Workshop on IoT Semantic/Hypermedia Interoperability

Fairhair

Teresa Zotti, Resource Model WG chair
Prague, 15th July 2017

Status Quo

- Building Automation and Lighting Control (BA&LC) market segment has a yearly global turnover of > $10B
- Many proprietary protocols are used, resulting in a fragmented market and many sub-market verticals
- But a few established 'ecosystems' represent a considerable share of this market
  - **BACnet and KNX** based systems and components account for an estimated yearly global turnover of > $3.5B
  - **Zigbee** is emerging as key application ecosystem for wireless Lighting Control propositions

Opportunity

- There are many advantages opened up by the use of "IPv6" and IoT technologies in BA&LC
  - Scalability, seamless integration of multiple physical media, integration with IT and Smart Devices, compliance to IT security practices and policies, …
- Eco-systems BACnet, KNX and Zigbee are seeking to extend and transition to the "IoT space"
  - Ecosystems maintain their core assets: Data Model, tooling, branding, organization, certification programs

  New technologies like **Thread** facilitate this transition by providing a cost-effective, reliable wireless IP solution

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Fairhair Mission & Approach

Mission

- Fairhair envisions a future where the BA&LC industry uses IoT technologies to build **cost-effective, scalable, and secure systems solutions**

Approach

- Fairhair does not aim to define a new application layer protocol and ecosystem; Fairhair fully recognizes the value and knowledge captured in the Data Models, brand promise, and tooling of **strong established ecosystems, primarily BACnet, KNX and Zigbee**

- Solutions are based as much as possible on the state of the art from the IETF. Fairhair does not define IP-based network layer solutions; instead it intends to **cooperate with IETF and alliances like the Thread Group and Wi-Fi Alliance to extend their network solutions** to be fully suitable for BA&LC propositions in Smart Buildings.

