**IEEE P802.15**

**Wireless Personal Area Networks**

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **Applications-Providers-Requirements** | |
| Date Submitted | [14 Nov., 2013] | |
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| Re: | [Ground Work for Layer 2 Routing] | |
| Abstract | [Working document] | |
| Purpose | [see Re:] | |
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**Application/Use Cases – Providers - Requirements**

# Applications/Use Case Examples

## Example Application 1 - Smart Metering (HAN and NAN)

The NIST Knowledgebase defines the metering use case as follows:

“Advanced metering infrastructure (AMI): Currently, utilities are focusing on developing AMI to implement residential demand response and to serve as the chief mechanism for implementing dynamic pricing. It consists of the communications hardware and software and associated system and data management software that creates a two-way network between advanced meters and utility business systems, enabling collection and distribution of information to customers and other parties, such as competitive retail suppliers or the utility itself. AMI provides customers real-time (or near real-time) pricing of electricity and it can help utilities achieve necessary load reductions.”

AMI (Smart Meter) use cases include (see doc. # 15-13-0564-00-0010 for details):

* **A Bulk Meter Readings**
* **On Demand Meter Reading from CIS**
* **Remote Programming of Smart Meter**
* **Remote Meter Firmware Update**
* **Meter Remote Connect Disconnect**
* **Outage Notification**
* **Outage Restoration Notification**
* **Real Time Price HAN Messaging**
* **Last Gasp Message**
* **Direct Load Control Event**
* **DR HAN Pricing & Event Customer Opt-Out**
* **AMI Network**
* **DR HAN Device Provisioning**
* **Plug In Electric Vehicle (PEV) Charging at Premise**



## Example Application 2 - Smart City - Street Lighting/Parking/Meters…

A smart city is considered as one which improves the quality of life of people by leveraging modern communication infrastructure and sustainable economic development. Wireless sensor networks are considered a specific technology to help to create smart cities.

Smart City use cases include:

* **Traffic System**
  + **Traffic Signal Control**
  + **Parking Guidance System**
  + **Street Light Control**
  + **Real Time Traffic Messaging (board or in car)**
* **Environment Monitoring**
  + **Pollution Monitoring**
  + **Noise Mapping**
  + **Disaster Notification**
* **Municipal Administration**
  + **Water Leak Detection**
  + **Garbage Collection System**
* **Structure Monitoring** 
  + **Bridge Monitoring**
  + **Tunnel Monitoring**
  + **Building Monitoring**
* **Irrigation Optimization**
  + **Park Management**
  + **Smart Agriculture**
* **CEMS, BEMS, HEMS (City, Building, Home Energy Management Systems)**
  + **Sustainable Subsistence System**

## 

## Characteristics of these applications include:

* Data flows
* Topologies
* Routing strategies
* Management
* Communications domains
* Latency vs. QoS vs. reliability
* Power saving

Focus of TG10 is on Routing strategies

* Proactive
* Reactive

In the context of the Topology:

* Mesh in particular

# Current Providers of Mesh Under Routing (Layer 2) Soln’s. – Proprietary and Non-Proprietary

* ARM (Sensinode)
* SiLabs (Ember)
* Linear Technologies (Dust)
* Synapse
* OKI
* Atmel
* Fujitsu
* NXP
* Philips
* Need to check on these – FireTide Networks, TI, Freescale, NEC, Renesas, Samsung, Mitsubishi, NXP, CSR, ZigBee, Z-Wave

# Requirements

This recommended practice will facilitate the routing of packets in dynamically changing wireless networks.

Facilitating:

* (Dynamic) Address network changes on the order of a minute time frame
* Minimizes impact to route handling

Specifically it will provide for automatic handling of route related capabilities such as:

* Route establishment and continuity
  + Effective frame forwarding
    - Priority vs. sphere of relevance (right size fit for the priority level)
  + Impact of maintaining security (don’t break it)
    - Impacts on provisioning, joining
* Dynamic route reconfiguration
  + Discovery and addition of new nodes
  + Breaking of established routes
  + Loss and recurrence of routes
  + Pruning of routes
  + Restart of network
* Route determination metrics and real time gathering of link status (Policy & Metrics)
  + Intra
    - Quality of individual hop
    - Quality of end-to-end route
      * Reduction of end-to-end retransmissions
    - Latency
    - Data rate/multi-hop end-to-end route time
    - Resources (constraints)
  + Inter workings
    - Reported to system management
      * Persistent/consistent issues
      * Node outage (failure detection)
    - Respond to system management feedback
* Support scalability
  + Node density, network size etc.
  + Hardware resource requirements
  + Behavior at restarts
  + Secondary, tertiary route considerations
  + Scalability of # takeout points - bridges to connecting networks (take out points)
* Management of flooding, multicasts
  + Support of broadcast
  + Support of (efficient) multicast
* Allowing for single hop appearance at the networking layer  
  (not breaking standard L3 mechanisms)
* Multiple route approaches within a network, possibilities include:
  + Concentric based
  + Linear (highway based)
  + Function /behavior/ priority based

Are there different device requirements?