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Performance from Experience

Networked Appliances
Generic CAL Device Addressing and Control

Prepared For:

An SAIC Company

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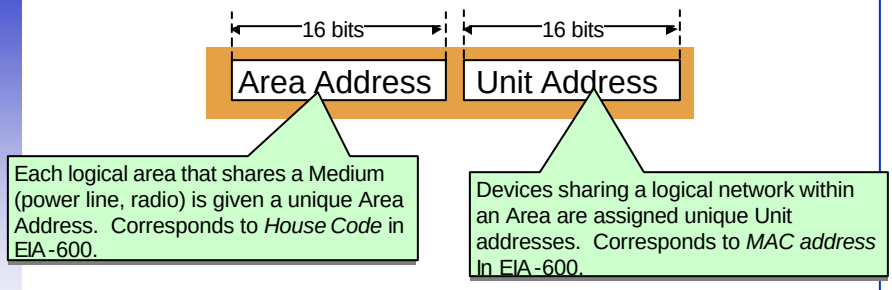
Generic CAL Device Addressing

- Device Addresses are either Physical or Logical
  - Physical Addresses may be hardcoded during manufacturing process
  - Logical addresses can exist at either Layer 3 or Layer 2:
    - Layer 3 Network Service Access points
    - Layer 2 Medium Access Control
- Device address may be Short or Long
  - Short device address
    - 2 x 16-bit words = 4 bytes
    - Backward compatible with EIA 600 (CEBus)
  - Long device address
    - 8 x 16-bit words = 16 bytes
    - Compatible with other protocols (e.g. IPv6)
- Node Control object (in Universal Context) is responsible for the management of addresses.

Generic CAL Device Addressing

Short Device Address



- Devices can determine their Unit and Area addresses either Statically or Dynamically.
  - Dynamic: Device asks other devices within the home or logical area for their Area Address. Unit address is determined by selecting an address not currently used under the Area Address.
  - Static: Addresses are allocated statically by another means

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MAC Addresses (CEBus)

- Individual MAC addresses identify particular nodes within the CEBus network.
- CEBus nodes must recognise: its individual *MAC address*, *Broadcast address*. Recognition of *Group addresses* is optional.
- Addresses are persistent (through power interruptions).
- Method for acquiring house code is not specified by EIA-600:
  - One allowable method is to use mechanical switches or factory preset addresses. (*Static allocation*)
  - Another method is to use the Resource Allocation function to allow a node to *dynamically* select and acquire its own individual address and group address.

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MAC Addresses (CEBus)

Address range	Usage
F000 – FFFF	Reserved
8000 – EFFF	Individual
8000	Reserved
1001 – 7FFF	Individual
1000	Reserved
0101 – 0FFF	Group
0100	Reserved
00FE – 00FF	Reserved for Routers
0001 –00FD	Individual
0000	Broadcast Address

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House Codes (CEBus)

- House codes are used in the Medium Access Control (MAC) layer to identify particular nodes in a CEBus network.
- House codes are the equivalent of CAL Area Addresses.
- House codes can be either:
  - **House system address**: used with a group of devices which span multiple physical media
  - Or **House zone address**: only associated with a group of devices which reside on a single physical medium
- House code 0x0000 is the broadcast house code
- Method for acquiring house code is not specified by EIA-600:
  - One allowable method is to use mechanical switches or factory preset addresses. (Static allocation)
  - Another method is to use Resource Allocation function to allow a node to dynamically select its own individual address and group address.

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House Codes (CEBus)

Address range	Usage
F000 – FFFF	Reserved
8000 – EFFF	House System Addresses
8000	Reserved
0200 – 7FFF	House Zone Addresses
0100 – 01FF	House System Addresses
0001 – 00FF	House Zone Addresses
0000	Broadcast House Code / Global Network Address

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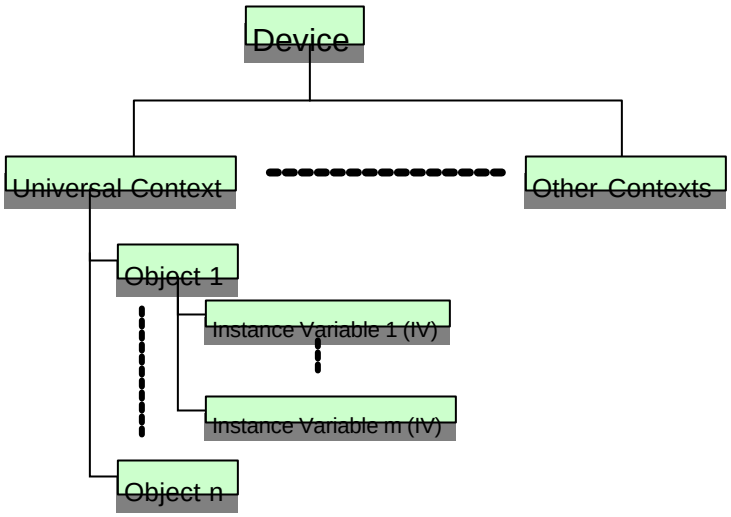
Generic CAL Device Object Hierarchy