CISCO **LUTRON** **OSRAM**

PHILIPS **SILICON LABS**

Sponsor members

KNX **NXP** **runtime.io**

TRILUX SIMPLIFY YOUR LIGHT. **zumtobel group**

Regular members

BACnet INTEREST GROUP EUROPE **OpenAIS**

zigbee alliance

Liaisons
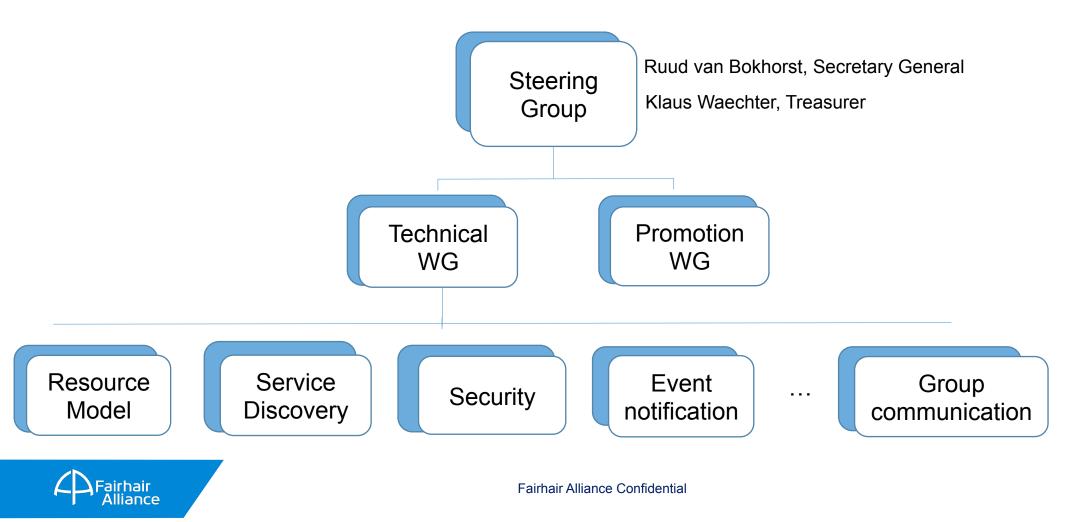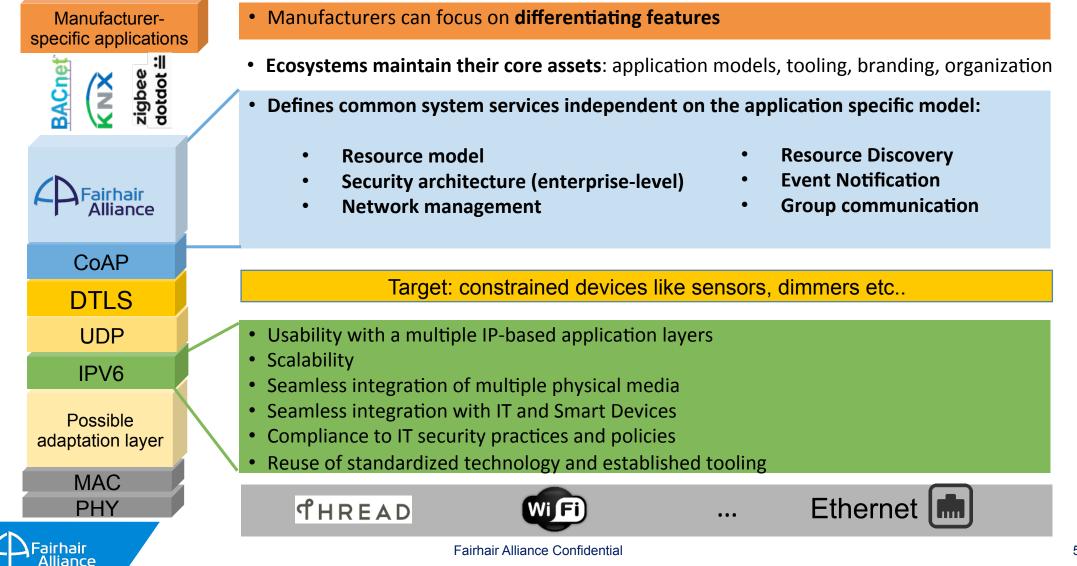
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Fairhair Alliance organization

The Fairhair Alliance is an open, global consortium of silicon vendors, lighting, building automation, and IT companies, organized as a Member Program of IEEE-ISTO

Steering Group

Ruud van Bokhorst, Secretary General

Klaus Waechter, Treasurer

Technical WG

Promotion WG

Resource Model

Service Discovery

Security

Event notification

…

Group communication

Technology stack & main building blocks

Manufacturer-specific applications

BACnet | KNX | zigbee dotdot

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CoAP

DTLS

UDP

IPV6

Possible adaptation layer

MAC

PHY

- Manufacturers can focus on **differentiating features**

- **Ecosystems maintain their core assets**: application models, tooling, branding, organization

- **Defines common system services independent on the application specific model:**

  - **Resource model**
  - **Security architecture (enterprise-level)**
  - **Network management**

  - **Resource Discovery**
  - **Event Notification**
  - **Group communication**

Target: constrained devices like sensors, dimmers etc..

- Usability with a multiple IP-based application layers
- Scalability
- Seamless integration of multiple physical media
- Seamless integration with IT and Smart Devices
- Compliance to IT security practices and policies
- Reuse of standardized technology and established tooling

ↄHREAD | WiFi | ... | Ethernet

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Expected process

- ❑ Fairhair Alliance to deliver **technical specifications for common services**

- ❑ Solutions to be **adopted by target ecosystems** to facilitate transition to IoT

