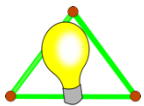


Open DC Grid Project

2020 September



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Agenda

- ❖ In-band Communications – Joe Decuir
- ❖ Review of CoAP and OCF
- ❖ 12V Revisions and Open Questions
- ❖ Compatibility Discussion
- ❖ 48V Vehicle to Grid
- ❖ Related Standards / Industry Developments
- ❖ Next Meeting / Feedback

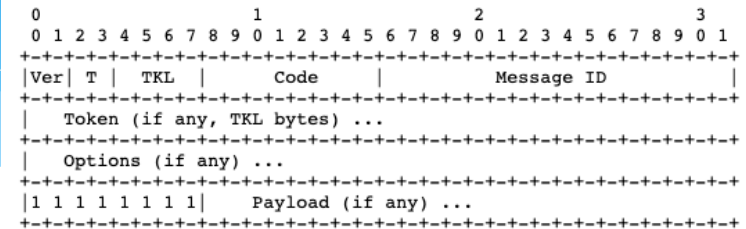


In-band Communications

[See Joe Decuir Presentation...](#)



CoAP – Constrained Application Protocol



- * Client/server but most devices use both roles
- * Efficient REST transactions with reliable transmission
- * Fits between lower transport and application
 - * Usually uses UDP or TCP but doesn't have to
 - * Can use DTLS encryption but doesn't have to
 - * Unicast or multicast (critical for OCF)
- * Message types:
 - * Confirmable, Non-confirmable, Ack, Reset
- * Message Codes:
 - * Get, Put, Post, Delete, with response and error codes
- * Much of the protocol defined by options
 - * Block transfers
 - * Observability / Notifications
 - * Format negotiation: JSON, CBOR



CoAP Tools – Copper (Chrome Plugin)

The screenshot displays the Copper Chrome extension interface, which is used for interacting with CoAP (Constrained Application Protocol) services. The interface is divided into several sections:

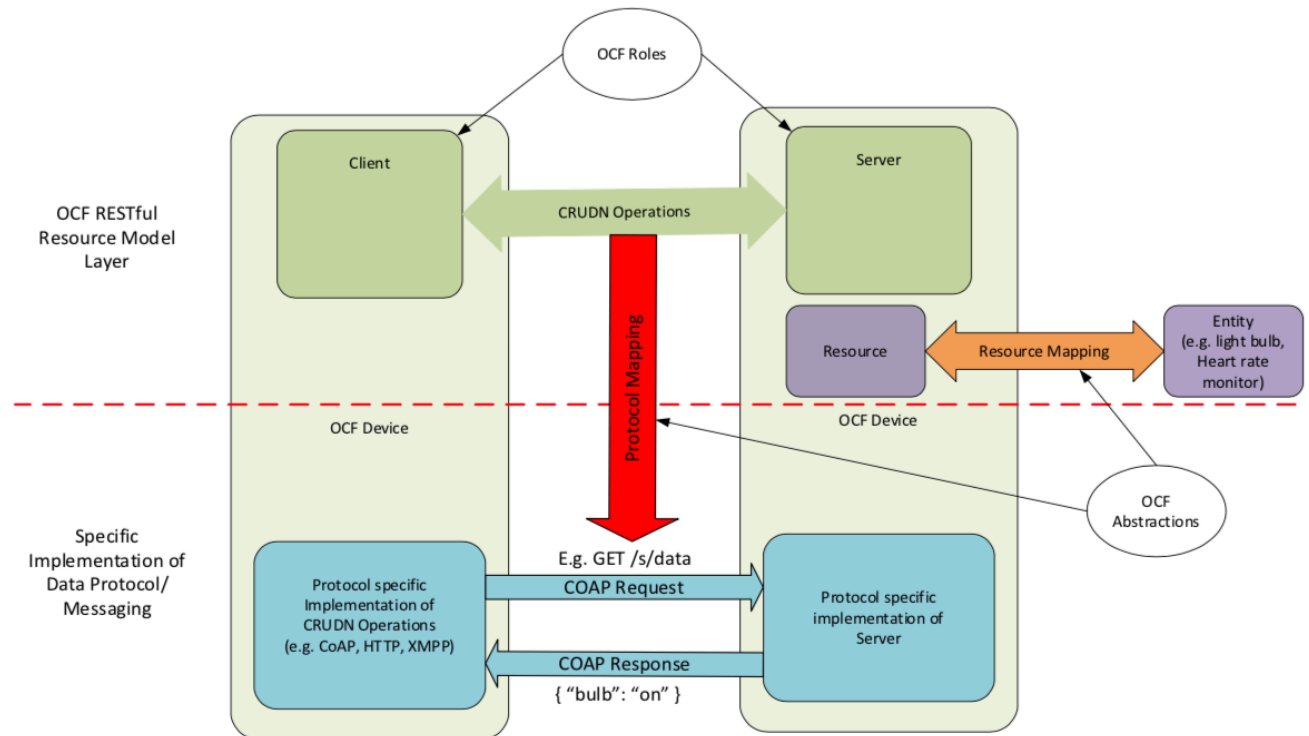
- Top Bar:** Shows the extension name "Copper (Cu4Cr) Extension" and the current URL: `chrome-extension://hehbmchbkiogponanpbmkhboahfof/index.html?coap%3A%2F%2Fcalifornium.eclipse.org%3A5683%2Flarge`.
- Message Log:** A table at the bottom showing the history of CoAP messages. The current message is a 2.05 Content message with the following details:

Time	Type	Code	MID	Token	Options	Payload
20:13:45	ACK	2.05 Content	5083	0x1234	Content-Format: 0, Block2: 0/1/1024, Size2: 1280	RESOURCE BLOCK NO. 1 OF 5 [each line contains 64 bytes] RESOURCE BLOCK NO. 2 OF 5 [each line contains 64 bytes] RESOURCE BLOCK NO. 3 OF 5 [each line contains 64 bytes] RESOURCE BLOCK NO. 4 OF 5 [each line contains 64 bytes] RESOURCE BLOCK NO. 5 OF 5 [each line contains 64 bytes]
- Message Details:** A detailed view of the selected message, showing the following information:
 - Status:** 2.05 Content (RTT 333 ms) (Download Finished)
 - Header:** Type: ACK, Code: 2.05 Content, MID: 5083, Token: 0x1234.
 - Option:** Content-Format (12), Block2 (23), Size2 (28).
 - Payload:** A large block of data, currently rendered as a hex string.
- Debug Control:** A section on the right side of the interface, containing various checkboxes and input fields for debugging the CoAP message, such as "Debug Control", "Request Options", "Response Options", and "Custom Options".



OCF Model - CRUDN

- * Create
- * Retrieve
- * Update
- * Delete
- * Notify



OCF is an abstract way of managing devices via network messages

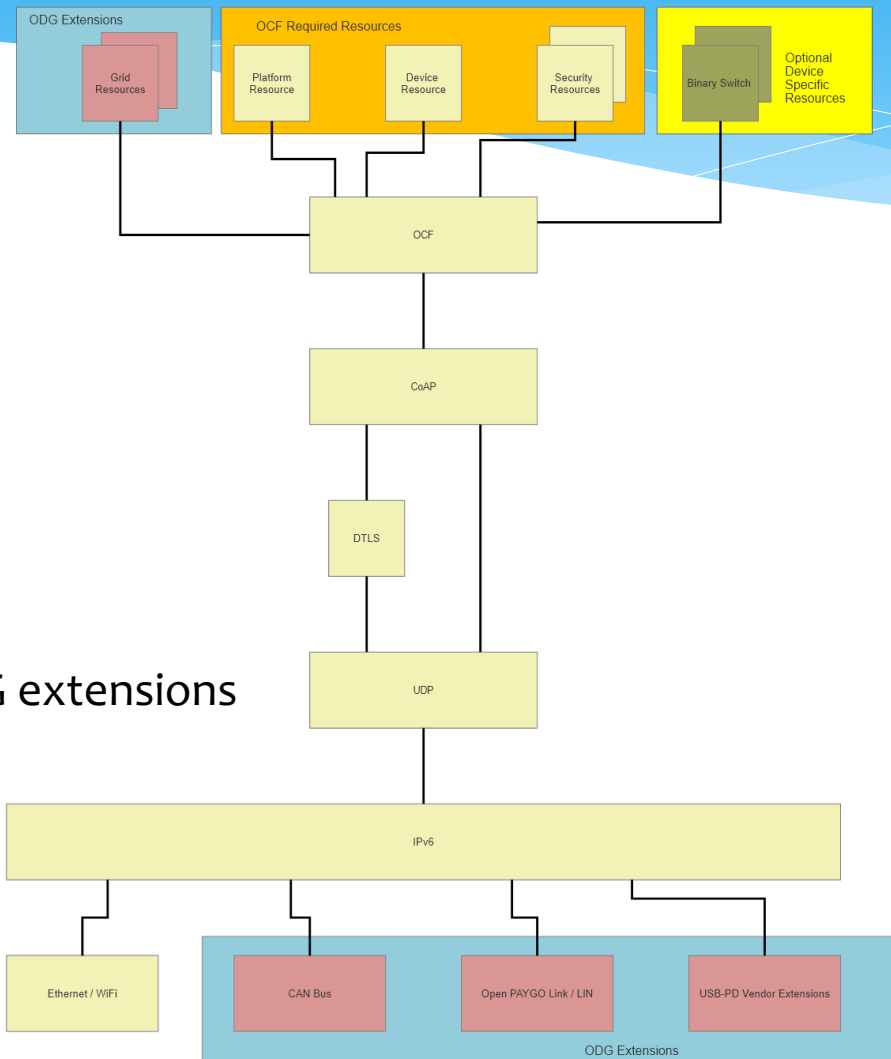


OCF - What is a Resource?

- * Software interface to HW function or set of info
 - * Very abstract form of device driver
- * Has a path ~ name:
 - * Device relative URL: /oic/d
- * Has named properties eg “value” or “pi”:
 - * Bool: on/off, Number: voltage, String: vendor
 - * Set of key-value pairs
- * Has a public type
 - * What CRUDN functions it implements
 - * Data formats supported: JSON / CBOR



