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| Re: | IEEE 802.16 Session #103 GRIDMAN Call for Contributions | |
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Subject: Draft Applications Submission to IEEE GRIDMAN Task Group

Topic: Initial Summary of Applications and General Requirements

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Date: 5/16/2016

**Introduction:**

Equipment meeting the proposed must support a wide range of uses. In general, the 802.16s amendment is intended to provide more reliable, faster and more cost effective wireless communications networks to support critical infrastructure industries: “CIIs”. This paper is intended to provide initial descriptions of potential uses and applications. These descriptions may be circulated to experts at critical infrastructure companies, engineering firms and wireless equipment manufacturers in the hopes that they can revise, supplement, expand and improve upon these simple descriptions. In the end, a better understanding of the user’s requirements and applications will lead to higher quality wireless operations and generally better support of overall CII operations.

To date, I’ve included three specific applications. If this format is useful to the standardization effort, I or others may add more – either with an expanded version of this document or via separate submissions to the Working Group.

Areas where I was particularly unsure are marked in [square brackets]

**Organization of this Document:**

General Technical Standards that will apply to each application are listed first.

Then, each of initial potential applications is briefly described in the following order:

1. **Name** and Summary
2. Potential **Users** (e.g. electric utilities, water or gas companies, pipeline operators, energy production companies)
3. Identification of **typical configuration** and operating procedures
4. Draft summary of **technical requirements specific to particular applications** (e.g. range, bandwidth, latency, number of devices).

**General Technical Standards:**

Regardless of the specific application, the GRIDMAN wireless system should comply with the following:

1. The system should include its own diagnostics and have the capability to report back on the status of each remote and on the performance of the multipoint transceiver and the overall GRIDMAN system. [This diagnostic interface should comply with the \_\_\_\_\_ standard]
2. The system should support at least two Ethernet interfaces [and one serial interface] for data communications
3. The system should be type certified by the relevant governmental authorities.
4. The system should operate on government licensed channels between 100 kHz and [1000] kHz in total channel bandwidth.
5. Example frequencies include, but are not limited to,:
   1. 217-220 MHz
   2. 757-788 MHz
   3. 901-941 MHz

Applicable frequencies will vary according to national licensing rules

1. Operation to fixed remote terminals is a required capability. Operation to nomadic or mobile terminals is a desirable, but not required, option. Mobile handoff, roaming validation, and other features typically associated with commercial mobile wireless operation are not required.
2. The system should be capable of transmitting with a minimum output power of at least \_\_ watts.
3. Systems may operate in Full Duplex (Frequency Division Duplex) operation, Half Duplex (Time Division Duplex) [or simplex (one-way transmission)] modes.
4. The system should be capable of delivered two-way speeds of at least [200 kbps] per remote site provided that signal to noise ratios exceed \_\_ and carrier to interference ratios exceed \_\_\_. Faster speeds are desirable.
5. The system should support operation of over distances of up to 30 kilometers in line-of-sight situations.
6. Overall one-way latency (input to output) in the system should not exceed [\_\_ ms] in either direction.

**Application 1: Substation Connections**

1. **Substation Connections** provide a primary or secondary link from one or more substations in a given area into a utilities Surveillance Control And Data Acquisition “SCADA” network or for other data communications requirements to interconnect the substation with other substations or with higher level control stations.
2. **Users** may include electric, gas, water and wastewater utilities or any critical infrastructure company that operates a distributed network including multiple substation locations. Many such users are replacing previous wireline services – typically leased from a telephone company or other provider – with wireless connections. In some cases, previously available services have been cancelled by the wireline supplier. In other cases, additional speed or better economics are the reason for the change.
3. **Configurations** may vary, but and a user may serve a single substation on a pt-pt link or multiple substations from a central tower utilizing a pt-multipoint architecture. Substation connections are fixed, and may be line of sight, near line of sight or non-line-of-sight. In situations where the connection provides the sole or primary data communications link with between the substation and higher levels within the utility’s data communications network, it may be appropriate to include redundant electronics, antennas and power sources to allow for highly reliable service. Automatic protection switching in order to use backup equipment may also be appropriate. Substations are generally housed in secure (fenced or walled) locations, so it is often possible to mount directional antennas within substations utilizing towers, masts or the sides or roofs of buildings.
4. **Technical Requirements:** 
   1. In Pt-Multipoint configuration, the system should be able to support at least 10 remote sites.
   2. With line-of-sight operation, the system should be able to support ranges of at least 30 km. Distances may be shorter with near or non-line-of-sight operation.
   3. Uplink speed (remote to central site) for any given site should variable up to 10 times faster than downlink speed and vice-versa.
   4. The actual delivered speed should be variable by location, time, and direction so that the wireless system will flexibly allocate bandwidth to the locations that need it at any particular time.

