

## A Brief Study on Wireless Communication Network Architecture and Sensor Networks

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**Abstract :** In today's focused the operational and business requests of electric utilities require an elite information correspondence arrange that backings both existing functionalities and future operational necessities. In this appreciation, since such a wireless communication network constitutes the core of the electric system automation applications, the design of cost-effective and reliable system engineering is urgent. In this paper, the open doors and difficulties of half breed system engineering are talked about for electric framework automation applications of wireless networks. All the more specific, Internet based Virtual Private Networks, power line correspondences, satellite interchanges and remote interchanges of sensor networks are depicted in point of interest. The inspiration of this paper is to give a superior comprehension of the system engineering that can provide a brief idea of heterogeneous wireless networking system automation application necessities. In such manner, our point is to exhibit an organized structure for electric utilities that plan to use new correspondence advancements for automation of cutting edge wireless networks.

**Keywords:** System Automation, Internet based Virtual Private Network, Power Line Communication, Satellite Communication, Wireless Sensor Networks, Wireless Mesh Networks, WiMAX.

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### I. Introduction

Electric utilities, especially in urban zones, persistently experience the test of giving dependable energy to end users at focused costs. Gear disappointments, lightning strikes, mishaps, and regular disasters all causes power unsettling influences and blackouts and frequently bring about long administration interferences. Electric framework mechanization, which is the production of a dependable, self-recuperating electric framework that quickly reacts to constant occasions with proper activities, plans to keep up continuous force administration. The operational and business requests of electric utilities require a high performance information correspondence organize that backings both existing functionalities and future operational necessities. Subsequently, the outline of the system engineering is vital to the execution of the framework. Late improvements in correspondence innovations have empowered solid remote control frameworks, which have the capacity of checking the continuous working conditions and execution of electric frameworks. These correspondence advances can be classier into four classes, Power Line Communication [2], Satellite [19] Communication, Wireless [6] Communication, and Optical Fiber Communication. Every correspondence innovation has its own particular favorable circumstances and disservices that should be assessed to decide the best correspondence innovation for electric framework computerization. With a specific end goal to stay away from conceivable interruptions in electric frameworks because of startling disappointments, an exceedingly solid, versatile, secure, strong and cost effective correspondence system [12][16] in the middle of substations and a remote control focus is key. This elite correspondence system ought to additionally ensure extremely strict Quality of Service (QoS) prerequisites to keep the conceivable force unsettling influences and blackouts. At the point when the correspondence necessities of electric framework automation are viewed as, Internet can offer an option correspondence system to remotely control and screen substations in a practical way with its effectively existing correspondence foundation. Nonetheless, Internet cannot ensure extremely strict QoS prerequisites that the automation applications request, since information correspondence in Internet depends on best exertion administration worldview. Moreover, when an open system like the Internet is used to interface the substations to a remote control focus, security concerns emerge. In this context, Internet based Virtual Private Network (VPN)[9] advancements, which are changing the Internet into a safe rapid correspondence system, constitute the foundation for giving strict QoS certifications of electric framework automation applications. Web VPN advancements offer a mutual correspondence system spine in which the expense of the system is spread over countless while all the while giving the benefits of a devoted private system. Thusly, Internet VPN innovation as a fast correspondence center system can be used to empower least cost and exceedingly solid data sharing for computerization applications.