OCF Existing (Iotivity-lite) + ODG



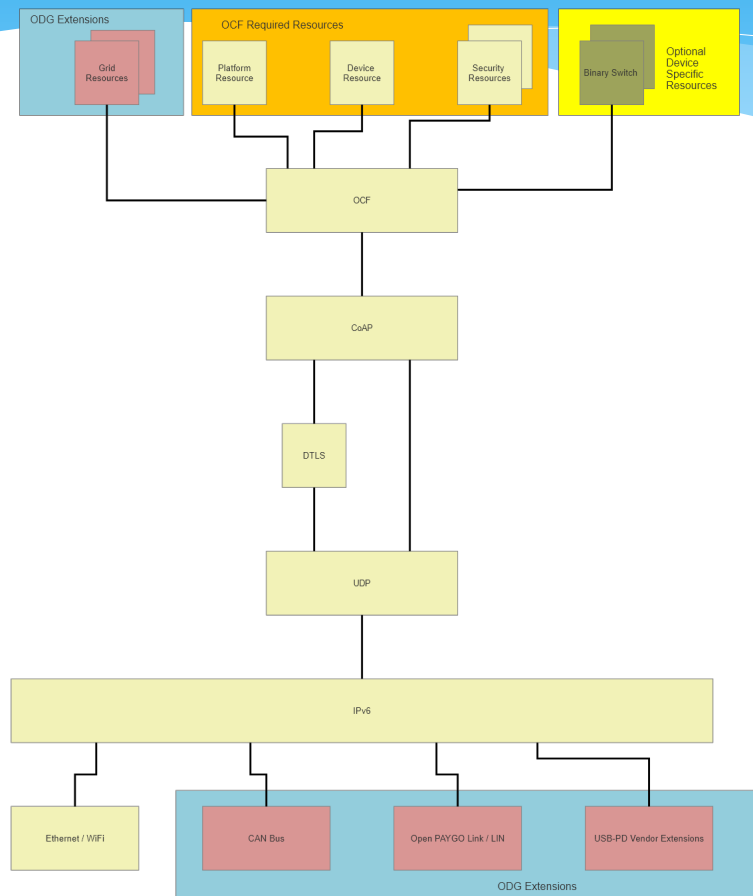
Full OCF with ODG extensions



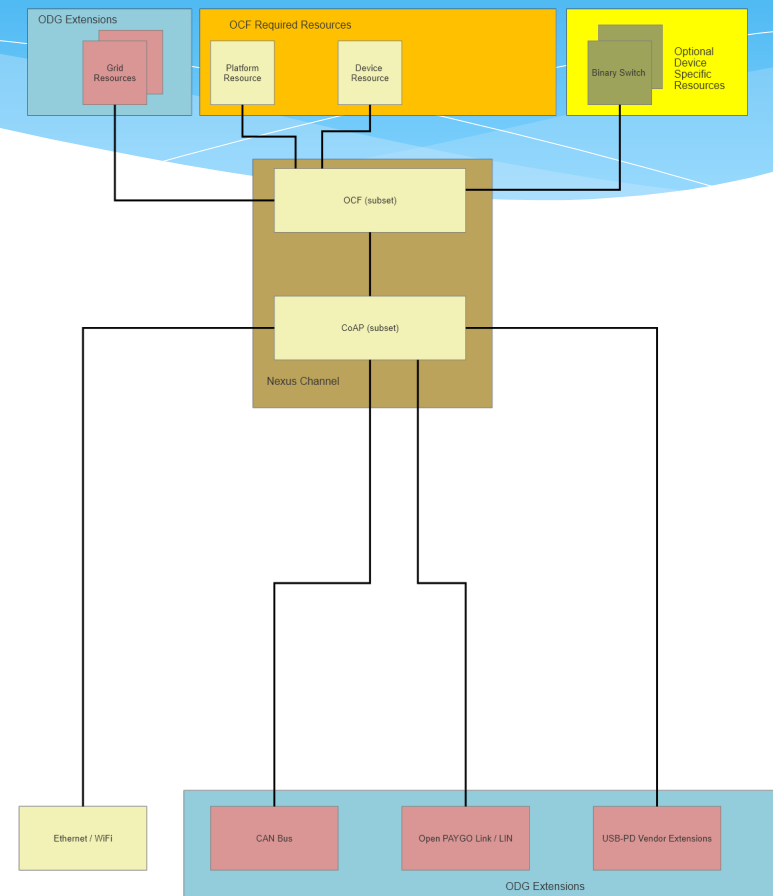
Rev 1

September 8, 2020

ODG Constrained Stack



Full OCF with ODG extensions



Nexus reduced OCF with ODG extensions



OCF Protocol in Action

202009011843121468 - OCF Device Spy network trace.pcap

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl>->

No.	Time	Source	Destination	Protocol	Length	Info
100	14:43:45.706445	192.168.0.146	239.255.255.250	UDP	122	46213 → 51200 Len=80
101	14:43:45.809014	192.168.0.197	142.250.27.188	TCP	60	50994 → 5228 [ACK] Seq=1 Ack=1 Win=2048 Len=0
102	14:43:45.963632	142.250.27.188	192.168.0.197	TCP	66	[TCP ACK unseq segment] 5228 → 50994 [ACK] Seq=1 Ack=2 Win=275 Len=0 TSval=2552949093 TSecr=
103	14:43:46.688165	Ubiquiti1 5e:90:62	Broadcast	ARP	60	who has 192.168.1.1? Tell 192.168.0.71
104	14:43:46.856952	192.168.0.121	224.0.1.187	CoAP	69	NON, MID:24293, GET, TKN:6e f1 a0 5d, /oic/res
105	14:43:46.857524	fe80::110b:92f7:d8fc:91c4	ff02::1:58	CoAP	89	NON, MID:24294, GET, TKN:72 3e 66 78, /oic/res
106	14:43:46.858151	fe80::110b:92f7:d8fc:91c4	fe80::110b:92f7:d8fc:91c4	UDP	1117	45632 → 49157 Len=1055