- ❑ Challenges:
  - ❑ Different timelines
  - ❑ Backward compatibility
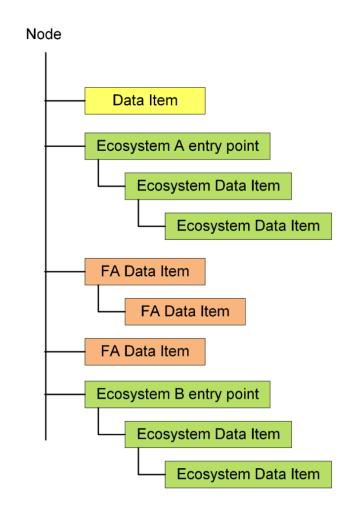 - ❑ Often different requirements

Fairhair Resource Model

- [ ] The **Resource Model (RM)** is a generic framework to represent devices and their capabilities in a RESTful way
  - [ ] Ecosystems like BACnet, KNX, Zigbee dotdot can define a specific resource model based on this framework

- [ ] Does not prescribe a specific URI structure; expects ecosystems to define a resource tree representation for their data models
  examples: zcl/e/ep#/clusterID/c/commandID
  .bacnet/ObjectTypeID,instance#

- [ ] Recommends ecosystems adopt a unique entry point name (e.g. /zcl, /.bacnet, /knx) below the node root

- [ ] Defines a /.fa/<common services> URI to hold Fairhair services common for all ecosystems

Node
- Data Item
- Ecosystem A entry point
  - Ecosystem Data Item
    - Ecosystem Data Item
- FA Data Item
  - FA Data Item
- FA Data Item
- Ecosystem B entry point
  - Ecosystem Data Item
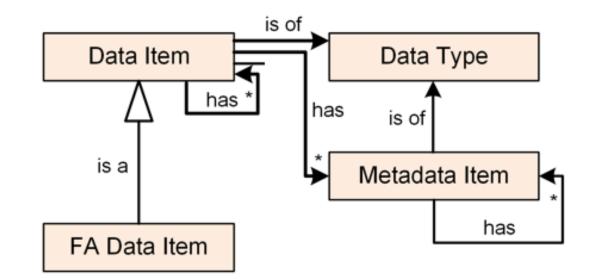   - Ecosystem Data Item

Fairhair Resources: Data & Metadata

❑ Data items arranged into hierarchies

❑ High-level model resource model

   ❑ data has metadata → semantically enriches data items, irrespective of whether the data item is a FA data item or is ecosystem defined

   ❑ metadata may have metadata (e.g. language of description metadata)

   ❑ Data is of a specific data type (e.g. Boolean)

Fairhair semantic interoperability: Metadata

❑ Standard common set of metadata across multiple ecosystems applied to any resource

❑ Ecosystems and manufacturer can **seamless extend metadata** beyond those standardized

Metadata	Description	Resource Name (mnemonic)
Type	The specific type name of the data item.	$type
Base	The base data type of the data item (e.g. Boolean, unsigned integer)	$base
Display Name	A name for the data item intended for human consumption. MAY be localized (i.e. expressed in the language of a specific location like EN, DE, NL)	$disp
Unit	The engineering unit of the data item (e.g. meter, Celsius, Fahrenheit)	$unit
Min	The minimum value allowed for the data item.	$min
Max	The maximum value allowed for the data item.	$max
Access	The allowed methods of accessing the data item (i.e. readability, writability, etc.)	$acc
Variability	The expected variability of the data item	$var

