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RENEWABLE GENERATION PLANT COMMUNICATIONS

by

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SUMMARY

This technical report has been motivating discussions on the use of Mesh Networks, to meet the demand of Electric System, in special case, Renewable Generation, as part of integration with other information systems and telecommunications, automation of operations and greater mobility to perform the services.

Mesh Network allow the inclusion of the management of Power Plant Grid's Communication System as good solution for different network sizes and applications. Interconnecting between renewable power plant, like wind turbines, reclosers, solar farms, etc. (Renewable Generation) with Collector Substations. The system provides a mean of communication to cover the operational needs, with broadband.

A feature of these Systems and flexibility for implementations, and topology changes. The facilities are simple and quick, and with reduced amount of cabling and lower infrastructure costs.

KEYWORDS

Mesh Network;

Electric System;

Renewable Generation;

Power Plant Grid's Communication System;

Flexibility.

1. INTRODUCTION

This technical paper has been motivating discussions on the use of mesh networks, to meet the demand of the Electric System within the integration with other information systems and telecommunications, automation of operations and greater mobility for performing services.

The communication systems of the companies responsible for generation, transmission and distribution of electrical system require high levels of availability and reliability, traditionally these companies use systems Power Line Carrier (PLC), Optical Systems, Networks in unlicensed 900 MHz, Cellular and WiMAX, 802.11 and Zigbee.

2. APPLICATION

These systems are covering the operational needs of companies, but in the past a new scenario is being formed, and new applications are emerging requiring greater flexibility and larger coverage areas, what happens to limit the role of technologies in use, especially needs of physical connections.

The most of countries electric system projects growth to meet increased demand population and industrial future, adding to the current model where there is predominance of hydro generation sources, sustainable energy sources, such as Wind Generation, Solar, Biomass, etc. Has shown great growth.

4.1. New Scenario

In this new scenario Generation and Distribution Companies require a communication system shall provide monitoring and coordination of the operation, demand, power outages and power quality. For the Distribution Companies an unidirectional current networks to collect data from meters, AMR: Automated Meter Reading, are giving way bidirectional networks with more advanced communication, acting beyond the collection of meters, AMI also: Automated Metering Infrastructure, supporting the management control demand.

For Business Generators, especially using renewable sources, usually plants (Wind Farms, Solar, among others) occupy large areas and large number of connection points. In traditional applications, e.g. optical fiber transmissions, the infrastructure for interconnections require long lead times for implementation, high costs and low flexibility for possible topology changes.

The systems described above bands required and the areas served, see Figure 1.

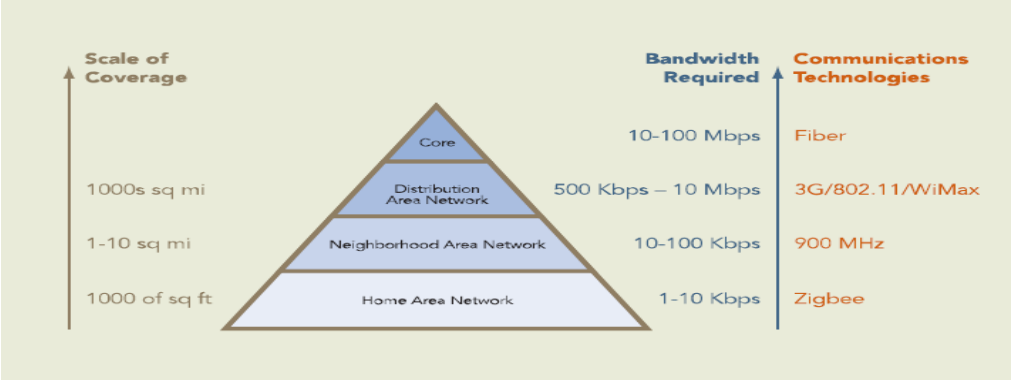

FIGURE 1 – Technologies of the Communication and Hierarchy

4.2. Features of Mesh Networks

The Mesh Networks can provide technical resources that enable the service to this new scenario. This technology meets the needs of different network sizes and different application fields, and their expansion or alteration facilitated by the features of the equipment

Mesh networks come meet this new scenario, i.e., faster deployment; lower costs and high flexibility because they require low infrastructure costs, see the figure 2.

FIGURE 2 – Wind Farm

These networks are formed by Access Points (Gateways and Nodes), which communicate with each other according to the definitions of the IEEE 802.11 and

802.16. These access points can be fixed or mobile, ensuring a great advantage of these systems in relation to other technologies currently used, which is mobility.

This mobility can be observed both in the access points installed in vehicles (trucks, cars, work force, etc.) Such as wireless clients (phones, tablets, notebooks, etc.), See Figure 2 above.

