow and timing of control*
Networks	*Connection management classes*
Managers	*Device housekeeping classes*

Class Tree

Showing inheritance from base classes



Control Class Repertoire

Actuators

Classes that control audio processing

OcaActuator	*Base class for classes that control audio processing*
OcaMute	*Signal mute*
OcaPolarity	*Signal inversion*
OcaSwitch	*1 of n selector*
OcaGain	*Simple gain in dB*
OcaPanBalance	*Pan or balance control*
OcaDelay	*Signal delay in mSec*
OcaDelayExtended	*Signal delay in mSec, ft, m*
OcaFrequencyActuator	*Frequency*
OcaFilterClassical	*Bessel, Butterworth, etc.*
OcaFilterParametric	*Peaking or shelving parametric filter*
OcaFilterPolynomial	*Rational polynomial filter*
OcaFilterFIR	*FIR specified by coefficients*
OcaFilterArbitraryCurve	*Magnitude vs freq curve*
OcaDynamics	*Generalized compressor/expander*
OcaDynamicsDetector	*Side-chain detector*
OcaDynamicsCurve	*Dynamics input vs output level curve*
OcaSignalGenerator	*Multi-waveform signal generator*
OcaSignalInput	*Device signal input port*
OcaSignalOutput	*Device signal output port*
OcaTemperatureActuator	*Temperature parameter*
OcaIdentificationActuator	*Device identification light or other flag*

Elementary types

OcaBasicActuator	*Base class for weakly typed actuators*
OcaBooleanActuator	*Weakly typed actuators …*
OcaInt8Actuator	…
OcaInt16Actuator	…
OcaInt32Actuator	…
OcaInt64Actuator	…
OcaUint8Actuator	…
OcaUint16Actuator	…
OcaUint32Actuator	…
OcaUint64Actuator	…
OcaFloat32Actuator	…
OcaFloat64Actuator	…
OcaStringActuator	…
OcaBitStringActuator	…

Sensors

Classes that monitor the device

OcaSensor	*Base class for classes that monitor the device*
OcaLevelSensor	*Signal level*
OcaAudioLevelSensor	*Audio level with standard meter laws*
OcaTimeIntervalSensor	*Time interval*
OcaFrequencySensor	*Frequency*
OcaTemperatureSensor	*Temperature*
OcaIdentificationSensor	*Monitors a button push or something*
OcaBasicSensor	*Base class for weakly typed sensors for general use*
OcaBooleanSensor	...
OcaInt8Sensor	...
OcaInt16Sensor	...
OcaInt32Sensor	...
OcaInt64Sensor	...
OcaUint8Sensor	...
OcaUint16Sensor	...
OcaUint32Sensor	...
OcaUint64Sensor	...
OcaFloat32Sensor	...
OcaFloat64Sensor	...
OcaStringSensor	...
OcaBitStringSensor	...

Blocks, Matrices, and Networks

Blocks	***Classes that allow grouping of device control elements***
OcaBlock	*Container that allows collection of Workers, Agents, and Networks into organized groups*
OcaBlockFactory	*Constructor for OcaBlock objects; to be used with dynamically-reconfigurable DSP devices*

Matrices	***Class for managing rectangular arrays of objects***
OcaMatrix	*Specialized container for 2-dimensional arrays of processing elements; superset of conventional gain matrix.*

Networks	***Connection management classes***
OcaApplicationNetwork	*Abstract base class for other network classes*
OcaControlNetwork	*Application network for transport of control traffic (e.g. an AES70 network)*
OcaMediaTransportNetwork	*Application network for transport of media content (e.g. an AES67 network); connection management features*

Agents

OcaAgent	*Base class for agent classes*
OcaGrouper	*Control aggregator*
OcaRamper	*Time interval*
OcaNumericObserver	*Frequency*
OcaNumericObserverList	*Temperature*
OcaPowerSupply	*Power supply or battery*
OcaMediaClock3	*Media clock*
OcaTimeSource	*Time reference - PTP, GPS, internal clock, etc.*
OcaPhysicalPosition	*Six-axis position & orientation in various formats*

Managers

OcaManagers	*Base class for manager classes*	
OcaDeviceManager	*Manages global device identification & status*	*required*
OcaSubscriptionManager	*Manages controllers' subscriptions to events*	*required*
OcaSecurityManager	*Manages encryption keys*	*required for secure devices*
OcaNetworkManager	*Collects media transport and control networks*	*required*
OcaMediaClockManager	*Collects OcaMediaClock3 objects*	*optional*
OcaDeviceTimeManager	*Holds master device time*	*optional*
OcaCodingManager	*Manages codecs*	*optional*
OcaLibraryManager	*Collects OcaLibrary objects*	*optional*
OcaTaskManager	*Manages and runs OCA Tasks*	*optional*
OcaAudioProcessingManager	*Contains global audio processing options*	*optional*
OcaFirmwareManager	*Provides a failsafe firmware upload feature*	*optional*
OcaDiagnosticManager	*Base class for proprietary debugging features*	*optional*

Mechanism Details

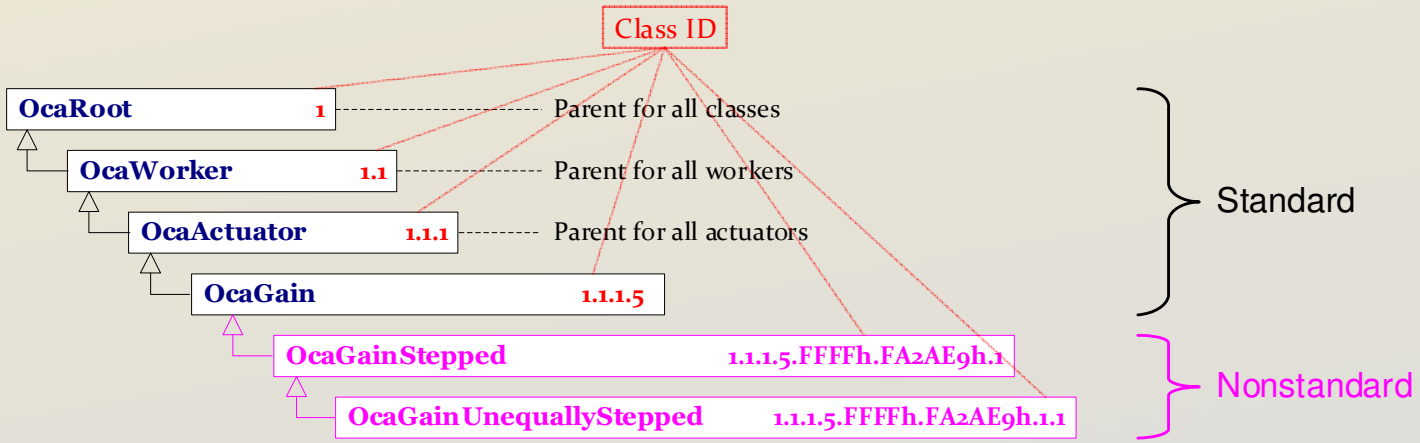
ClassIDs

- A **ClassID** is a multifield data structure that uniquely identifies a class.
- Each **ClassID** has an associated version number.
- The **ClassID** design allows graceful extension for:
  - future evolution of OCA
  - inclusion of proprietary classes
- **Format**
  - **ClassID** ::= {i_1.i_2.i_3. ...} where i_n is a nonzero positive integer called a **class index**.
  - A class index uniquely identifies a class within its siblings at a particular level of the class tree.
  - A class's ClassID is an ordered set of class indices that identify the entire lineage of the class, beginning with the root class **OcaRoot**, whose class index is always 1.
  - For example, a ClassID value of **1.2.12.7** is interpreted as follows:
    - 1 designates the root class.
    - 1.2 designates the second child of the root class.
    - 1.2.12 designates the twelfth child of the class whose parent is 1.2.
    - 1.2.12.7 designates the seventh child of the class whose parent is 1.2.12.

