AES70
Object Model
- an introduction -

AES70 Object Model

Concepts

AES70 Object Model

What's in AES70

- An object-oriented framework for control interfaces that audio devices present to a data network;
- A standardized device object model for controllable devices;
- A rich and extensible repertoire of control class definitions (the **AES70 Object Model**) that represent the signal processing, control logic, and network connection functions of modern audio devices; a class may be thought of as an API for a particular function or set of functions.
- An application protocol called OCP.1 ("Open Control Protocol 1") that defines command and response formats and sequences for control and monitoring of OCA-compliant devices over IP networks. *OCP.1 is defined separately from the Object Model and is not described in this presentation.*

What's ***not*** in AES70

- Audio program transport;
- A programming model for OCA-compliant devices;
- A user interface definition or generation scheme for OCA-compliant devices;
- Standardized semantics for controllable elements (e.g. standard filter shapes);
- Standard device profiles (e.g. "standard mixer", "standard power amp").

AES70 defines the set of APIs a device exposes to the network.

AES70 Object Model

Objects

Categories of Control Objects

- **Managers** Standard housekeeping objects, mostly the same in every device.
- **Workers** Objects that correspond to audio processing control functions.
- **Agents** Devices that provide various control functions or modify the control command stream, but do not map directly to signal processing elements.
- **Networks** AES70's connection management feature set.

Elements of Control Objects

- **Properties** Variables that define the state of the object
- **Methods** Operators that change properties and cause actions
- **Events** Signals emitted by objects to indicate state changes
- **Object Number** (aka ONo) Unique identifier of object within the device

AES70 control objects are abstractions that define a device's network API. They may or may not correspond one-for-one with software or hardware elements of the device. For example, a master gain control object may in fact control several real gain-setting elements in the device.

AES70 Object Model

Classes

- Templates from which control objects are created.
- Every class is uniquely identified by a **class ID**, a structured identifier used in various ways throughout AES70.
- AES70 classes inherit elements in the standard object-oriented manner. Only simple inheritance is supported.
- The set of OCA classes (aka "AES70 Object Model aka "AES70 Class Tree" aka "OCC") defines AES70 's functional repertoire.
- The object model will evolve over time to accommodate new device types and new manufacturers.
- Object model inheritance rules create a constrained evolution regime that maximizes upward compatibility and ensures graceful evolution through orderly class specialization.
- Object model inheritance rules support the addition of proprietary classes to the class tree in a way that maximizes compatibility with the standard classes

AES70 Object Model

Events

- Event: transient state of an object that can cause it to send one or more event notification messages.
- Events have class-specific types. Each class may have a repertoire of events of various types.
- Event definitions are inherited.
- The most commonly used event is OcaPropertyChanged, an event that causes an object to emit a notification whenever a value of any of its properties changes.
  - OcaPropertyChanged is an event of the root class OcaRoot, and is therefore defined for all classes in the tree.
- Notifications are sent only to subscribing objects.
- Subscriptions are registered with and managed by the Subscription Manager.

AES70 Object Model

- summary -

Object Model Overview

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

Workers

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*

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

Workers

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	...

Workers

Blocks and Matrices	***Classes that allow grouping of device functions***
OcaBlock	*Container for Workers, Agents, and Networks that defines a related set of device functions*
OcaBlockFactory	*Constructor for OcaBlock objects; to be used with dynamically-reconfigurable DSP devices*
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)*

AES70 Object Model

AES70 Device Model

The AES70 Device Model is a deployment of objects defined by classes in the AES70 Object Model. It defines the basic object configuration of all AES70-compliant devices. In practice, other objects will be instantiated from the Object Model to represent the specific functions of each device.