**Application 2: Distribution Automation**

1. **Distribution Automation** is increasingly utilized by electric utilities to monitor and operate switching and control devices in their distribution networks. Such devices are designed to control the flow of power, maintain proper voltage levels and protect the system from cascading outages. Devices include Volt VAR (advanced voltage control), reclosers, capacitor banks and similar systems. Other types of utilities have distribution systems with similar functions and/or communications requirements in their gas, water and/or wastewater systems. While traditionally many of these systems operated based only on local conditions and without central monitoring or control, utilities are increasingly extending intelligent central monitoring and control to these devices. The results may include more consistent and reliable power delivery performance, better understanding of delivery network operation, reduced outage occurrences, improved time to repair and reduced fossil fuel consumption,.
2. **Users** include primarily electric utilities, although other types of utilities may have similar requirements. While long haul gas pipelines don’t really follow the Distribution Automation model, wastewater and energy production networks can be thought of as collection networks or “distribution in reverse” and [may] have similar requirements for devices that measure, report on and control flows and pressures to understand and maintain good performance.
3. **Configurations:** By their nature – indeed as implied by their name – distribution networks generally are dispersed over geographic areas of operation. Accordingly, pt.-multipoint wireless networks typically will be appropriate for the needed connections. Elements of distribution networks may be mounted on poles, in line, in pedestal configurations or even underground. In most cases, non-line-of-sight operation will be required. In many cases, the antennas utilized will be simple omnidirectional dipole or similar configurations with limited gain. The central multipoint transceiver will typically feature tower, rooftop or building side mounted panel or pole (omnidirectional) antennas.
4. **Technical Requirements**
   1. In Pt-Multipoint configuration, the system should be able to support at least 10 remote sites.
   2. With non-line-of-sight operation, the system should be able to support ranges of at least 5 km depending on transmission parameters and link configuration.
   3. Uplink speed (remote to central site) for any given site should be variable up to 10 times faster than downlink speed and vice-versa.
   4. The actual delivered speed should be variable by location, time and direction so that the wireless system will flexibly allocate bandwidth to the locations that need it at any particular time.
   5. While not required, for distribution automation, it is desirable to have systems that are capable of being installed in locations that are not protected from the elements including temperature extremes, direct sun, rain, snow, hail and wind.

**Application 3: Automatic Meter Infrastructure**

1. **Automatic Meter Infrastructure “AMI”.** At present, many utilities directly collect meter information to aggregation points using unlicensed “mesh” networks or even data-over-powerline solutions. Many Such operations have been satisfactory form basic meter reading; however once the data has been aggregated to collector/contractor points; reliability and data speed become more critical. Accordingly, GRIDMAN can be an appropriate standard for connecting area collector/concentrators to the centralized utility data communications system. In additional, newer applications, such as variable pricing or demand response to adjust to peak power situations may ultimately call for higher bandwidth & more reliable connections directly between concentrator and meter.
2. **Users** may include electric, gas and water utilities.
3. **Configuration** will typically be pt.-multipoint communicating with multiple collection points. In most cases, non-line-of-sight communication will be required.
4. **Technical Requirements:** 
   1. Two-way communication is required. For typical meter reading activities, the majority of the bandwidth will be upstream from collector/aggregation point to hub of pt.-multipoint wireless system.
   2. Reliability should exceed [97% on first attempt and 99.9%] overall after required retransmissions.
   3. Total speed should exceed 20 kbps per collection point and 200 kbps overall.
   4. As demand response, user-generated electricity and other more communications-intensive applications become more common; speed objectives may increase 1.0 Mbps overall speed per hub site.
   5. Range should exceed two kilometers in non-line-of-sight pt.-multipoint operation.
   6. The actual delivered speed should be variable by location, time and direction so that the wireless system will flexibly allocate bandwidth to the locations that need it at any particular time.
   7. While not required, for distribution automation, it is desirable to have systems that are capable of being installed in locations that are not protected from the elements including temperature extremes, direct sun, rain, snow, hail and wind.