Class IDs, continued

- **Nonstandard Class IDs**
  - A **nonstandard class** is either a proprietary class or a public class defined by someone other than the AES.
  - Nonstandard classes are treated as custom extensions of the standard OCA class hierarchy.
  - The organization responsible for the definition of a nonstandard class is called the class's **authority.**
  - A nonstandard class must be defined either as a child of standard class or a child of a nonstandard class from the same authority.
  - In Class IDs of nonstandard classes, an **authority key** is interposed at the point of inheritance to identify the defining authority.
    - In such Class IDs, every class index to the right of the authority key is considered to be nonstandard.
  - Authority keys are IEEE 24-bit public CID (Company ID) or OUI (Organizationally Unique Identifier) values.
    - OUIs are used by companies who define MAC addresses
    - CIDs are used by companies who don't define MAC addresses
    - The address spaces of the two do not overlap.

Class ID Example



1.1.1.5.FFFFh.FA2AE9h.1
1.1.1.5.FFFFh.FA2AE9h.1.1

OcaGain | Flag | Authority ID | Nonstandard Class Indices

indicates next field is an Authority ID

Blocks

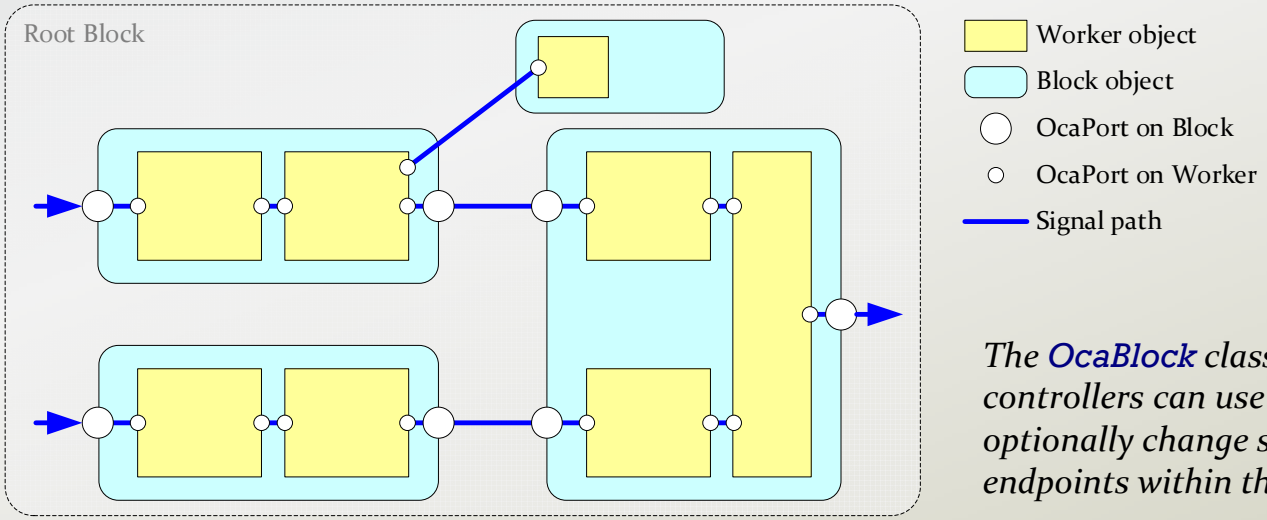
- A Block is an instance of the **OcaBlock** class.
- Blocks
  - Collect objects into meaningful groupings.
  - Keep track of how signals flow among the objects they contain.
  - Support construction and destruction of objects in dynamically-configurable devices.
  - Contain a re-use mechanism to allow a block's definition to be used in multiple instances.
- Every object except Manager objects belongs to exactly one block.
- Blocks **do not** provide control aggregation (mastering, submastering, ganging, grouping, etc.) features.
  - For these features, see Control Aggregation and Matrices.
  - Control aggregation topologies and matrix structures are independent of block membership.
- Blocks may be nested to any depth.

Blocks, continued

- Blocks are **Workers**. Therefore, each block has
  - an object number
  - an alphanumeric **roleName** property
  - **OcaPorts** for signals flowing into and out of the block. See Signal Flow for an explanation of OCA signal flows.
- Each block has an optional organizationally unique **blockType** property
  - Manufacturers may use **blockType** values to identify common block definitions for reuse in multiple products.
  - Standards organizations and trade associations may use **blockType** to identify recommended device and module profiles.
- Each block has object enumeration and search capabilities that
  - allow controllers to enumerate all objects in the block (and, optionally) in nested blocks as well
  - allow controllers to find objects in the block with given **roleName** values.
- At a minimum, each device must contain one block (the root block) to which all objects belong (except Managers).
  - More advanced devices will have multiple nested blocks.

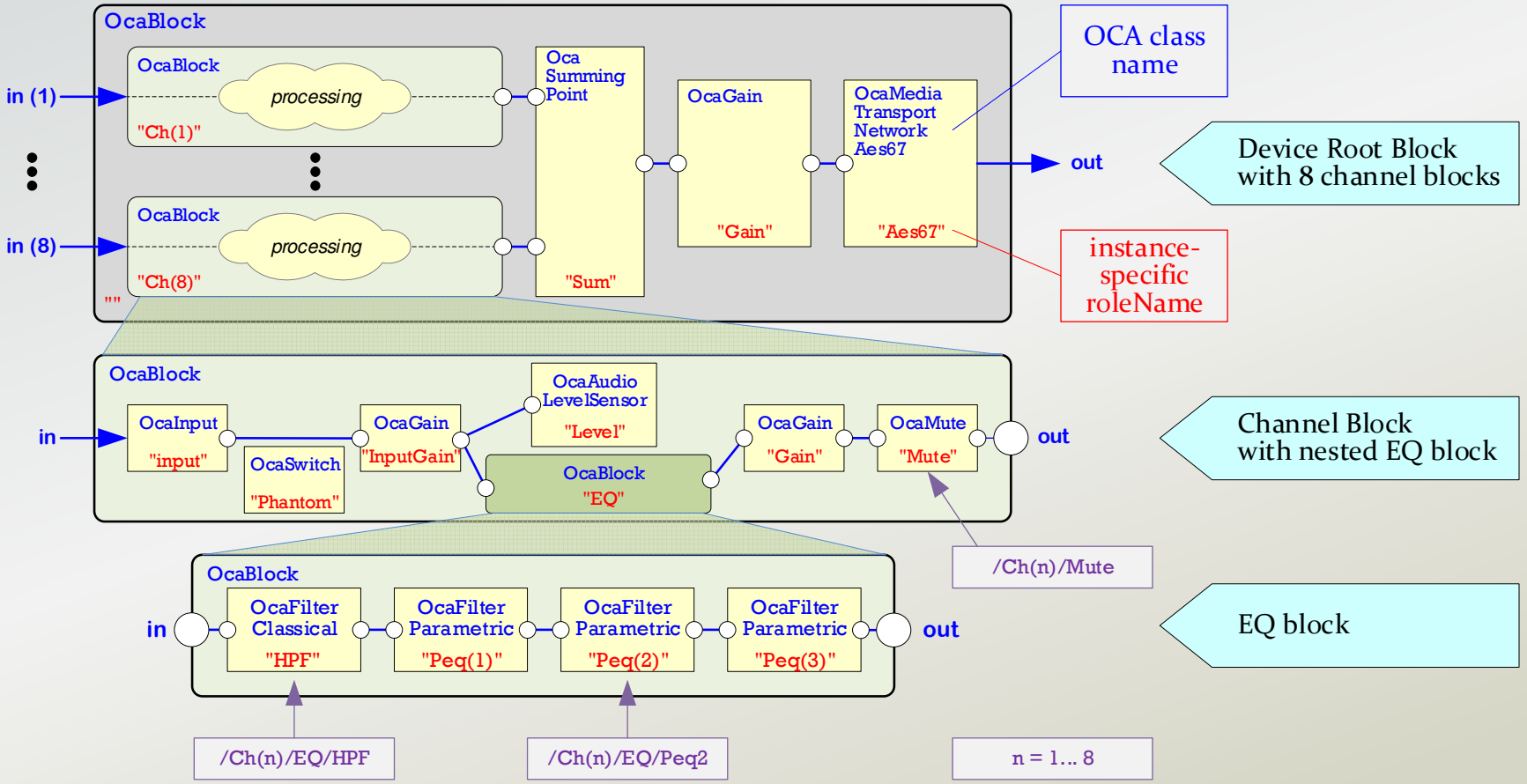
Blocks and signal flow

- The OCA model represent signal paths through a block via the **Signal Flow** mechanism.
- A block's **Signal Flow** is its set of **Signal Paths**.
- Each signal path is a one-to-one connection from a source **OcaPort** to a sink **OcaPort**.
- An **OcaPort** is a signal path endpoint on a Worker object.
- **OcaBlock** objects, since they are Workers, have **OcaPorts**. These ports are used for inter-block signal paths.
- Agent objects do not have **OcaPorts**, since they do not perform signal processing or sensing.