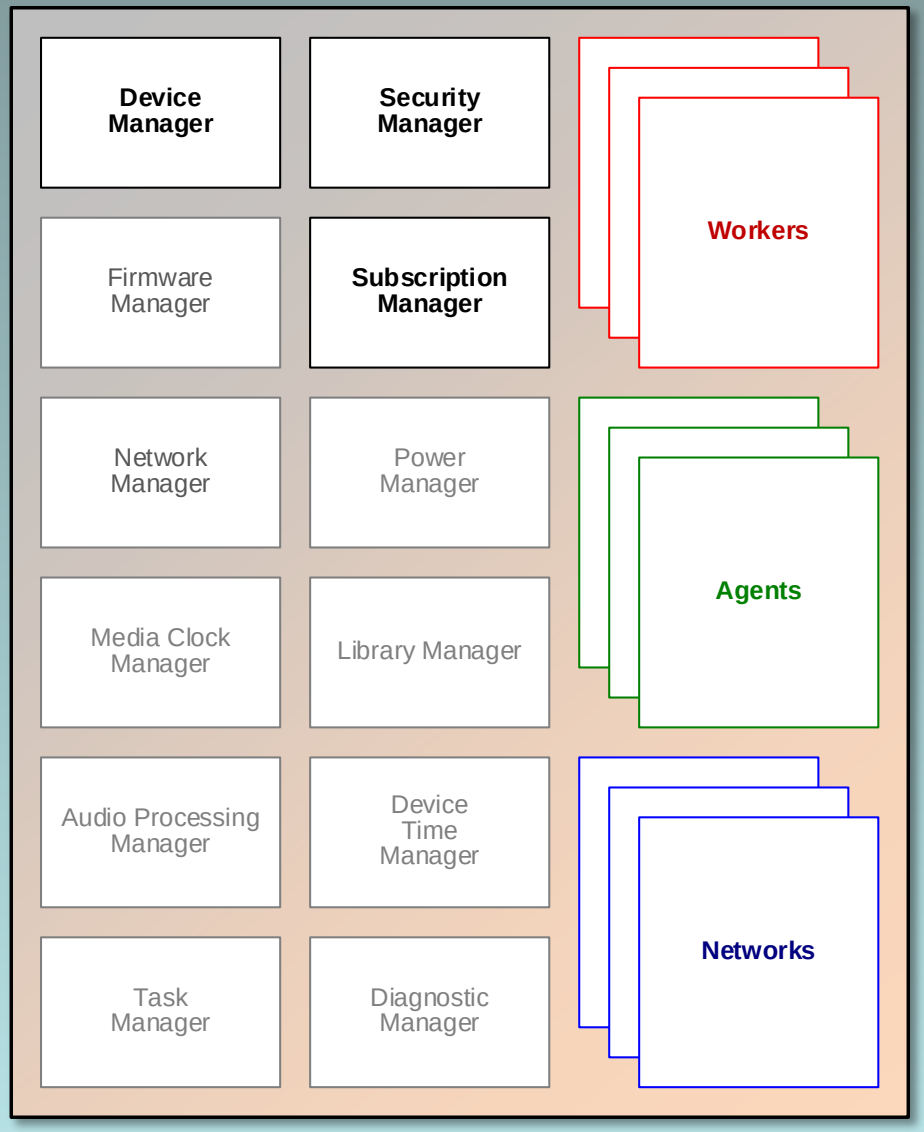
Device Model

REQUIRED MANAGERS

Device Manager
Manages information relevant to the whole device.

Security Manager
Manages security keys.

Subscription Manager
Manages event subscriptions.



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.

