**IEEE P802.24**

**Smart Grid TAG**

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802 applicability statement for Smart Grid

# Introduction, value and history of 802

IEEE 802 is the leading standards development organization for networking. IEEE 802 is actively developing standards for both wired and wireless networks.

The first IEEE 802 standard, 802.3 (Ethernet), was approved over 40 years ago. The first IEEE 802 wireless standard, IEEE Std 802.11, was approved in 1997. IEEE 802.15 and IEEE 802.16 both began in 1999 and have achieved substantial success as well. Other groups in IEEE 802 that are relevant to Smart Grid applications are

* 802.1 for bridging and security
* 802.21 for multicast handover
* 802.22 for wireless regional area networks (WRAN) in the TV white space (TVWS) bands

IEEE 802 has endorsed the OpenStand principles (<http://openstand.org>) which summarized below:

1. Cooperation – Respectful cooperation between standards organizations.
2. Adherence to Principles – Adherence to the five fundamental principles of standards development:
	1. Due process.
	2. Broad consensus
	3. Transparency
	4. Balance
	5. Openness
3. Collective Empowerment – Commitment by affirming standards organizations and their participants to collective empowerment..
4. Availability – Standards specifications are made accessible to all for implementation and deployment..
5. Voluntary Adoption – Standards are voluntarily adopted and success is determined by the market.

***Add M2M capabilities of 802 standards. Low power, low duty cycle***

 ***An umbrella platform that supports application layers that support sensor networks. The same network can support RFID, intelligent transportation systems, smart city applications, Internet of Things (IoT). (Kunal to provide full text, Farrokh will review). oneM2M organization.***

***Low latency options***.

Some 802 networking technologies offer the ability to bound the communication latency of a link. IEEE 802 technologies that are not based on multi-hop networks will generally offer better ability to bound the communication latency.

A list of Smart Grid standards that focus on PHY and MAC layer have been documented and approved by IEEE 802 [1].

IEEE 802 networking technologies bring the following advantages to Smart Grid communications:

* Enterprise grade security
* Backwards compatibility
* Huge ecosystem (billions of products, hundreds of manufacturers)
* Long term (20 year) battery powered operation
* Continued operation during line fault events when using wireless media.
* Wide choice of products across the spectrum of power versus performance.
* Can be implemented in resource constrained devices
* On-going development standards to address changing environment and technology.
* Wireless standards that operate in licensed and license exempt spectrum.
* A rich set of data rate/range/latency tradeoffs are possible
* Common upper layer interface to seamlessly integrate into existing IT systems

Operation in license exempt spectrum offers an alternative for the lack of licensed spectrum for utilities. TVWS is one example as a future source of spectrum.

***Ben to write mesh blurb for how it handles hard-to-reach places.***

Long term battery powered

***Add latency/data rate/range tradeoffs table? Scalable cost. (Godfrey)***

# Applications for Smart Grid

Smart Grid applications can be summarized by two categories called Advanced Metering Infrastructure (AMI) and Distribution Automation (DA).

## Advanced Metering Infrastructure

Advance Metering Infrastructure is a concept that includes a variety of advance features. The list of features includes: Utility service Outage and Restoration Management, meter reading, Demand Response, Load Management, remote service disconnection/re-connection and service pricing capabilities that include Real Time Pricing, Time of Use pricing & Critical Peak pricing.

Diagram: utility< –>WAN<- >DAP <–>FAN<->meter <-> HAN <-> consumer

***(diagram from Matt).***

## Distribution Automation

The electric power system is logically separated by three main roles, these roles include: Generation, Transmission and Distribution. Distribution Automation is a concept of extending intelligent control to the distribution system that includes the following capabilities: Voltage Optimization, Load Reduction/Optimization, system fault detection & remediation and SCADA.

## Application requirements for network communications

### Security

The security of power grid communications is vital from a national security point view. Security protocols and encryption need to be certified by international bodies. Security protocols need to be interoperable, widely deployed and with years of testing and deployment in the field

IEEE 802 link layer security is based on FIPS approved technologies and ***… (add some 802.1X)***. IEEE 802 link layer security has been widely deployed in enterprise environments where security of corporate data is of utmost importance. These protocols have been vetted by a large number of security professionals.

### Non-mains powered operations (for some devices)

***For (Need more text). Beecher***

### Coverage requirements

Fiber with IP/Ethernet frames for long runs and better integration with core IT functionality.

Communications over fiber or wireless gives resilience to induced voltage differences when operating in proximity to high voltages.

Mesh is used to get 100% coverage for hard to reach meters. 80% of the people lie within 20% of the service territory.

For shorter runs, Ethernet can provide connectivity for intra-substation networking as well as in the head end.

### Longevity, compatibility, upgradeability

Intra-substation

# Conclusions

(Gilb will write once paper is done)

# References

1. “IEEE 802 recommendations on IEEE 802 related Smart Grid standards”, https://mentor.ieee.org/802.24/dcn/12/24-12-0033-04-0000-package-of-802-smart-grid-standards.docx