*The **OcaBlock** class defines methods controllers can use to enumerate and optionally change signal paths that have endpoints within the block.*

Block example



eight-channel mono-out mic preamp with AES67 output

Blocks and paths

- Manufacturers should choose **roleName** values that are unique within the objects' containing blocks.
- If this is done, then an an object may be identified by a **pathname** that consists of the concatenation of the object's name with the names of its containing block(s).
  - The OCA model does not assume any specific pathname syntax - it represents paths simply as lists of **roleNames**.
  - If we choose to write pathnames as delimited concatenations of names and use "/" as a delimiter, then with an appropriate name syntax discipline, pathnames can be used to construct URI strings.
- By convention, the root block has a null pathname.
- Examples of pathnames using "/" as a delimiter (these correspond to the mixer example on the previous slide):

/Gain	Master gain
/Ch(2)/Mute	Channel 2 mute
/Ch(4)/EQ/Peq(3)	Channel 4's third parametric equalizer

Block enumeration

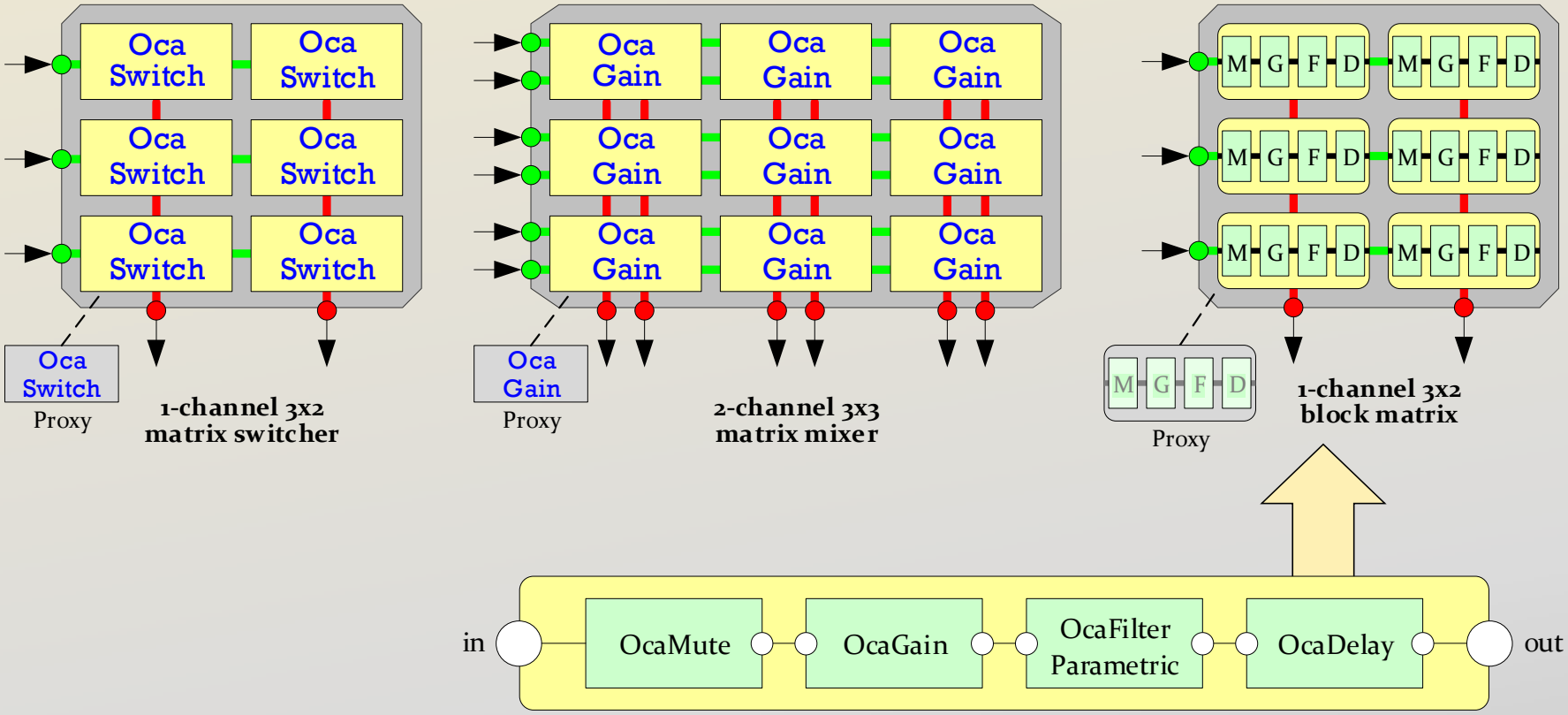
"Block enumeration" features allow a controller discovers what's inside a block, or a nest of blocks.

1. **Objects**. To discover the **objects** inside a block, a controller calls one of two OcaBlock methods:
   - GetMembers(BlockONo) Returns list of all objects in the given block.
   - GetMembersRecursive(BlockONo) Returns list of all objects in the given block and in all contained blocks.
2. **Signal flow.** To discover the **signal flow** inside a block, a controller calls one of two OcaBlock methods:
   - GetSignalPaths(BlockONo) Returns all signal paths with at least one endpoint in given block.
   - GetSignalPathsRecursive(BlockONo) Returns all signal paths with at least one endpoint in given block or in any contained block.

Matrices

- A Matrix is an instance of the **OcaMatrix** class.
- Matrices collect sets of identical Worker objects ("crosspoints") into 2-dimensional arrays.
  - A crosspoint may be any kind of OCA object, including an entire **OcaGroup** with multiple objects inside.
  - All crosspoints of a given Matrix must reside in the same device.
- Crosspoints may be accessed:
  - one at a time
  - one row at a time,
  - one column at a time, or
  - one whole matrix at a time
- Matrix objects are controlled via an auxiliary object called the **matrix proxy**.
  - The matrix proxy is identical to a crosspoint object.
  - Calls to the proxy affect one or more crosspoints at once.
  - Which crosspoints are affected is determined by **OcaMatrix** methods called **SetXY(...)** and **SetXYLock(...)**.
- Matrices support multichannel operation, with each crosspoint accepting (n) input signals and delivering (m) output signals.