107	14:43:46.860966	fe80::110b:92f7:d8fc:91c4	fe80::4103:bd04:cbd2:faae	UDP	66	49157 → 45632 Len=4
108	14:43:46.863709	fe80::110b:92f7:d8fc:91c4	fe80::4103:bd04:cbd2:faae	UDP	91	49157 → 45632 Len=29
109	14:43:46.864526	fe80::4103:bd04:cbd2:faae	fe80::110b:92f7:d8fc:91c4	UDP	1114	45632 → 49157 Len=1052
110	14:43:46.870064	fe80::110b:92f7:d8fc:91c4	fe80::4103:bd04:cbd2:faae	UDP	66	49157 → 45632 Len=4

> Frame 104: 69 bytes on wire (552 bits), 69 bytes captured (552 bits)
> Ethernet II, Src: VMware_44:c2:db (00:0c:29:44:c2:db), Dst: IPv4mcast_01:bb (01:00:5e:00:01:bb)
> Internet Protocol Version 4, Src: 192.168.0.121, Dst: 224.0.1.187
> User Datagram Protocol, Src Port: 49157, Dst Port: 5683
> Constrained Application Protocol, Non-Confirmable, GET, MID:24293

OCF Device Spy 1.2.4

Options Help

Client

General

Log Cancel

Device name: OCF_DeviceSpy

☒ SVRs SVRs secure port: 5685

OCF version

☐ OIC1.1 ☒ OCF2.0

☒ With oic.r.coapcloudconf

☒ Self-owned

State: RFNOP Owned: True

UUID: 45da964a-56a0-4cbb-9970-454ada0daede

Devices

Discover ☐ Custom URI /oic/res

☐ Only unowned

Device info

Provisioning Provision Onboarding Onboard Offboard

Devices:

Addresses:

Request

Send unsecure Send secure Credential: Method: GET Protocol: UDP

URI: /oic/res Accept: vnd.ocf+cbor

Code: Accept ver: 1.0.0

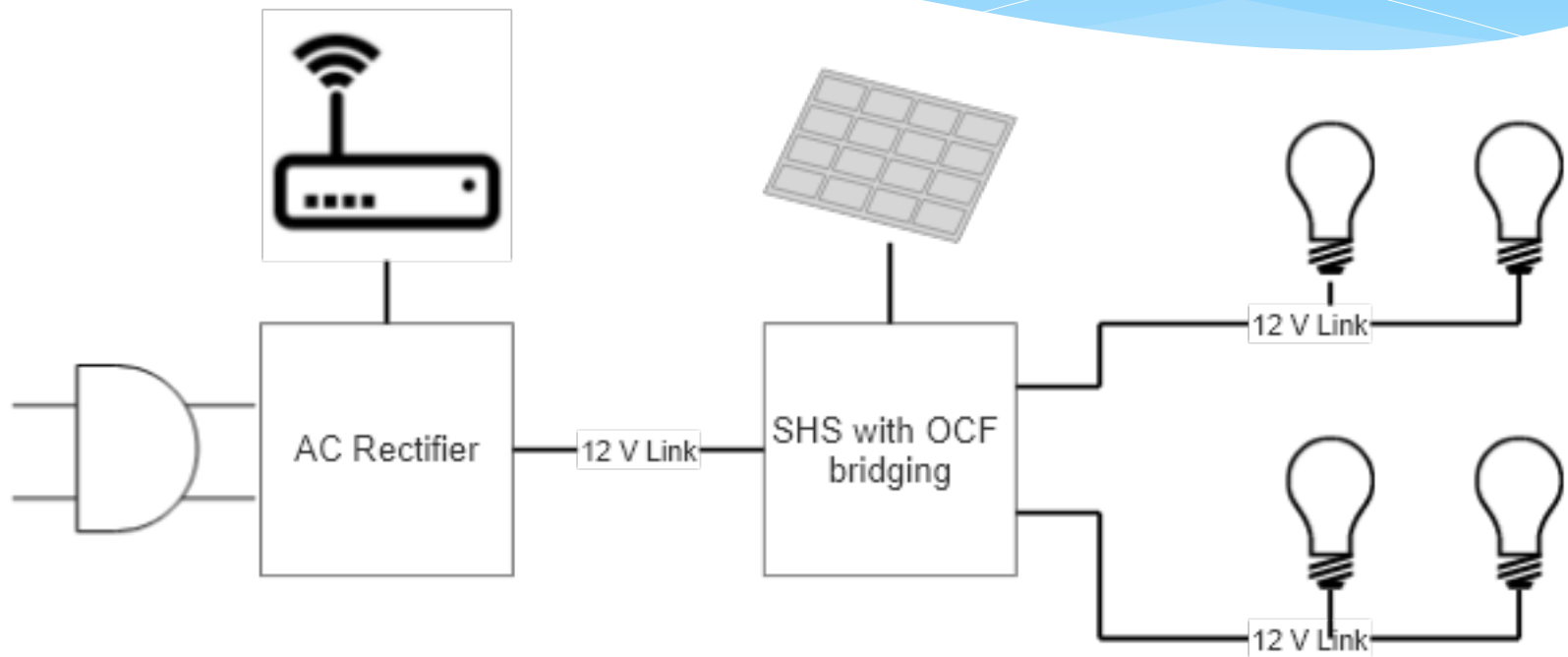
Request payload Response payload

Device Discovery finished

```
dbg@dbg-virtual-machine: ~/Projects/iotivity/iot-lite
File Edit View Search Terminal Help
OCF Server name : "server_lite_6583"
Initialize Secure Resources
storage at './device_builder_server_creds'
Introspection data set from 'server_introspection.cbor' for device 2
735 [bytes]
Register Resource with local path "/binaryswitch"
number of Resource Types: 1
Resource Type: "oic.r.switch.binary"
Default OCF Interface: "oic.if.a"
OCF server "server_lite_6583" running, waiting on incoming connections.
```