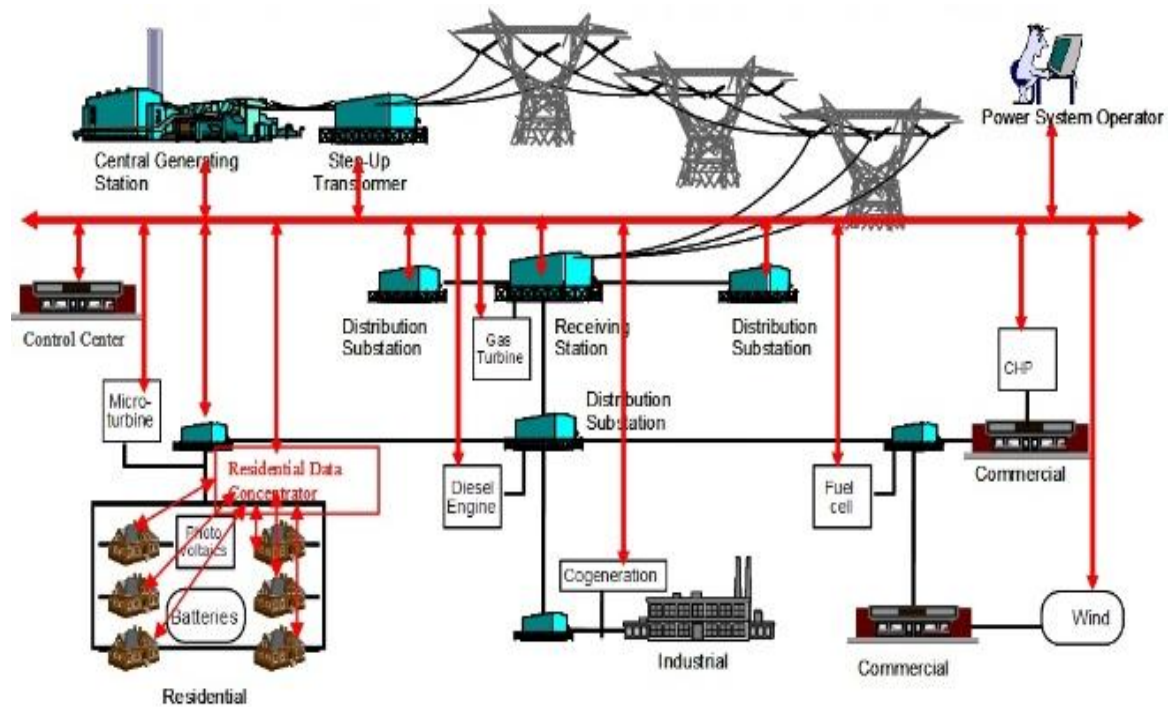


Fig.1.The overall communication network architecture for electric system automation.

This may not be the situation for substations in remote rustic areas where the fast correspondence is a center system. Consequently, when the individual correspondence abilities and areas of electric frameworks are considered, it is fitting to consider the general correspondence base as a half and half system as appeared in Fig. 1. This half and half system comprises of two separate parts:

- **High Speed Communication Core Network:** It can be either a private system or open system. Because of a few specialized preferences, Internet based Virtual Private Network can be considered as a financially savvy rapid correspondence center system for electric framework automation.
- **Last Mile Connectivity:** It speaks to the test of associating the substations to the fast correspondence center system. The correspondence innovations for last mile availability can be classified as: i) Power line correspondence, ii) Satellite correspondence, iii) Optical fiber correspondence, and iv) wireless [20] correspondence. Every conceivable correspondence option for last mile network presents its own particular focal points and drawbacks.

Numerous specialists and a few worldwide associations are at present adding to the required correspondence advancements and the universal correspondence standard for electric framework computerization. The outline of these correspondence framework improvement exercises is exhibited. Regardless of the impressive measure of continuous exploration, there still remains a significantly difficult errand for the examination group to address both benefits and weaknesses of every correspondence innovation. Subsequent to practical information correspondence system constitutes the center of the computerization applications, in this paper, the open doors and difficulties of a half breed system engineering are depicted for automation applications. All the more specifically, Internet based Virtual Private Networks [15], power line interchanges, satellite communications and remote interchanges are examined in point of interest. The inspiration of this paper is to give a superior comprehension of the cross breed system design that can give heterogeneous [17] electric framework computerization application necessities. In this regard, our point is to display an organized structure for electric utilities who plan to use new correspondence advancements for mechanization and subsequently, to make the decision making handle more powerful and direct.