Matrix examples



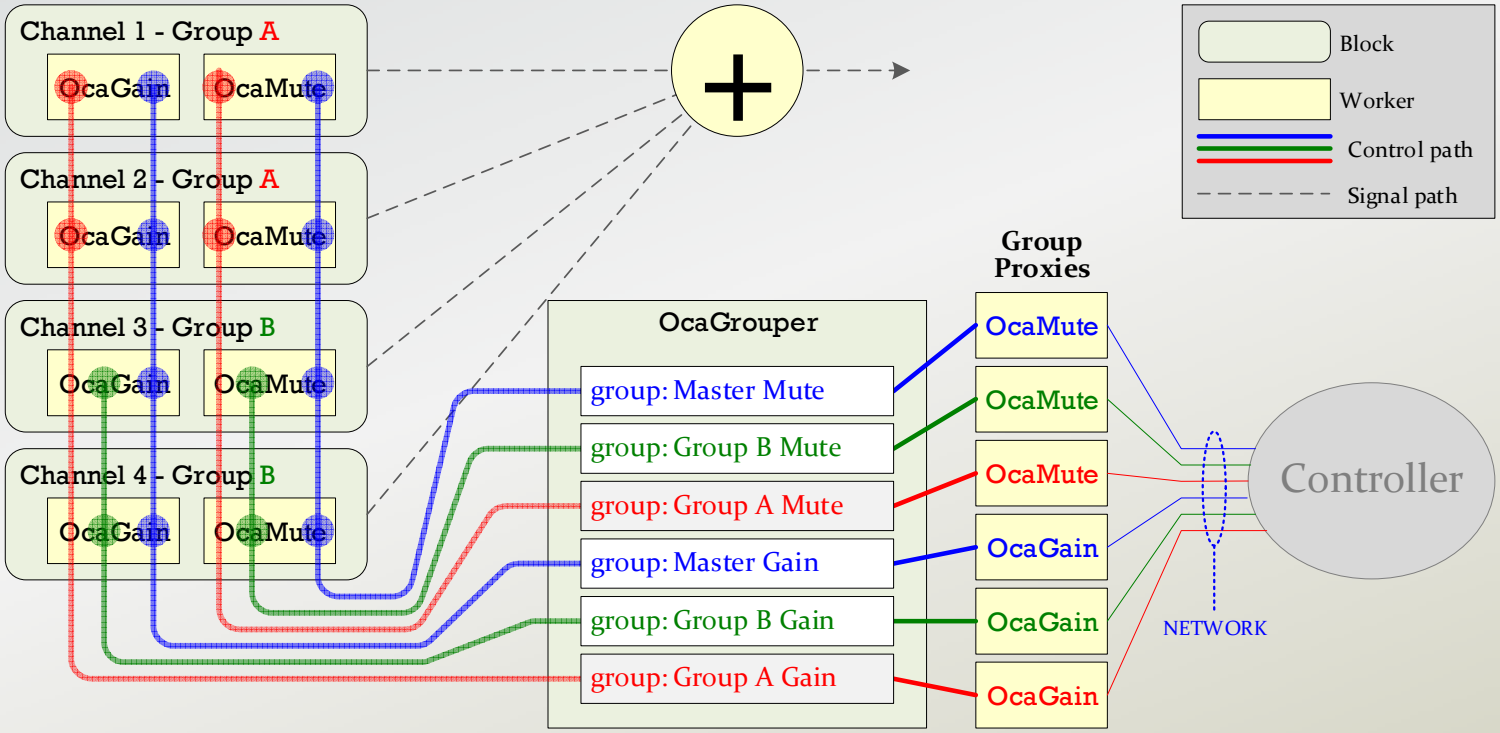
Control aggregation (grouping, mastering, submastering, and so on)

- Control aggregation is performed by objects of the OcaGrouper class.
- Each aggregated set of objects is called a "group".
- Any kind of object may be grouped, but all members of any given group must be of the same class.
- Group membership is independent of block structure.
- An object may belong to more than one group.
- A single grouper object can support multiple groups.
- Grouped objects may be in the same device as a grouper or in external devices.
- Groups are controlled by special objects called "group proxies", whose properties mirror the group's settings.

Example - next slide

Control aggregation example

- Four channel mixer, two mix groups



Dynamic configuration

- The **OcaBlock** class contains optional mechanisms that allow controllers to add and delete objects from **OcaBlock** instances.
- OCA supports the following levels of reconfigurability:

Fixed	The device has a permanently assigned object repertoire and signal-flow topology, defined at time of firmware programming.
Pluggable	The object repertoire and signal-flow topology of the device may be changed while the device is offline, by plugging and unplugging of hardware modules, adjustment of physical controls, reloading or readjustment of software, or other manual means.
Partially configurable	Controllers may change the signal-flow topology of the device while online.
Fully configurable	A superset of 'partially-configurable', with the addition that controllers may create and delete objects inside the device while online.

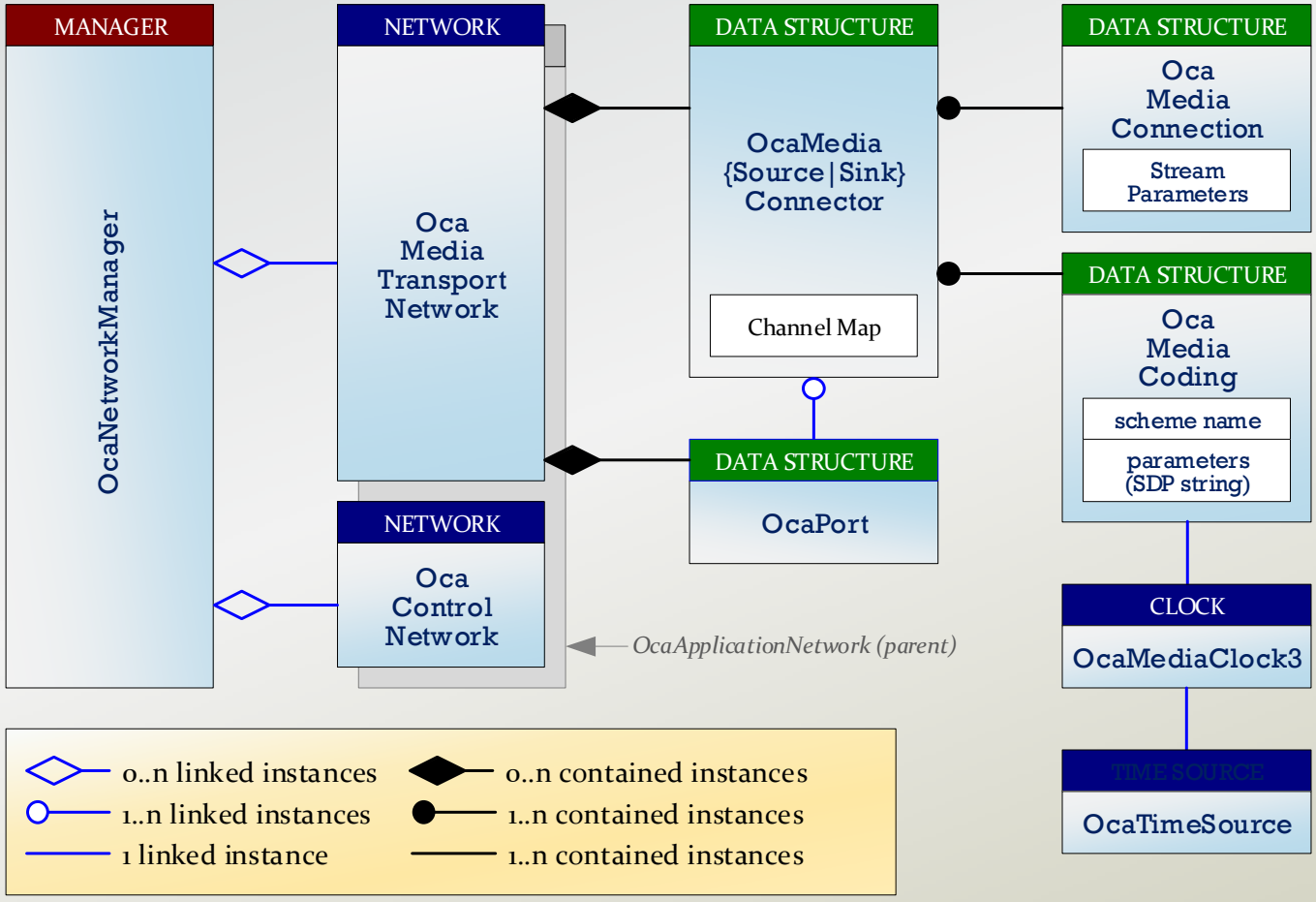
Connection management

- The OcaMediaTransportNetwork class and its associated set of datatypes define a comprehensive stream connection management capability named "CM3" that may be adapted to work with different media transport schemes.
- At present, CM3 adaptations exist or are being defined for:
  - AES67
  - ST 2110-31
  - Dante
  - AVB Milan
- CM3 supports
  - Multiple transport networks per device, not all of which need use the same media transport protocol
  - Multiple stream connections per transport network
  - Multichannel streams
  - Mapping of stream channels to internal **OcaPorts** (**OcaPort**, see Signal Flow, above)
  - Multiple coding schemes
  - Multiple clocking schemes
- Through normal OCA mechanisms, CM3 supports full monitoring and management of connection status.