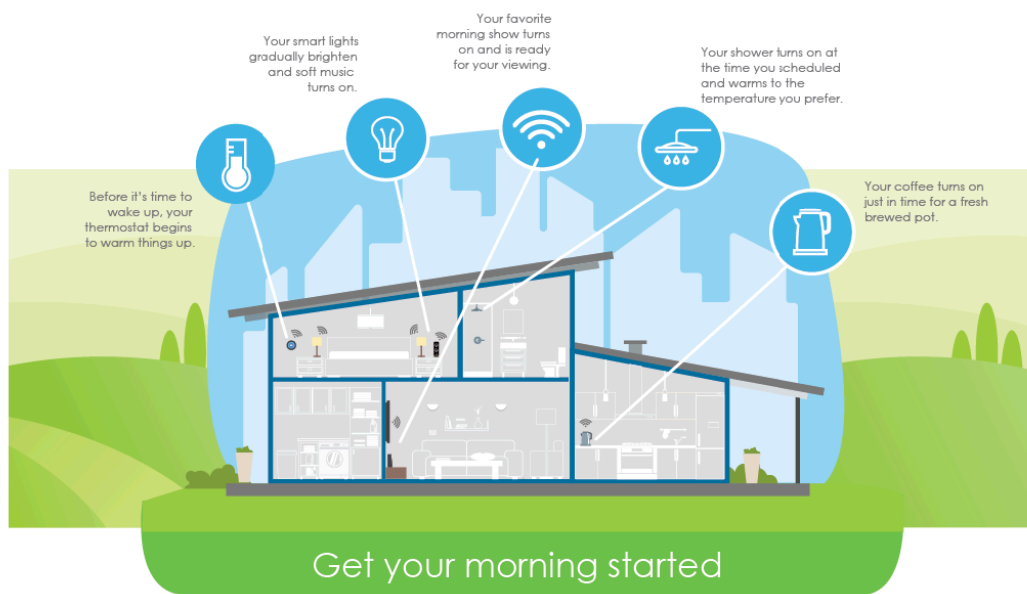


OCF Bridging on SHS



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Product Name	Certification	Company Name	Device Type(s)	Date Certified
WD My Cloud	UPnP	Western Digital Technolog...	Storage	08/13/2018
WD My Cloud EX4100	UPnP	Western Digital Technolog...	Storage	08/13/2018
Niux	AllJoyn	Electrolux	Home Appliances	07/30/2018
HB416	UPnP	Sony Mobile Communicati...	Phone, UPnP Media Renderer Control Point, DLNA Mobile Digital Media Server (M-DMS)	06/21/2018
Niux	AllJoyn	Electrolux	Home Appliances	06/13/2018
Niux	AllJoyn	Electrolux	Home Appliances	06/06/2018
DJNZ130	UPnP	Technicolor	Home Gateway	03/29/2018
WiFi Light Dimmer	OCF	Legrand Home Systems	Light	03/21/2018
WiFi Light Switch	OCF	Legrand Home Systems	Light	03/21/2018
Wireless Speaker	UPnP	Libratone A/S	Audio System	03/15/2018
THG3000g	UPnP	Technicolor	Home Gateway	03/06/2018
F-01K Android8.1	UPnP	Fujitsu Limited	Phone	03/06/2018
Gigabox	UPnP	Sercomm Corporation	Home Gateway, DLNA Digital Media Server (DMS)	02/16/2018
Vodafone H 500-s	UPnP	Sercomm Corporation	Home Gateway, DLNA Digital Media Server (DMS)	02/13/2018
SOV37, SO-03K, 702S0, SO-0...	UPnP	Sony Mobile Communicati...	Phone, UPnP Media Server Control Point, UPnP Media Renderer Control Point, DLNA Mobile Digital Media Server (M-DMS), DLNA Mobile Digital Media Player (M-DMP), DLNA Mobile Digital Media Controller (M-DMC)	02/09/2018
Haier Washer	OCF	Haier Group	Washer (Laundry)	01/24/2018
MediaAccess TG789vac v2	UPnP	Technicolor	Home Gateway	01/22/2018
MediaAccess TG799vac Xtrem...	UPnP	Technicolor	Home Gateway	01/22/2018
AEG BSE9992208	AllJoyn	Electrolux	Integration	01/16/2018
Electrolux EKS985Z	AllJoyn	Electrolux	Integration	01/16/2018