## II. Internet Based Virtual Private Networks

Late advances in Internet innovation and Internet-prepared IEDs have empowered cost effective remote control frameworks, which makes it plausible to bolster numerous computerization application administrations, e.g., remote access to IED/hand-off configuration ports, analytic occasion data, and video for security or gear status appraisal in substation and programmed metering. While conventional private Supervisory Control and Data Acquisition frameworks constitute the center correspondence system of today's electric utility frameworks,

the Internet based Virtual Private Network innovation gives an option financially savvy rapid correspondence center system for remote checking and control of the electric framework.

Specifically, Internet VPN innovation is a mutual correspondence system design, in which the expense of the system is spread over countless while all the while giving both the functionalities and the benefits of a committed private system. In this way, the primary goal of an Internet VPN for electric framework mechanization is to give the required financially savvy elite correspondence in the middle of IEDs and a remote control focus over a mutual system base with the same strategies and administration ensures that the electric utility encounters inside of its devoted private correspondence system. With a specific end goal to accomplish this goal, the Internet VPN arrangement ought to give the accompanying fundamental execution properties:

- **Quality of Service (QoS):** Web innovation itself can't promise exceptionally strict QoS necessities that utility applications require, since information correspondence in the Internet is basically in light of a best exertion administration worldview. In this admiration, QoS capacities of Internet VPN advances guarantee the prioritization of mission basic or postponement delicate traffic and oversee system clog under changing system traffic conditions over the mutual system base.

- **Reliability:** The correspondence system ought to have the capacity to work persistently over an expanded time [10] frame, indeed, even in the vicinity of system component disappointments or system clog. To accomplish this, the correspondence system ought to be legitimately outlined with the target of no misfortunes in every single working condition and ready to manage disappointment nimbly. Administration suppliers bolster Service Level Agreements (SLAs), which define the specific terms and execution measurements with respect to accessibility of system assets and offer the Internet VPN endorser a contractual certification for system administrations and system uptime. Along these lines, Internet VPN innovation ought to convey information in a dependable and opportune way for automation applications.

- **Scalability:** Since the quantity of substations and remote gadgets is vast and becoming quickly, the correspondence framework must have the capacity to manage extensive system topologies without expanding the quantity of operations exponentially for the correspondence system. Along these lines, the composed half and half system engineering ought to scale well to suit new correspondence prerequisites driven by client requests.

- **Robustness:** with a specific end goal to abstain from breaking down correspondence execution because of changing system traffic conditions, the dimensioning procedure to dole out the data transfer capacity to the virtual connections of the Internet VPN ought to be constructing not just in light of the primary transmission capacity request framework. In the event that the system clog cannot be maintained a strategic distance from with the present system traffic, low ought noncritical information traffic to be blocked so that the most basic information can be transmitted with QoS ensures [24]. Along these lines, extra transfer speed for high need information gets to be accessible to empower the constant correspondence of basic information, which is especially essential if there should be an occurrence of alerts in electric frameworks.

- **Security:** Security is the capacity of supporting secure correspondence between a remote control focus and field gadgets keeping in mind the end goal to make the correspondence safe from outer dissent of administration (DoS) assaults and interruption. At the point when an open system like the Internet is used to associate the field gadgets to a remote control focus, security concerns can emerge. Subsequently, Internet VPN needs to provide secure data transmission across an existing shared Internet spine and along these lines, ensure touchy information with the goal that it gets to be confidential over the common system.