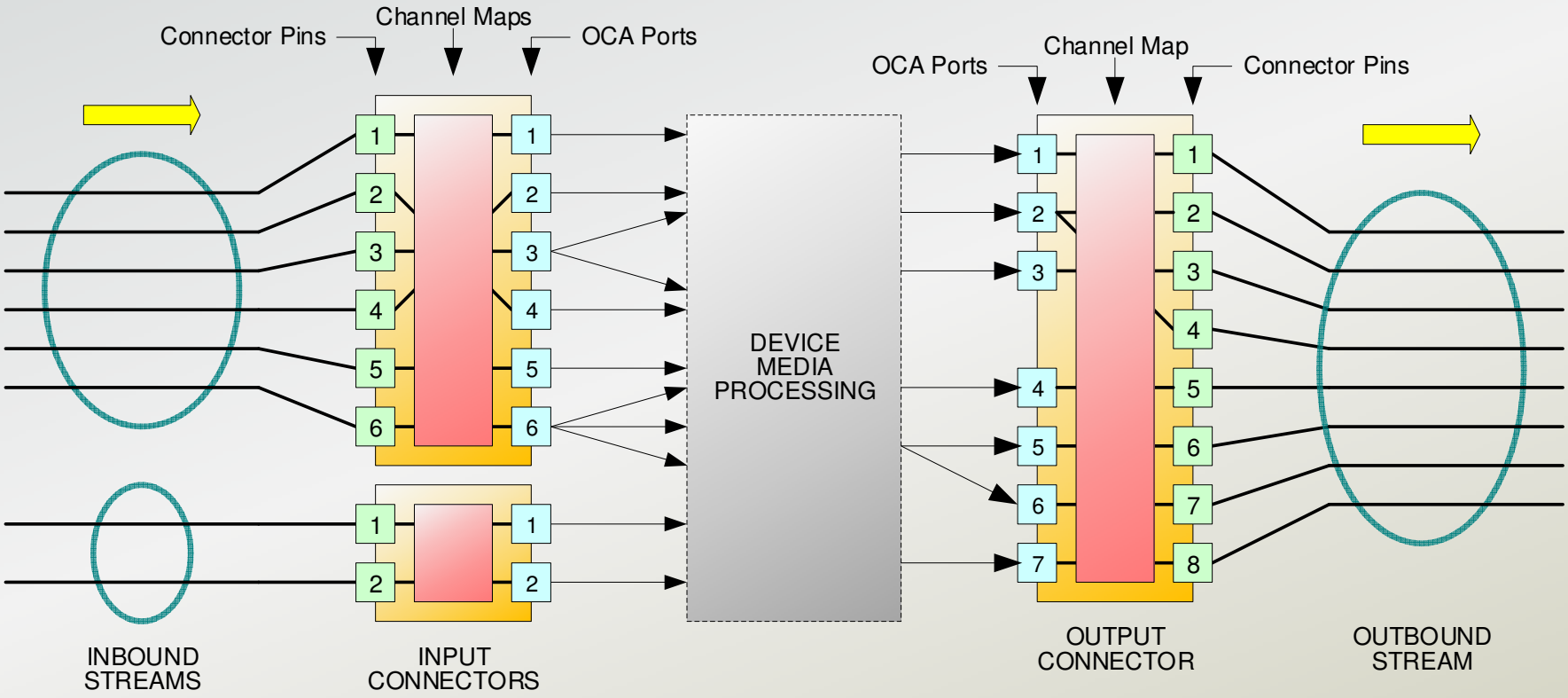
Connection management details

- A device has one or more *Application Network* objects:
  - An **OcaControlNetwork** object for AES70 traffic
  - Zero or more **OcaMediaTransportNetwork** objects for stream traffic
- Stream connections are controlled by a hierarchy of data structures inside the **OcaMediaTransportNetwork** object.
- The data structures (illustrated here) record:
  - source and endpoint names and addresses
  - sample clocking and coding information
  - mapping of stream signal channels to internal device signal paths (see illustration here)
  - transmission modes (unicast/multicast, secure/insecure)
  - endpoint digital reference levels
  - moment-to-moment status of the connection
  - … and whatever else may be required by specific media transport standards.
- Methods and events of **OcaMediaTransportNetwork** allow controllers to access these data structures and monitor their changes.

Connection management objects and data structures



Stream channel mapping



Connection management adaptations

- A connection management ***adaptation*** is a set of specialized classes inherited from the standard connection management classes.
- The adaptation classes customize the connection management mechanism to fit the special requirements of a particular media transport protocol.
- Adaptations are built according to the usual OCA inheritance rules, which ensure that specialized children of standard classes are maximally compatible with their parents.
- At present, adaptations are planned or are being developed for the following media transport protocols:
  - AES AES67
  - SMPTE ST 2110-30
  - AVnu Milan
  - Audinate Dante

Time and clocking

- The **OcaTimeSource** object manages an external or internal time reference. Multiple **OcaTimeSource** objects may be configured into devices that deal with multiple time references.
- The **OcaMediaClock3** object manages a device media clock source. Multiple **OcaMediaClock3** objects may be configured into devices that deal with multiple clock rates, phases, references, etcetera. When an **OcaMediaClock3** object is synced to an external reference, it links to the **OcaTimeSource** object that describes that reference.
- In OCA connection management, each stream connection is linked to an OcaMediaClock3 object. If all streams have common clocks, the connections will all link to the same **OcaMediaClock3** object. If not, various streams will link to various **OcaMediaClock3** objects as required.
- The device's time of day value is held by the **OcaDeviceTimeManager** object. If the object's time-of-day value is synced to an external reference, the **OcaDeviceTimeManager** object is linked to an **OcaTimeSource** object that describes the reference source.

Scripting

- The **OcaTaskManager** class provides the ability to run predefined scripts and script-like processes.
- OCA does not specify a scripting language - it stores scripts as featureless executables called **Programs.**
  - The device's collection of programs is called its **Program Library**.
  - Controllers may add and delete programs to the **Program Library.**
- **Programs** are executed by OCA **Tasks**.
  - **Tasks** are set up and controlled by the **OcaTaskManager** object.
  - The permissible number of simultaneously-running **Tasks** is limited only by the implementation.
  - A **Task's** execution may begin immediately upon controller request, or may be scheduled for a future time.
- **OcaTaskManager** provides full monitoring and control of task execution.

Libraries

- The **OcaLibrary** and **OcaLibraryManager** classes define a mechanism for storing and recalling predefined device configurations.
  - Using these classes, controllers can upload predefined device configurations or partial configurations into OCA constructs called **libraries**.
  - Subsequently, controllers can recall these configurations into **OcaBlocks** using the **OcaBlock** method **ApplyParamSet(...)**.
- OCA does not define the formats or contents of prestored configurations. Such formats are considered to be implementation-dependent. The library mechanism manages the configuration datasets as featureless binary objects.
- The library mechanism can be used for other purposes besides the management of prestored configurations.
  - Libraries are used to store **Programs** for **OcaTasks** to run - see Scripting.
  - Manufacturers may define their own library types to store device-specific data.

Physical position

- The **OcaPhysicalPosition** class provides a way to control and/or monitor the physical position of the device and/or physical or virtual elements within the device. For example:
  - An **OcaPhysicalPosition** object could monitor the physical location of a GPS-equipped device; or
  - An **OcaPhysicalPosition** object could control the virtual location of a sound object in an object-oriented mixing system.

- **OcaPhysicalPosition** supports up to six position coordinates in any of the following coordinate systems:
  1. Six-axis robotic coordinates - (x, y, z) and three rotational angles;
  2. Four object-based audio systems as specified by ITU object based audio per ITU-R BS.2076-1, section 8;
  3. Three-axis terrestrial navigation coordinates as used by GPS and other satellite systems.
  4. Proprietary systems as may be specified by manufacturers.

Device model

Base object configuration of all OCA devices.

Device Model

REQUIRED MANAGERS

Device Manager
Manages information relevant to the whole device.