The features listed below are achieved as a result of well-designed projects, planning, RF, defining the types of services, identification of sites, area to be covered, etc. Project is part of the definition of network gateways; this provides the best system performance.

To provide service to the needs above Mesh Networks have many features, as outlined below:

a. **Infrastructure -** service needs to changes in network topology and the areas to be covered are easily answered quickly and with reduced costs for Mesh Networks. Installation is relatively quick, and the mechanical assembly is needed few points of connection to the gateways (representing 5-10% of the network) and requires two connections, power and network point, since we only need the power.
b. **Adaptability -** flexibility for growth, interconnection with other systems, applications in different areas of coverage.
c. **Wireless Coverage -** characteristic mesh networks do not necessarily need the elements (nodes and gateways) have line of sight, this is possible due to the fact that the data being transmitted through reflections, thereby avoiding interference from obstacles. The coverage of large areas becomes easier.
d. **Interoperability / interchangeability -** the new technologies used in support of the management of electrical systems, must permit interconnection with systems in operation. Ensure that different manufacturers can utilize the network for the transmission of your data, so you must seek solutions normalized. The attendance Recommendations and Standards is required.
e. **Resilience -** a major feature of mesh networks is to provide different ways (re-routing), each gateway or we run the dynamic allocation of channels and bands, power control, data rates and re-routings. This results in a high fault tolerance and high availability (99.999%) reliability and redundancy when deployed in a planned manner.
f. **Latency -** the network must provide low latency, in order to allow broadcasts in real time.
g. **Throughput -** the network should possibility high performance with data rates.
h. **Security -** for safety information, it is necessary that the network has security features such as data encryption, access control (authentication and authorization).
i. **QoS -** possibility of controlling service quality for different applications.

j. Management - to ensure full control of the network, it must have management system that allows full control of the elements, their performances, data for performance analysis, this system should be protected from unwanted users

5. APPLICATIONS IP

From the above, the growing IP applications are necessary and inherent. The Mesh Networks enable a communication system entirely appropriate for these IP applications, including SCADA Systems, Automation of substations and distribution networks, Integration Generation System with Alternative Sources (Wind, Solar, etc.), Smart Grids, Surveillance Systems (Video), IP Telephony and Mobility for field work.

The equipment has features and facilities to suit the needs of these networks, providing users the Availability, Reliability and Security expected. These systems hitherto see meeting the operational needs of companies, but in the past a new.

6. FREQUENCIES

The system operates in the frequency bands of 2.4 GHz and 5.8 GHz when applied in accordance with Resolution 506 does not require registration with the FCC, this facilitates implementations.

The channels of these ranges are chosen automatically, in order to obtain better performance and lower levels of interference.

Standards are indicated each frequency band, see Table 1, these rules as well as data about the protocols also define the velocities for each frequency band.

TABLE 1 – Standards for the frequencies

2,4 GHz	IEEE 802.11b	7 Mbps*
2,4 GHz	IEEE 802.11g	24 Mbps*
5,8 GHz	IEEE 802.11a	24 Mbps*

NOTE: Due to the header (overhead) protocol of 802.11
Typical rates of 11 Mbps (7 Mbps) and 54 Mbps (24Mbps) are not achieved in throughput.

7. QUALITY OF SERVICE

As defined in RFC 2386, QoS is a set of requirements that must be met to be secured data transmission end to end.

Services (data and VoIP) to be transmitted require excellent rates for quality (QoS). With a good network planning, high levels of QoS are met. As no communication between the network nodes, the contention traffic (inbound and outbound) within the nodes, number of nodes for an end to end communication and negotiation for access between neighbouring nodes can interfere with the QoS

Another important factor that adds complexity to ensure the QoS in mesh networks is the application of mobility. When there is mobility of nodes, connections are changed to the closest nodes of the mobile unit, but the connections that these mobile units already had with the network still exist. This mobility can be called macro-mobility and inter-domain.

The Mesh Networks should allow conditions to adjust the QoS settings for different services to be met, for example you can define a VoIP service has priority, 802.1p, higher than the other services. This procedure is part of the project development.

7.1. Security

Security is one of the most important factors in most networks, and should be included in project planning. Thus the networks should allow resources to enable applications in IP.

7.1.1 802.1x Authentication

Server that identifies clients through digital certificates, atuamente the most used method is RADIUS (Remote Authentication Dial-In User Service).

7.1.2 WPA with predefined keys

For systems that do not have non-centralized authentication servers, mesh networks should provide security through WPA1 or WPA2, so to access the mesh network users are identified by predefined keys.

7.1.3 Level Encryption in Wireless (WEP, WAP)

Complementing the above item, mesh networks must also provide WEP (Wired Equivalent Privacy).