- **Network Management:** keeping in mind the end goal to give the correspondence necessities of computerization applications, electric utilities request flexible and versatile system administration capacities. The essential system administration abilities of Internet VPN include: i) data transmission star visioning, ii) introducing security and QoS strategies, iii) supporting Service Level Agreements, iv) flaw identification and determination, v) expansion and evacuation of system substances, vi) change of system capacities, vii) bookkeeping, charging and reporting. Notwithstanding these system management capabilities, Internet VPN technology can enable fast execution and conceivable modifications of the correspondence system at a sensible expense. Consequently, Internet VPN innovation with powerful system administration approaches gives a flexible practical arrangement that can be effortlessly adjusted to future correspondence necessities that utility computerization applications request. Regardless of the broad examination in Internet VPN innovations, there are still a few open exploration issues, e.g., efficient asset and course administration systems, between space system administration, that should be created for automation applications. In the present writing, two extraordinary and correlative VPN models in light of Multi-Protocol Label Switching (MPLS) and IP Security

(IPsec) innovations are rising to shape the prevalent correspondence outline work for conveyance of superior VPN administrations. In, we look at both the points of interest and weaknesses of MPLS based VPN and IPsec VPN designs regarding execution qualities depicted previously. As appeared in, every Internet VPN innovation underpins the execution credits to shifting degrees and in this manner, the most proper decision relies on upon the specific correspondence prerequisites of the electric utilities. In, a choice tree for picking a proper Internet VPN innovation for electric framework automation is shown. As appeared in, if an electric utility requires a superior correspondence system guaranteeing exceptionally strict Quality of Service (QoS) prerequisites, the following choice point in the choice tree can be the measure of the correspondence system, i.e., the quantity of correspondence elements that should be interconnected. Electric utilities that need to interface a substantial number of substations and a remote control focus ought to favor financially savvy MPLS based Internet VPN innovation, since they can decrease the correspondence cost significantly contrasted with devoted private rented correspondence lines. The quantity of destinations is not expansive in the system; electric utilities can use a mixture system including IP Sec Internet VPN and layer 2 innovations, for example, Frame Relay and ATM for the automation applications. On the off chance that there are no QoS correspondence necessities, the conceivable choices incorporate either utilizing open Internet when no protected correspondence is required or utilizing an IP Sec Internet VPN when secure correspondence is required in computerization applications. Truth be told, the real determination of Internet VPN innovation relies on upon a few components, for example, the expense of correspondence engineering, geographic scope of the correspondence design, the areas of substations and a remote control focus, administration level understandings, system administration sorts, i.e., client based or organize based administration, and so on. Subsequently, electric utilities ought to assess their extraordinary correspondence prerequisites and the abilities of Internet VPN innovations extensively keeping in mind the end goal to decide the best Internet VPN innovation for automation applications.

### **III. Last Mile Connectivity For Electric Utilities**

In this segment, both points of interest and hindrances of conceivable correspondence advancements for last mile availability are clarified in subtle element. The correspondence advancements assessed for last mile network are: i) Power Line Communication, ii) Satellite Communication, iii) Optical Fiber Communication, iv) Wireless Communication [7].

**A. Power Line Communication** Power Line Communication (PLC) is transmission of information and power at the same time over existing electrical cables as a different option for developing committed interchanges base. In spite of the fact that PLC has been in operation since the 1950s as low information rate administrations, for example, remote control of force network gadgets, it has turned out to be more imperative as of late because of improvements in innovation, which empower PLC's potential use for rapid correspondences over medium (15/50 kV) and low (110/220 V) voltage electrical cables. Nonetheless, there are still a few specialized issues and administrative issues that are uncertain. Also, a far reaching hypothetical and viable methodology for PLC is as yet lost and there are just a couple general results on a definitive execution that can be accomplished over the electrical cable station. Subsequently, industrially deployable, rapid, long separation PLC still requires further research endeavors regardless of the way that PLC may give an option financially savvy answer for the last mile availability issue. In the accompanying, we clarify both preferences and disservices of electrical cable correspondence innovations for automation applications.

#### **Advantages:**

- **Extensive Coverage:** PLC can give a broad scope, since the electrical cables are as of now introduced all over. This is invaluable particularly for substations in country regions where there is typically no correspondence framework.
- **Cost:** The correspondence system can be set up rapidly and expense successfully in light of the fact that it uses the current wires to convey the correspondence signals. In this way, PLC can offer substations new cost-saving techniques [3] for remotely observing force uses and blackouts.