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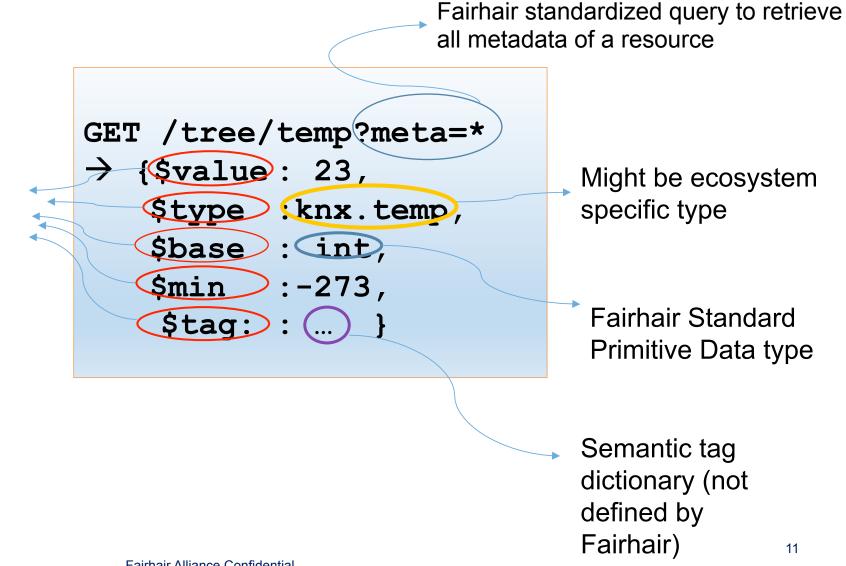
RESTful interface to access resources

- ❑ Runtime access to self description of system
- ❑ **RESTful** principles, **CoAP** methods (i.e. GET, PUT, POST, DELETE)
- ❑ **JSON / CBOR** representation
- ❑ scalability – get the information you need at the relevant time

- ❑ RESTful access to resources → **URI**
  - ❑ Data value only
  - ❑ Data value and complete metadata
  - ❑ Direct access to specific metadata
  - ❑ Filter options
    - ❑ e.g. granularities, or specific metadata

```
GET /tree/temp
→ 23


GET /tree/temp?
meta=$type
→ temperature
```

Example of standardized metadata

Fairhair standardized query to retrieve all metadata of a resource

```
GET /tree/temp?meta=*
→ {$value: 23,
   $type   :knx.temp,
   $base   : int,
   $min    :-273,
   $tag:   : ...   }
```

Standard Fairhair mnemonics

Might be ecosystem specific type

Fairhair Standard Primitive Data type

Semantic tag dictionary (not defined by Fairhair)

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Fairhair standard data types

❑ **Primitive Data Type**
Set of data types that can't be derived from other data types

❑ **Complex Data Type**
Set of data types composed of Primitive Data Types

❑ **Metadata which express restrictions to Data Types** (e.g. resolution, range, length)

Current status: Fairhair spec 0.7

The first three draft specifications from Fairhair cover Resource Modelling, Resource Discovery, and Security.

An overview of the three draft specifications is available in a White Paper published on the Fairhair website at www.fairhair-alliance.org/technology/white-papers.html.

Fairhair decided to benchmark the scope and direction of its work by opening up to a selected group of external companies, organizations and university groups, who were asked to review the draft specifications.

Valuable input drives next steps

Desirable properties

Self-descriptive: the system would benefit if Fairhair standard metadata and their description would be made available in a machine-readable format.

Future-proof: descriptions and mnemonics of metadata needs to be maintained/updated.

Flexibility:
- Add context for better interpretation of metadata (Linked data style)
- Key/value system might have some limitations for ecosystems interested to adopt "triples".

Actions planned

Initial Modelling in turtle started

Seek for landing spot to p... metadata descriptions (e.g. IE... ...a.org (?))

Opportunity for collaboration

Investigation on extens... ... model to support Linke...

Opportunity for research

- Which serialization format?
- Payload efficiency on constrained device?
- Which query mechanisms on end nodes?

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Come and join the Fairhair Alliance

❑ Companies, associations and universities can benefit by:

 ❑ Recognition as one of the leaders making the Internet of Things in smart buildings a reality

 ❑ Breaking down the traditional silos of independent building-automation and lighting-control systems in buildings

 ❑ Co-creating specifications for a common network infrastructure

 ❑ Defining requirements and validating related specifications to create an aligned, unified, IP-based solution

 ❑ Co-creating draft specifications for the application protocol layer, for adoption by the respective ecosystems

 ❑ Getting access to specifications

 ❑ Participating in interoperability testing with other members

❑ **Contacts**
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Thank you

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