7.1.4 Suppressing the ESSID

Another method to provide greater security to networks, and suppressing the ESSID for specific users, so these users can not be detected by intruders.

7.1.5 MAC Address Filter

The filter prevents the MAC address identification devices.

7.1.6 Filters for nearby networks

During the preparation of the project when there nearby networks, the networks should enable the creation of filters that allow only traffic end to end using VPNs (Virtual Private Network), see Figure 3 below.

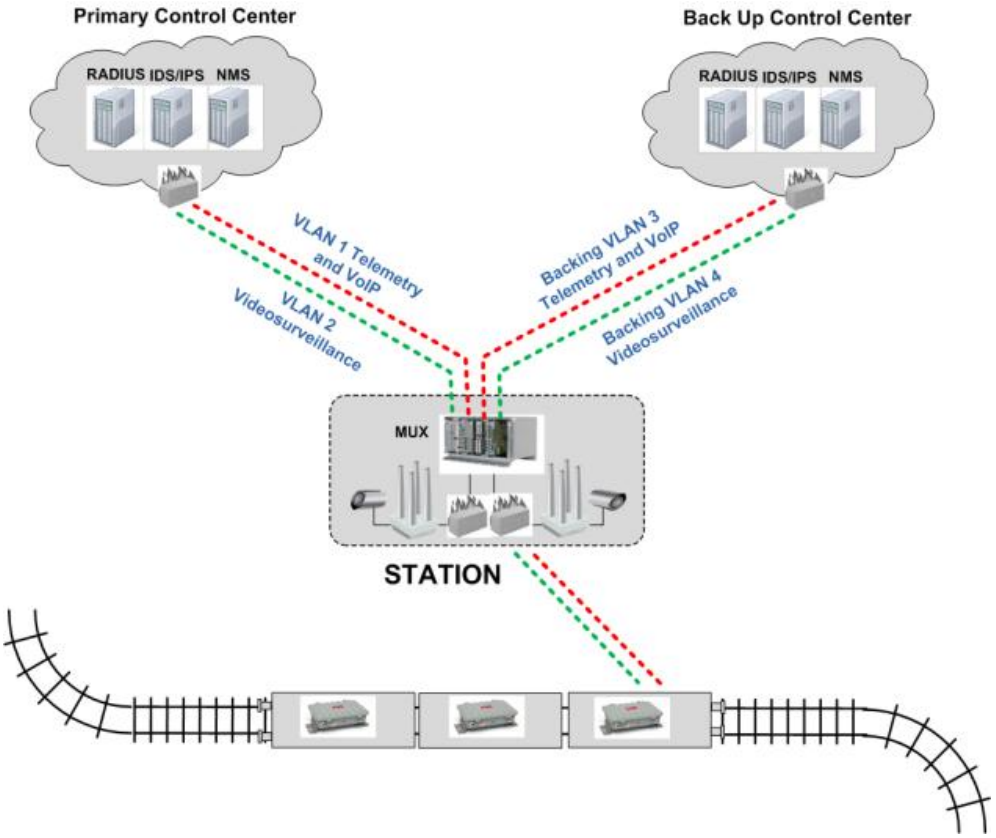

FIGURE 3 – VPN Configuration

7.1.7 Suppressing the ESSID

Another method to provide greater security to networks, and suppressing the ESSID for specific users, so these users can not be detected by intruders.

7.1.8 MAC Address Filter

The filter prevents the MAC address identification devices.

7.1.9 Filters for nearby networks

Networks should allow control of the lit routers via https, ssh and other managements of ports by addressing the IP subnet.

8. CONCLUSION

The Mesh Networks enable all required infrastructure for applications with IP addressing. As described here in these networks were developed mainly to the highest levels of security required in IP applications.

As the operations of the companies go through constant evolution processes, require increasingly advanced forms of control and integration, and using large-scale applications increasingly facing IP networks, the use of this technology, Mesh Network, will call flexible where complex areas, such as cities, can be met with advantages over currently used systems.

It is known that IP networks also undergo processes of evolution, covering larger areas, transmitting information with higher rates and steady growth of the need for security, see Mesh Networks cover this new scenario.

Many challenges exist for this new technology, with the objective coverage of operations:
- Large scale integration of renewable energy into the electrical system and the Cities
- Integration of distributed and generation form of economy
- Energy Efficiency, Demand Control and Load Control
- Efficiency, Reliability, Security and Stability of Power System

In Brazil some applications in Wind Farm to provide the control of the operation, including mobility. Other large application of the Mesh Network is in Railway systems and Mines over /under ground, to provide all communication infra structure.

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10.0 BIOGRAPHICAL DATA

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