**Burdens:** High clamor sources over electrical cables: The electrical cables are boisterous situations for information interchanges because of a few commotion sources, for example, electrical engines, power supplies, fluorescent lights and radio [11] sign impedances. These clamor sources over the electrical cables can bring about high piece mistake rates amid correspondence which seriously debase the execution of PLC.

- **Capacity:** New mechanical advances have as of late empowered a model correspondence modem which accomplishes a most extreme aggregate limit of 45 Mbps in PLC. In any case, since electrical cable is a mutual medium, the normal information rate per end client will be lower than the aggregate limit contingent upon incidental use, i.e., the quantity of user son the network kit the same time and the applications they are utilizing.

In this way, conceivable specialized issues ought to be exhaustively tended to with different field tests before the PLC innovation is broadly sent.

- **Open circuit issue:** Communication over the electrical cables is lost with gadgets in favor of an open circuit. This seriously confines the helpfulness of PLC for applications particularly including switches, recloses and sectionalizes.

- **Signal weakening and bending:** In electrical cables, the constriction and contortion of signs are colossal because of the reasons, for example, physical topology of the force system and burden impedance fluctuation over the electrical cables. What's more, there is significant signal constriction at specific recurrence groups because of wave reflection at the terminal focuses. Along these lines, the correspondence over electrical cables may be lost because of high flag lessening and bending.

- **Security:** There are some security attentiveness toward PLC emerging from the way of electrical cables [20]. Power links are not bent and utilize no protecting which implies electrical cables create a decent measure of Electro Magnetic Interference (EMI). Such EMI can be gotten through radio recipients effortlessly. In this way, the correct encryption strategies must be utilized to keep the capture of basic information by an unapproved individual.

#### **A. Satellite Communication**

Satellite Communication can offer creative answers for remote control and checking of substations. It gives a broad geographic scope, and therefore, can be a decent option correspondence foundation for electric framework automation so as to achieve remote substations where other correspondence bases, for example, phone or cell systems won't not exist. In commonsense applications, Very Small Aperture Terminal (VSAT) satellite administrations are as of now accessible that are particularly custom-made for remote substation checking applications. Besides, with the most recent advancements in electric framework automation, satellite correspondence is not just utilized for remote control and observing of substations additionally utilized for Global Positioning System (GPS) based time synchronization, which gives microsecond precision in time synchronization. Likewise, satellites can be utilized as reinforcement for the current substations correspondence system. If there should arise an occurrence of blockage or connection disappointments in correspondence, basic information traffic can be directed through satellite. In the accompanying, we exhibit both points of interest and drawbacks of satellite correspondence advances.

#### **Favorable circumstances:**

- **Global Coverage:** Satellite correspondence bolsters a wide geological scope autonomous of the real land separation between any pair of conveying elements. In the event that no correspondence foundation exists, particularly for remote substations, satellite correspondence gives a financially savvy arrangement.

- **Rapid establishment:** Satellite correspondence offers clear preferences as for the establishment of wired systems. A remote substation can join a satellite correspondence system by just securing the vital specialized gear without the requirement for cabling to get rapid administration. Cabling is not a savvy or a straightforward employment when the substation is situated in a remote spot. Because of temperate reasons, a few utilities have as of now introduced satellite correspondence for country substations observing.

#### **Inconveniences:**

- **Long Delay:** The round-outing delay in satellite correspondence, particularly for Geostationary Earth Orbit (GEO) satellites<sup>1</sup>, is considerably higher than that of physical correspondence joins. The vehicle conventions created for physical correspondence connections, for example, TCP are not suitable for satellite correspondence, since vital information rate conformities of TCP can take quite a while in high delay systems, for example, satellite systems. Then again, it is conceivable to diminish the round-trek delay by using satellites in lower orbits. Particularly, LEO satellites offer significantly decreased postponement, which is equivalent to that of physical systems.