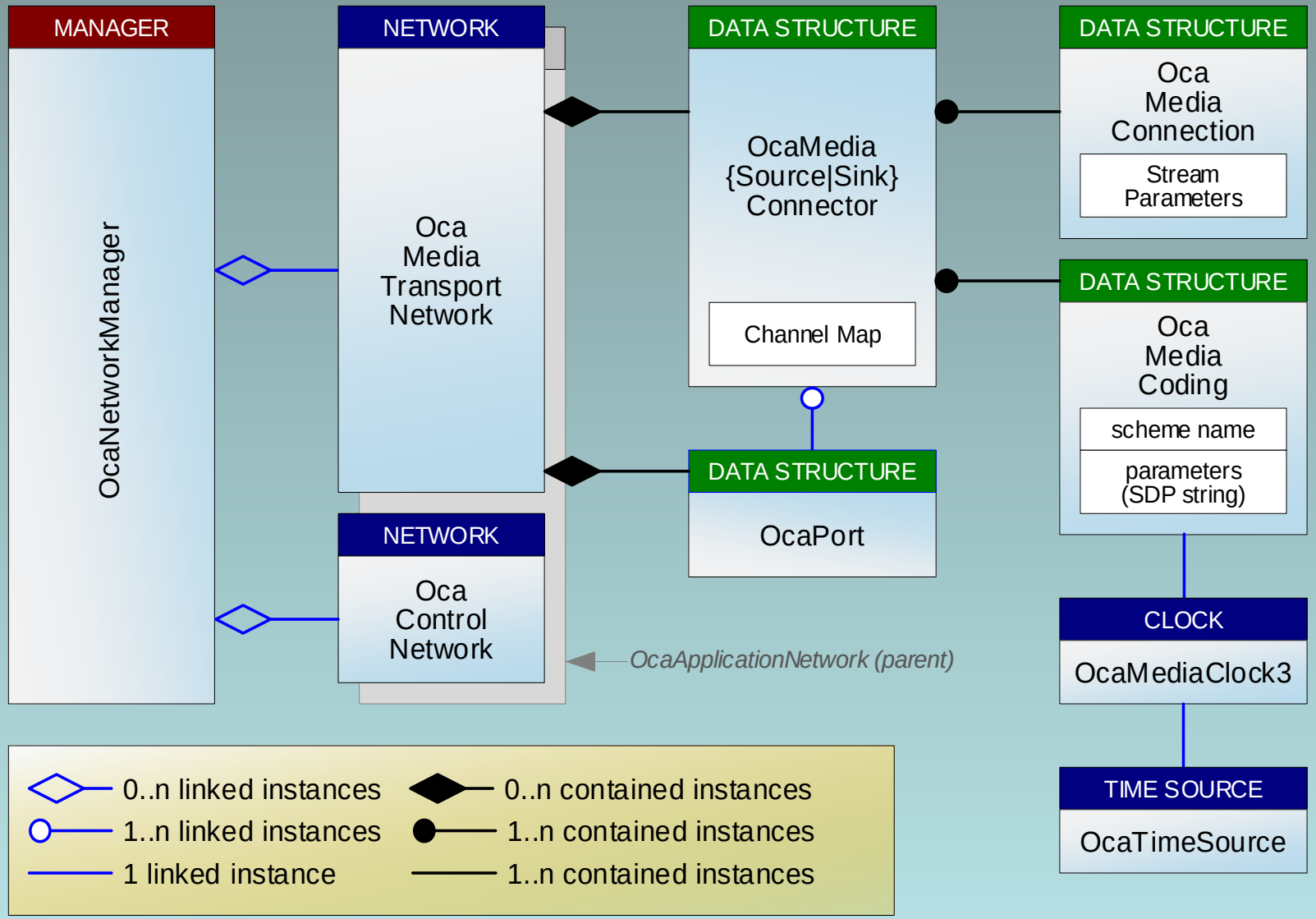
Task Manager
Manages stored processing sequences.

Diagnostic Manager
Offers features to help installation and setup.

AES70 Connection Management 3 (CM3)

AES70 Connection Management 3, or CM3, is a set of classes defined in the AES70 Object Model that support the use of AES70 for managing stream data connections.