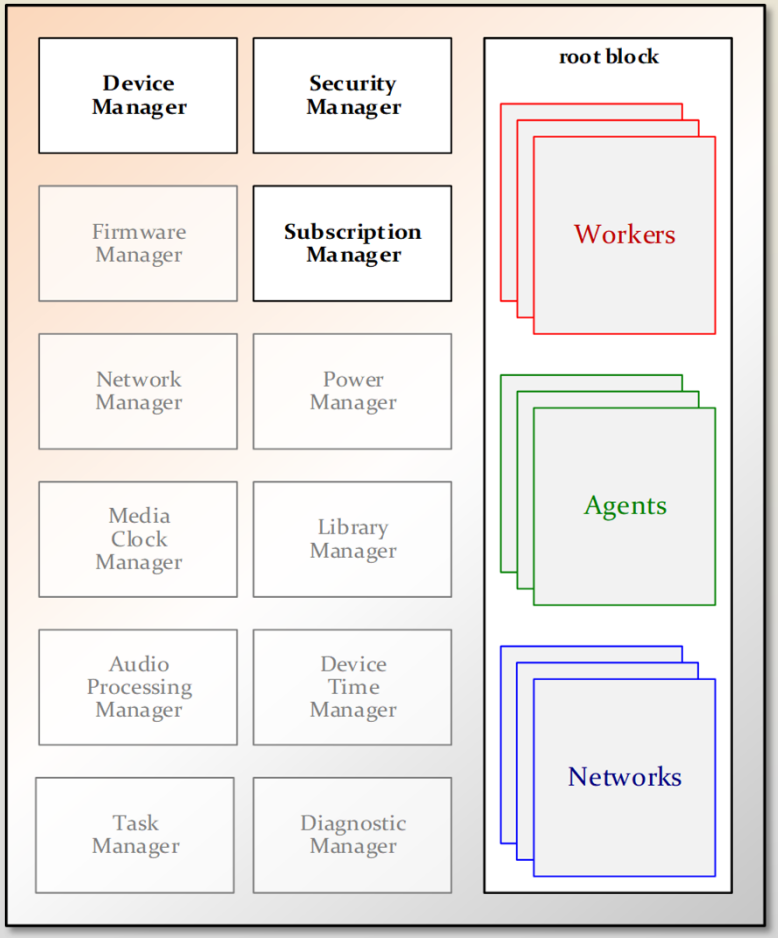
Security Manager
Manages security keys.

Subscription Manager
Manages event subscriptions.

ENUMERATION

Controllers can discover what Managers the device implements by retrieving the Device Manager property **Managers**.

Controllers can discover what Workers, Agents, and Networks the device implements by enumerating the root block.



OPTIONAL MANAGERS

Power Manager
Manages power supplies and batteries.

Firmware Manager
Manages firmware versions and, optionally, updates.

Network Manager
Manages connection(s) to network(s).

Media Clock Manager
Manages media clocks.

Library Manager
Manages stored parameter settings.

Audio Processing Manager
Holds global signal processing parameters.

Power Manager
Manages power supplies and batteries.

Device Time Manager
Manages time reference objects.

Task Manager
Manages stored processing sequences.

Diagnostic Manager
Offers features to help installation and setup.

Design example

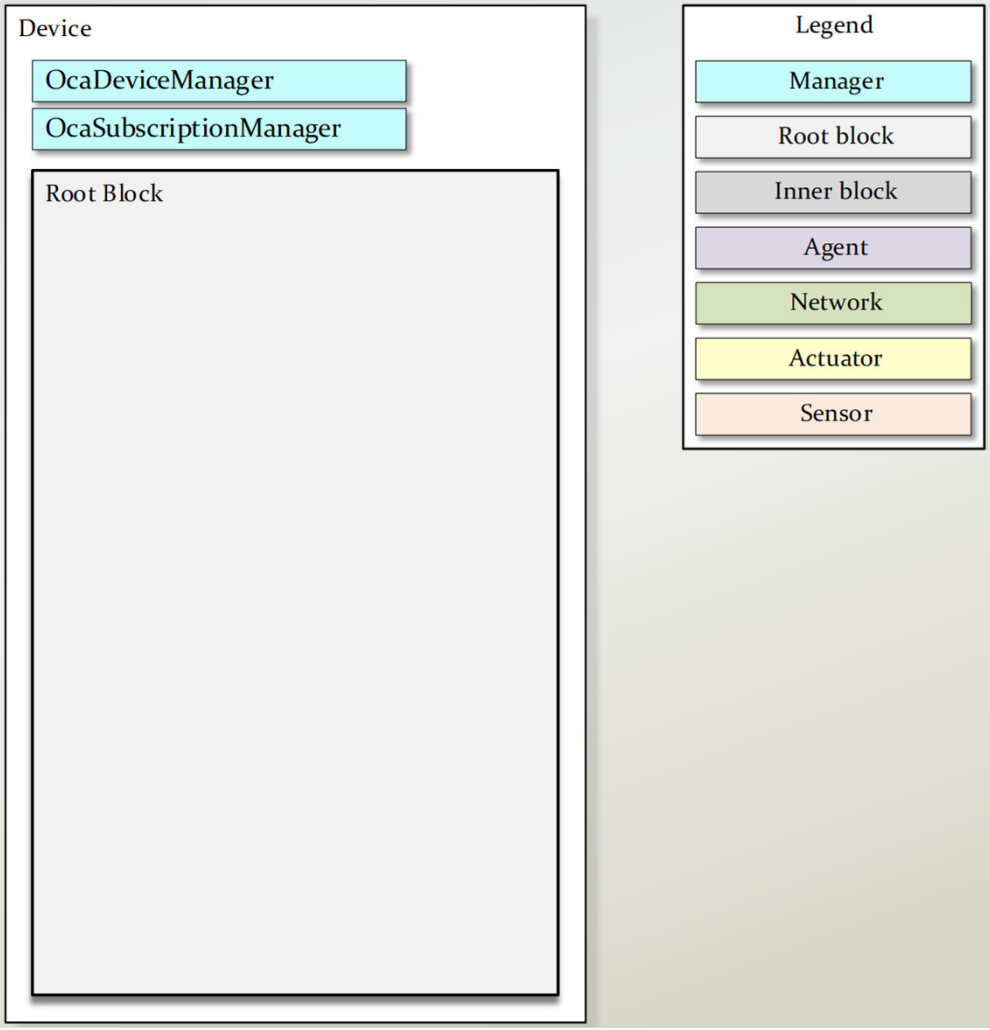
8-channel mic preamp

Eight-channel mic preamp

- 8 analogue inputs, switchable line/mic level
- Each input with phantom power, high-pass filter, and polarity switch
- AES67 output