- **Satellite station attributes:** Different from cabled and terrestrial network communications, satellite channels qualities change contingent upon the climate conditions and the impact of blurring, which can vigorously corrupt the execution of the entire satellite correspondence framework. In this way, these correspondence difficulties ought to be taken in to account while evaluating the communication advances for electric framework automation.

- **Cost:** Although satellite correspondence can be a cost effective answer for remote substations if whatever other correspondence framework is not accessible, the expense for working satellites for all substation correspondence systems is still higher than that of other conceivable correspondence alternatives. High starting venture for satellite handsets is one of the impediments of satellite correspondence.

### **B. Optical Fiber Communication**

Optical fiber correspondence frameworks, which were first presented in the 1960s, offer significant focal points over conventional copper-based correspondence frameworks. In electric framework computerization, an optical fiber correspondence framework is one of the actually appealing correspondence foundations, giving greatly high information rates. Furthermore, it's Electro Magnetic Interference (EMI) and Radio Frequency Interference (RFI) insusceptibility attributes make it a perfect correspondence medium for high voltage working environment in substations. Besides, optical fiber correspondence frameworks bolster long separation information correspondence with less number of repeaters<sup>2</sup> contrasted with conventional wired systems. This prompts lessened foundation costs for long distance communication that substation monitoring [14] and control applications request. For instance, the run of the mill T-1 or coaxial correspondence framework requires repeaters about each 2 km while optical fiber correspondence frameworks require repeaters about each 100-1000 km. Albeit optical fiber systems have a few specialized favorable circumstances contrasted with other wired systems, the expense of the optical fiber itself is still costly to introduce for electric Satellites can be classified into Geostationary Earth Orbit (GEO) satellite, Middle Earth Orbit (MEO) satellite, Low Earth Orbit(LEO) satellite according to the circle elevation over the world's surface. <sup>2</sup>In long separation correspondences, it is important to acquaint repeaters intermittently all together with make up for the lessening and bending of the correspondence signals utilities. Be that as it may, the tremendous data transmission limit of optical fiber makes it workable for substations to impart the transfer speed ability to flip side clients which significantly recoups the expense of the establishment. In this admiration, optical fiber correspondence frameworks may be practical in the rapid correspondence system spine since optical fibers are now generally sent in correspondence system spines and the expense is spread over an expansive number of clients. Therefore, fiber optic systems can offer elite and very dependable correspondence when strict QoSsubstations correspondence necessities are considered. In the accompanying, we portray both points of interest and hindrances of optical fiber correspondence for automation applications.

#### **Points of interest:**

- **Capacity:** Extremely high transmission capacity limit of optical fiber correspondence can give superior correspondence to automation applications. Current optical fiber transmission frameworks give transmission rates up to 10 Gbps utilizing single wavelength transmission and 40 Gbps to 1600 Gbps utilizing wavelength division multiplexing<sup>3</sup> (WDM). What's more, low piece blunder rates (BER=10<sup>-15</sup>) in fiber optic correspondence are watched. Because of high data transmission limit and low BER qualities, optical fiber is utilized as the physical layer of Gigabit and 10 Gigabit Ethernet systems.
- **Immunity attributes:** Optical fibers don't transmit significant vitality and don't get obstruction from outside sources. In this manner, contrasted with electrical transmission, optical fibers are more secure from tapping furthermore safe to EMI/RFI obstruction and crosstalk.

#### **Hindrances:**

- **Cost:** Although fiber optic systems have a few specialized favorable circumstances, the expense of its establishment may be costly with a specific end goal to remotely control and screen substations. Nonetheless, fiber optic systems may be a practical correspondence base for fast correspondence system spines, since optical fibers are as of now broadly sent in the correspondence system spines and the expense is spread over countless.