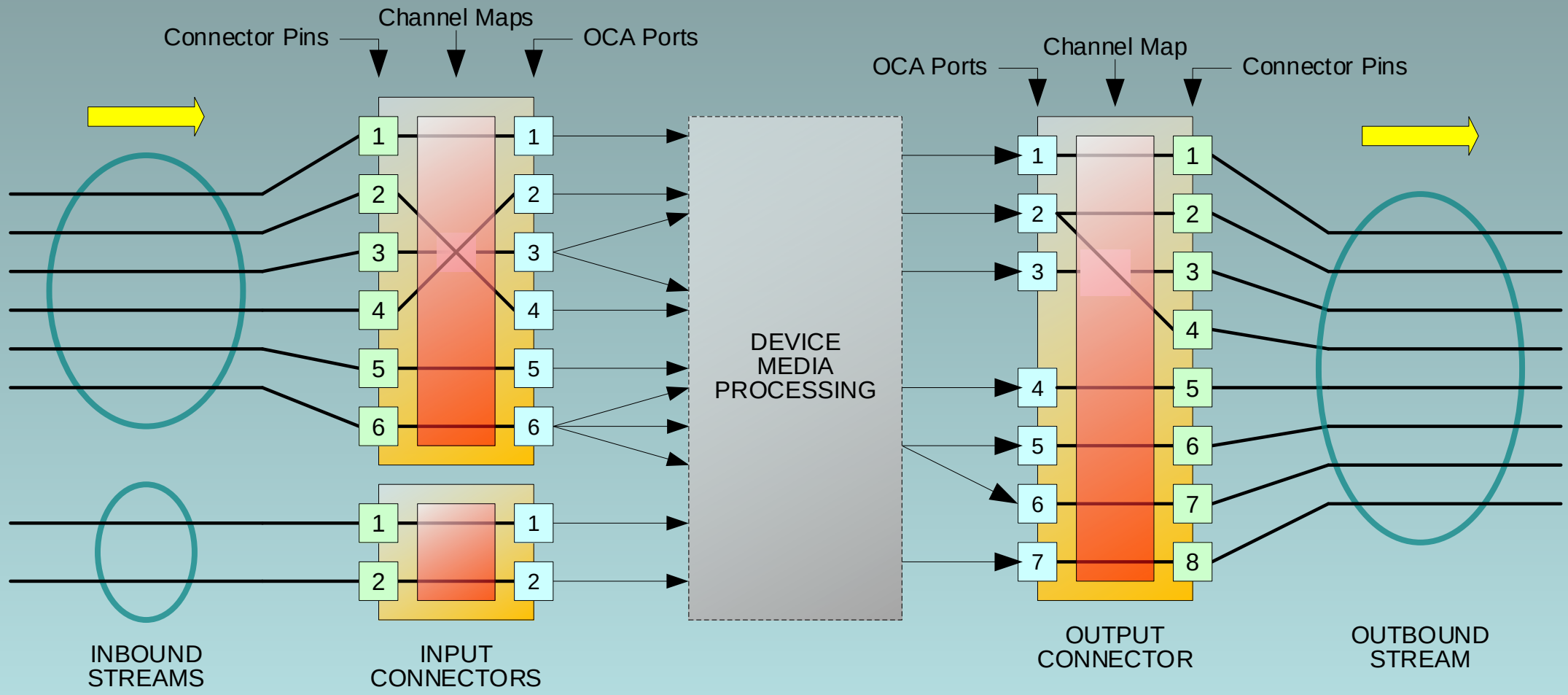
CM3 object model (part of AES70 Object Model)



AES70 Object Model

- A device has **Application Network** objects
  - An OcaControlNetwork object for AES70 traffic
  - One or more OcaMediaTransportNetwork objects for stream traffic
    - Each OcaMediaTransportNetwork object has one or more OcaMediaConnector control blocks that describe stream connection endpoints.
      - Each OcaMediaConnector contains
        - » an OcaMediaConnection control block that contains
          - » connection parameters
          - » a secure-connection flag
        - » the Channel Map that associates stream channels with device channels
        - » the connector's Alignment Gain value
        - » an OcaMediaCoding control block that
          - » identifies and parameterizes the codec being used
          - » links to an OcaMediaClock3 clocking object
            - » the OcaMediaClock3 object links to an OcaTimeSource object

CM3 in action



AES70 Object Model

AES70 Resources

Sites

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

Implementations and tools available through the Techsite

- OCA Microdemo
  A free AES70 implementation, including hardware designs for a small demo PCB. Unencumbered, fully usable for commercial purposes.
- Focusrite Rednet OCA Virtual Device
  Windows executable that simulates an AES70 device.
- oca.js JavaScript library
  Javascript library that supports AES70. For building web-based AES70 device controllers.
- OCA Wireshark plugin

  This plugin allows analyzing AES70 network traffic using Wireshark, the popular free network protocol analyzer.

Information on the Techsite

- **AES143 Presentations**
  Slides from two presentations, "How to Make an AES70 Device", and "How to Make an AES70 Controller", originally given at AES 143 in 2017 October. Audio recordings of these presentations is available through the AES website.

Commercial AES70 Implementation

- **Bosch AES70 Reference Implementation**
  Fully engineered, commercial-grade AES70 development kit. Not free. Licensable from Bosch Communications. Jeff Berryman has for further information.

OCA Alliance resources

- Additional resources are available to OCA Alliance member companies. Basic membership costs $1500 per year. Contact Jeff or the OCA Alliance business manager Tina Lipscomb.