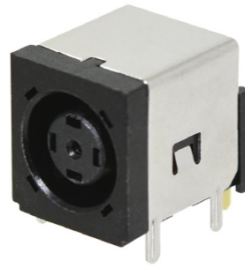
PREVIOUS Page 3 of 7 20 rows NEXT



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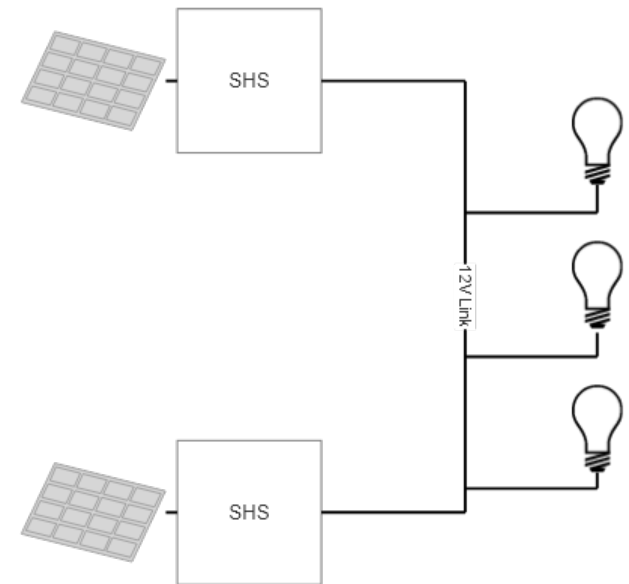
12V Link – Load Simplification Update



- * Currently loads can have either female socket or male plug (flying lead)
- * Currently all loads must operate 10V – 20V
 - * Needed to protect against Laptop plugged into load
 - * Observation: only relevant if load has female port
- * Update:
 - * Load with male connector only needs to support 10—15V
 - * Bidirectional ports (female socket) still need to accept 20V? Maybe protection only?
- * Question: Should load lower limit be 10.5V to harmonize with ISO?
 - * If so – what should load limit be? IR drop?

12V Link Questions - Droop

- * Do all sources ports need to support droop control?
- * Choice 1: yes
 - * All sources contribute power based on ratio of droop slopes
 - * Requires DC-DC on every source
- * Choice 2: no – protection only
 - * Diode or equivalent on every source
 - * Highest voltage source wins
 - * Higher power source potentially locked out
- * Choice 3: droop optional, gating required.
 - * Source must be capable of output gating
 - * DC-DC converter not required. Switches only.
 - * Grid selects highest power source to enable
 - * Droop utilized if available



12V Questions – Temporary Overloads

- * Motor starts and capacitor charging are reality
 - * Refrigerator starting current 5x – 7x operating current
 - * Can occur for 3-5 seconds
- * What to do about it?
 - * Minimum requirement: no fires or equipment damage
 - * Should we require sources to operate in overload envelope?
 - * Slow-blo fuses or electronic equivalent?
 - * Do we define the envelope or let the source define the envelope?
 - * How do we define test requirements?
 - * Should we require soft-start appliances?
 - * Capacitors and motors are different problems
 - * Current spec requires 100 mSec dropout – enough for caps?
- * If we permit short source overloads, what about voltage?
 - * Do sources have to maintain voltage within range?



Interoperability – Why does it Matter?

- * Energy access markets
 - * Primarily a vendor issue
 - * Vendors want more choice in sourcing components
 - * Vendors want to reduce engineering and support costs
 - * Vendors need efficient ways to collect money and manage systems
 - * Not specific to ODG – GOGLA initiative, Verasol (Lighting Global)
 - * Long term goal of consumer choice
- * Global markets
 - * More of a consumer issue
 - * Reduce e-waste
 - * Reduce consumer aggravation and support costs
 - * OCF demonstrates the significance and commitment



ODG - Interoperability

Thanks to Chris Moller..

- * Essential Interoperability
- * Specifically excluded criteria
- * Debatable points

Nothing is cast in stone... everything is open to discussion

- * **Observations:**
 - * Nearly every requirement has a BOM cost
 - * We need to understand the cost implications and trade off wisely
 - * Every requirement must be testable – recommendations excluded
 - * Nearly impossible to test for negatives
 - * Use positive requirements to force expected behavior
 - * How far can we push industry practice beyond accepted norms?
 - * The best is the enemy of the good...
 - * The project's goal has always been to create practical solutions to benefit end users