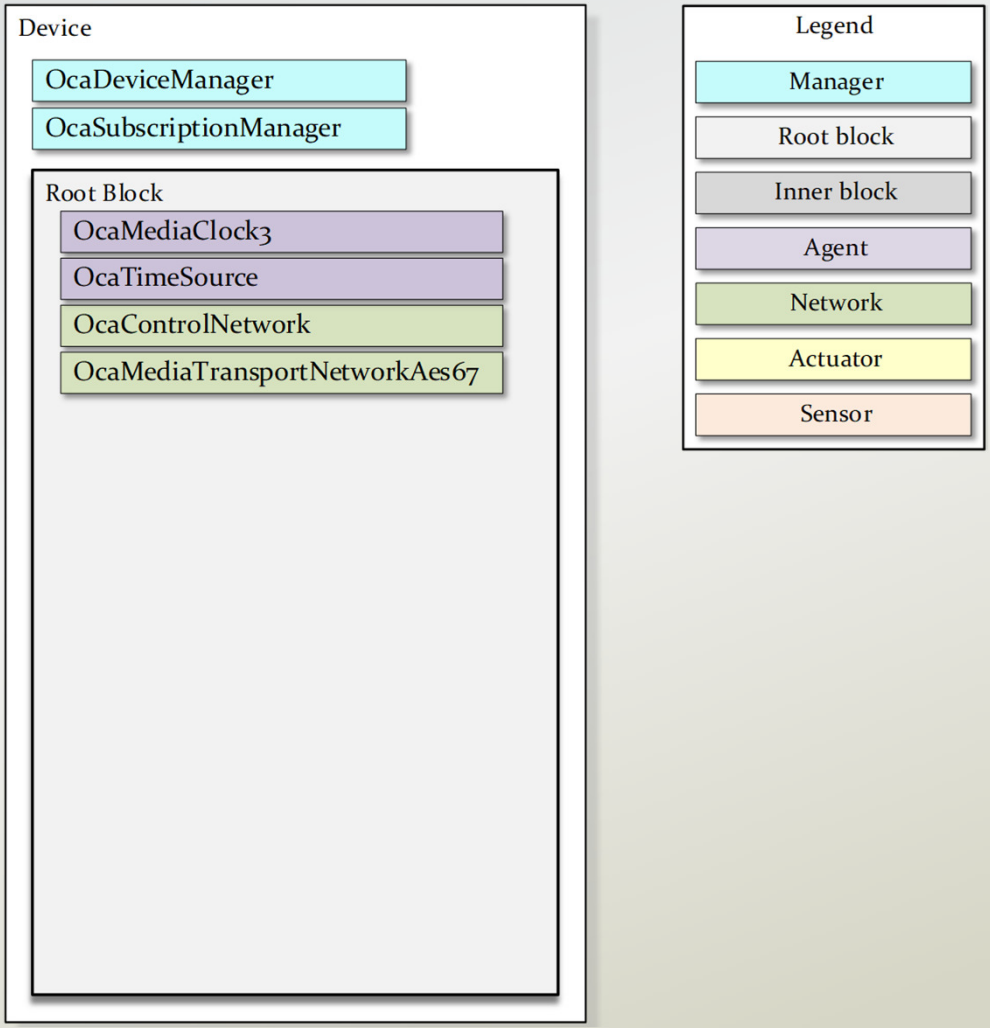
Start

- Basic null device
- Compliant with AES70 minimum device specification



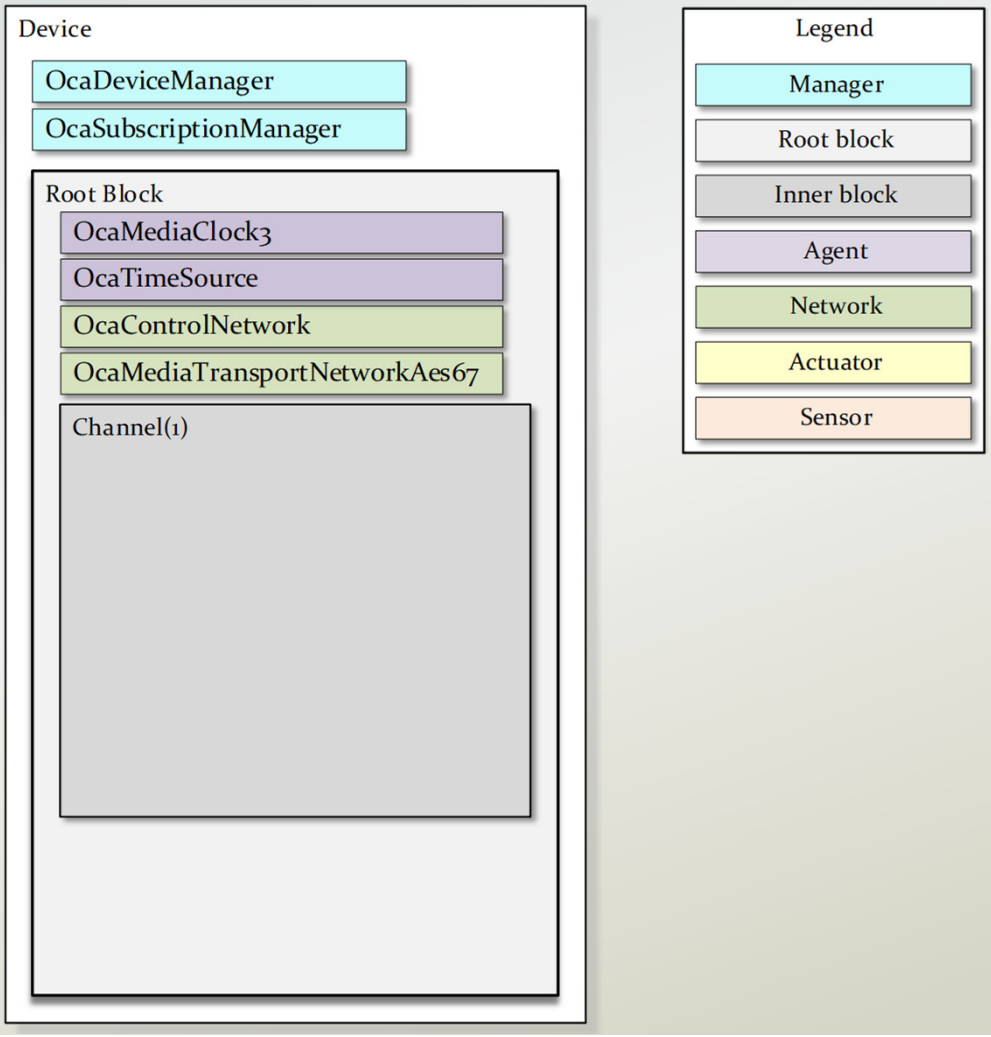
Add clocking and networking

- Clock object
- Control and AES67 media network objects



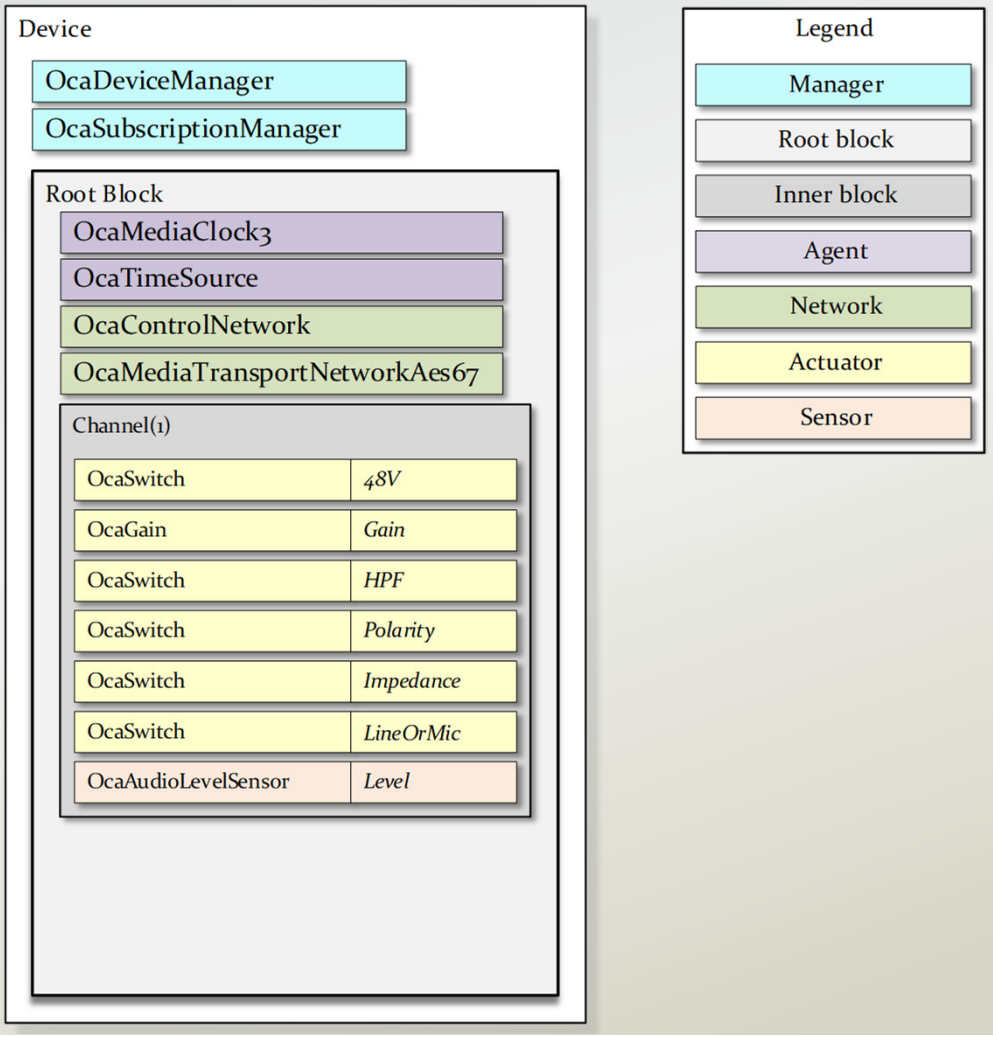
Add an audio channel block

- Inner **OcaBlock** object



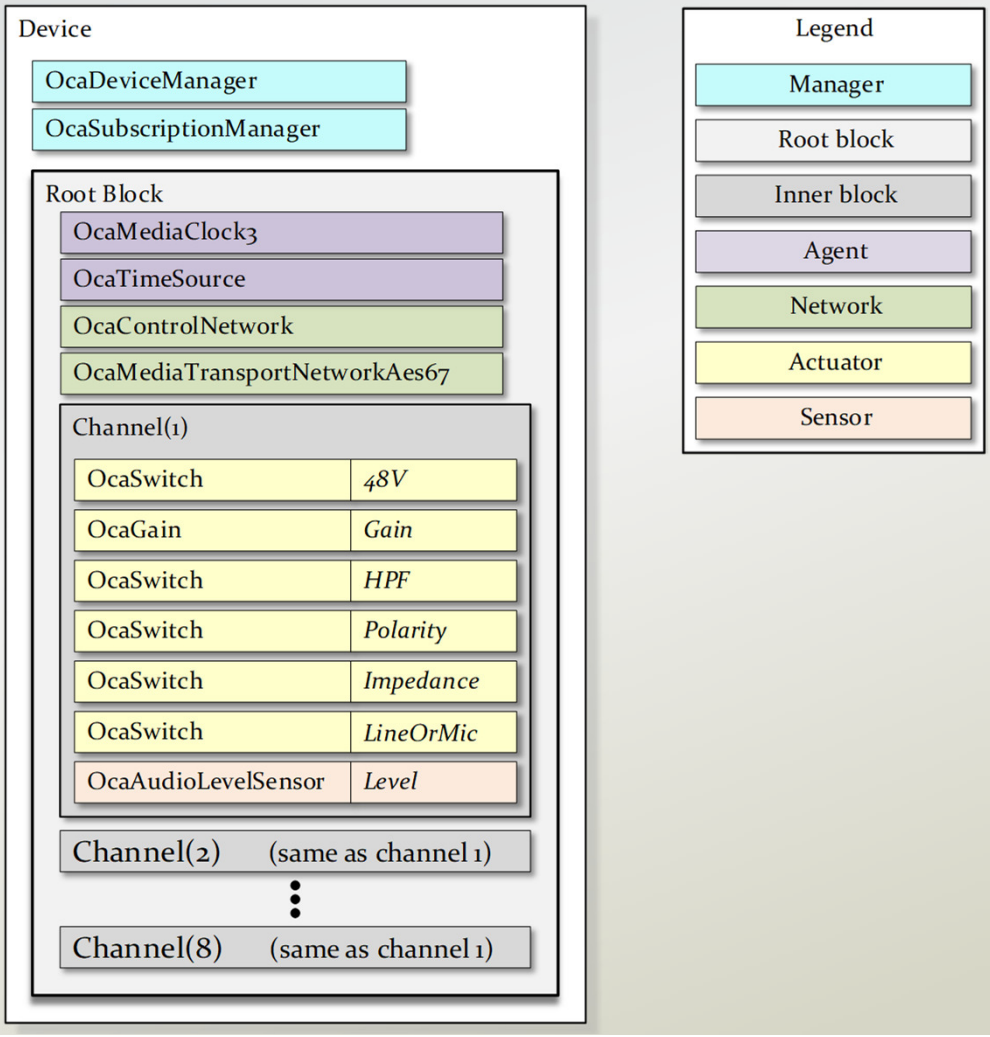
Populate the audio channel block

- Switch objects
- Gain control object
- Level monitor object



Replicate the audio channel block

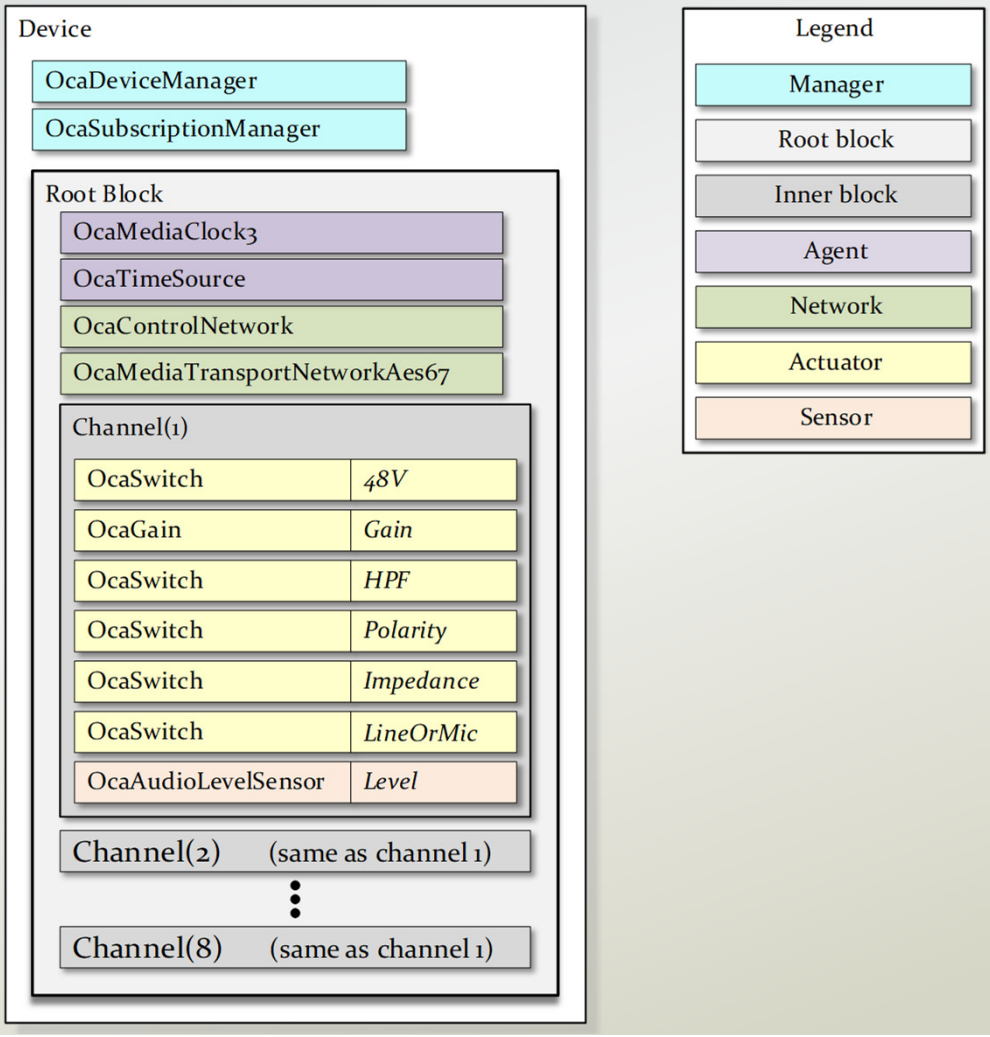
- Clone seven more channels.



Done!

What's the resulting device API?

- Each object publishes its own API.
- The device's complete control API is the union of all its objects' APIs.
- Each class's definition automatically implies a specific API definition - no further specification work is required.



Resources

The AES70 Standards Family

- **AES70-1** — OCA framework. Fundamental mechanisms. ~50 pages. Required reading to understand the OCA model.
- **AES70-2** — Class structure. The OCA object model. Details are in Annex A, a UML file.
- **AES70-3** — AES70 binary protocol ("OCP.1") for IP networks. Part of the AES protocol suite, but not part of the OCA object model.

Near future (*official names TBD*):

- **AES70-4** — AES70 JSON protocol ("OCP.2")
- **AES70-21** — AES70 connection management adaptation for AES67 and ST 2110-30 media transport protocols.
- **AES70-22** — AES70 connection management adaptation for the Milan AVB transport protocol.

Current version of AES70-1,2,3 is **2018**.

Updates are expected in 2020.

Sites

- https://ocaalliance.github.io/ aka the **AES70 Techsite**
  Free public technical resources *for AES70 developers.*
- http://ocaalliance.com/
  The usual sort of organizational website.

How to get AES70 standards documents

- **This page** on the AES70 Techsite has a guide to accessing the official AES70 standard.

The OCA Alliance

- The OCA Alliance is responsible for the technical content of OCA.
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