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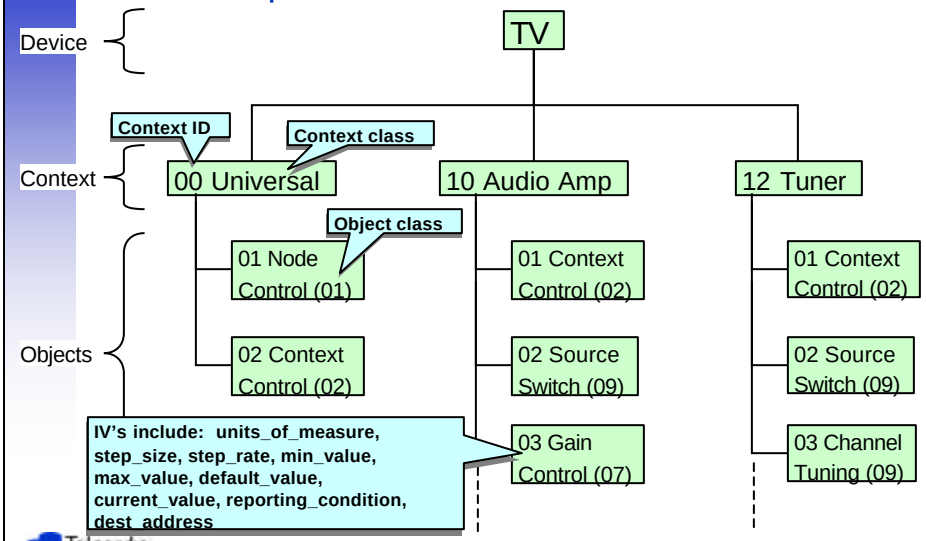
Generic CAL Device Object Hierarchy
TV example



Generic CAL Contexts

- Different Context for each control on a device…
- Universal
- User Interface
- Operation Group
  - Audio
  - Video Display
  - Tuning
  - Security Zone
  - Environmental
  - (plus others to be added…)

Generic CAL Objects
Overview

- Object model implemented by Instance Variables (IV's)
  - Change device characteristics by changing IV's
  - IV's are identified by:
    - Name, Function, Data type,,Read-write-able, "Secured"
- "Reporting" objects
  - Report on conditions, events
  - Employ reporting_condition IV with dest_address IV
  - Use "report" method
- Node Control Object
  - Product_class IV set by manufacturer
  - Includes Power, On_offline, Reset IV's

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Generic CAL Objects
Listing

- 01 NODE CONTROL
- CONTEXT CONTROL
- 03 DATA CH RCVR
- 04 DATA CH XMTR
- 05 BINARY SWITCH
- 06 BINARY SENSOR
- 07 ANALOG CONTROL
- 08 ANALOG SENSOR
- 09 MULTI_STATE SWITCH
- 0A MULTI_STATE SENSOR
- 0B MATRIX SWITCH
- 0C MULTIPLANE SWITCH
- 0D GANGED ANALOG CTRL
- 0F METER
- 10 DISPLAY
- 11 TRANSPORT
- 13 DIALER
- 14 KEYPAD
- 15 LIST MEMORY
- 16 DATA MEMORY
- 17 MOTOR
- 19 SYNTHESIZER/TUNER
- 1A TONE GENERATOR
- 1C COUNTER
- 1D CLOCK

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Generic CAL Object Methods
Listing

- 40 NOP
- 41 SETOFF
- 42 SETON
- 43 GETVALUE
- 44 GETARRAY
- 45 SETVALUE
- 46 SETARRAY
- 47 ADD
- 48 INCREMENT
- 49 SUBTRACT
- 4A DECREMENT
- 4B COMPARE
- 4E SWAP
- 4F REPORT
- 52 EXIT
- 53 ALIAS
- 54 INHERIT
- 55 DISINHERIT
- 56* IF
- 57* DO
- 58* WHILE
- 59* REPEAT
- 5A* BUILD
- 5B* COPYVALUE

- * indicates a “complex” method

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Generic CAL Object Responses
Listing

- FE COMPLETED
- FD ERROR
- FC FALSE EVALUATION

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Conclusions

- The Generic CAL (CEBus) addressing scheme operates on the Medium Access Control (MAC) layer (I.e. Layer 2).
- Uses hierarchical address (Area, Unit) and potentially supports IPv6 addressing (by using Long address).
- EIA-600 provides information on Area & Unit Address ranges.
- Does not specify how these addresses are acquired (which is what we are really interested in). ☹
- So Generic CAL has not solved our device addressing problem, and we will have to develop our own way to allocate addresses… ☹
- (Home Plug 'n' Play extends Generic CAL with concept of "Sub-systems". Further investigation is required into this.)

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