Essential Interoperability

- * Any ODG load must operate as expected when attached an ODG source
 - * Unless prevented by system policy
- * ODG compliant system controller must be able to balance the grid
 - * If technically possible – **not sure what this means**
 - * For any mix ODG components and dumb loads
- * Nothing that happens within a load may affect the operation of any other load
 - * ODG compliant or dumb, including faults – **can't protect from dumb overloads**
 - * Unless by design
- * Failure modes must only disable what is absolutely necessary – **at what cost?**
- * Higher level messages of any ODG-12-compliant product must not interfere with or be able to be confused with any higher-level messages of any other vendor's ODG-12-compliant product.
 - * **Implicit in protocols**



Excluded from ODG

- * Anything relating to contractual constraints (PAYGO, etc)
 - * Recommend but not require a PAYGO implementation (Nexus?)
 - * Support multiple business models including vendor exclusive grid
- * Messages relating to the function of a load (remote controls, alarms, status reports), except deferrable loads as in (9) above
 - * Include OCF stack – get interoperable functions for “free”
- * Messages to or from the vendor’s external platform that need to be transmitted over the ODG-12-compliant grid.
 - * Implicit in protocols
 - * Demonstrate but not require IP bridging for remote management



Interoperability – Open Questions

- * Any ODG electricity supply product that does not contain a battery must be usable with any vendor's ODG-compliant storage product.
 - * What about 2 batteries on same grid? Do they both need DC-DC converters?
- * If sold as able to be doubled-up to increase power, any vendor's ODG-12 electricity supply product must be able to work in parallel with any other ODG-12-compliant electricity supply product.
 - * Requires DC-DC converters on sources...
- * Any vendor's ODG-12 system controller must be able to operate an energy management strategy for a system that includes other vendors' ODG-12-compliant electricity sources and storage products.
 - * How is the strategy selected if vendors have conflicting policies?
- * Any vendor's ODG-12 system controller must be able to operate an energy management strategy for a system that includes ODG-12-compliant deferrable loads (and dumb loads?) from other vendors.
 - * Implicit in the standard?
- * ODG-12 will include a prioritization system for the order of shutdown of loads in the event of running out of energy, and ODG-12-compliant loads must recognize this. (Dumb loads cannot be controlled, unless on a separate controllable branch circuit.)
 - * Do we standardize how priorities are presented to the user?
- * Securely encrypted ODG-12 information must contain sufficient unencrypted information to identify the vendor.
 - * Suggest we follow OCF recommendations.

Many of these are presented as vendor-vendor compatibility but there is a deeper question of whether it can be done at all...



Vehicle to Grid – What about the low End?



- * V2G – vehicle batteries supplying power to the grid
- * Potentially a major storage source for a renewable grid
- * Focus has been on cars
- * Why not apply this technology in the energy access market?
 - * Widespread use of electric bikes, scooters, moped etc. inevitable
- * Currently no or minimal standards for DC charging
 - * Bharat (India) Charger Specification (based on GB/T 20234.3)
 - * OCPP – Open Charge Point Protocol (CAN bus for cars)
- * Wide range of voltages: 24, 36, 42, 48, 52
- * Many connectors: XLR (18A), barrel, even IEC C14



Existing DC Charging Connectors



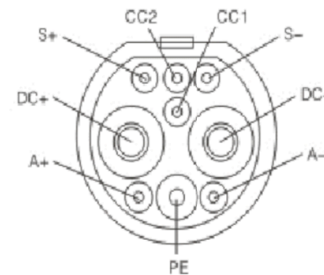
36V Charger



48V Charger



DC+ : Positive DC power
 CC2 : Connection confirmation 1
 DC- : Negative DC power
 CC1 : Connection confirmation 2
 PE : Protective ground cable
 A+ : Positive Low auxiliary power
 S+ : Charging Communication CAN-H
 A- : Negative Low auxiliary power
 S- : Charging Communication CAN-L



GB/T 20234.3 Connector

Related Standards / Industry Developments

- * [P2030.10](#)
 - * Voting complete!
- * [P2030.10.1](#)
 - * Draft 4 released – minor changes
- * [GOGLA](#) Interop activities
 - * Wider audience for September 3rd meeting
- * [OpenPAYGO Link](#)
- * [Angaza Nexus Channel](#) / Nexus Channel Core
- * [Open Connectivity Foundation](#) / [IoTivity](#)



Next Meeting / Feedback

- * Next Meeting

- * 13 October 2020 – 1400 UTC

- * [Zoom – Meeting ID 87518284403](#)

- * Sharing Portals

- * Web site: <https://open-dc-grid.org/>

- * GitHub: <https://github.com/open-dc-grid>

- * Feedback?