## **IV. Remote Communication**

Several wireless communication technologies currently exist for electric framework computerization. At the point when contrasted with traditional wired correspondence systems, remote correspondence advancements have potential benefits keeping in mind the end goal to remotely control and screen substations, e.g., investment funds in cabling expenses and quick establishment of the correspondence foundation. Then again, remote correspondence is more helpless to Electro Magnetic Interference (EMI) and regularly has confinements in bandwidth capacity and maximum distance among communication gadgets. Besides, since radio waves in remote correspondence spread noticeable all around, listening stealthily can happen Wavelength division multiplexing (WDM) is a successful way to deal with endeavor the transfer speed limit accessible in optical fiber. In WDM, different wavelengths are utilized to convey a few information streams at the same time over the same fiber. What's more, it may be a danger for correspondence security. Electric utilities investigating

remote correspondence alternatives have two options; i) using a current correspondence base of an open system, e.g., open cell systems, ii) introducing a private remote system.

Using a current correspondence base of an open system may empower a practical arrangement because of the reserve funds in required beginning speculation for the correspondence foundation. Then again, private remote systems empower electric utilities to have more control over their correspondence system. In any case, private remote systems require a significant establishment venture and also the upkeep cost. In electric framework computerization, remote correspondence innovation has as of now been sent. As of late, Short Message Service (SMS) usefulness of the computerized cell system has been connected with a specific end goal to remotely control and screen substations. The control channel of the phone system is likewise used in some caution based substation checking cases. Be that as it may, both of these correspondence innovations are suited to the applications that send a little measure of information and therefore, they cannot give the strict Quality of Service (QoS) necessities that continuous substation checking applications request. In the accompanying, we portray both points of interest and drawbacks of remote correspondence advances.

**Points of interest:**

- **Cost:** Utilizing a current remote correspondence system, e.g., cell system, may empower a financially savvy arrangement because of the funds in required starting venture for the correspondence base. In remote correspondence, cabling expense is additionally wiped out.

- **Rapid Installation:** The establishment of remote correspondence is quicker than that of wired systems. Remote correspondence gives more flexibility contrasted with wired systems. Inside of radio scope, correspondence elements can begin to convey after a short correspondence framework establishment.

Drawbacks:

- **Limited Coverage:** Private remote systems give a constrained scope, e.g., the scope of IEEE 802.11b is roughly 100 m [19]. Then again, using existing open remote system, e.g. cell system, or WiMAX innovation can bolster considerably more broad scope contrasted with remote neighborhood. Be that as it may, some land territories, e.g., remote rustic areas, might in any case not have any remote correspondence administrations.

- **Capacity:** Wireless correspondence innovations give normally bring down QoS contrasted with wired correspondence systems. Because of constraints and obstruction in radio transmission, a restricted data transfer capacity limit is upheld and high piece mistake rates ( $BER = 10^{-2}$  to  $10^{-6}$ ) are seen in correspondence. What's more, since remote correspondence is in a mutual medium, the application normal information rate per end client is lower than the aggregate transmission capacity limit, e.g., greatest information rate of IEEE 802.11b is 11 Mbps while the normal application information rate is roughly 6 Mbps. In this way, every level in the communication protocol stacks hold adapt to wireless connection qualities in a proper way, considering the versatile methodologies at alternate layers, with a specific end goal to enhance system correspondence execution.

- **Security:** Wireless correspondence postures genuine security challenges subsequent to the correspondence signs can be effectively caught by adjacent gadgets. Along these lines, efficient confirmation and encryption procedures ought to be connected keeping in mind the end goal to give secure correspondence. Note that with the late advances in remote correspondences and computerized hardware, cross breed system models have empowered option adaptable remote correspondence frameworks, which can give strict nature of administration (QoS) prerequisites of automation applications. The subtle elements of these late remote technologies, i.e., wireless sensor [4] networks, WiMAX and wireless lattice systems, are depicted in the accompanying segments.

## **V. Remote Sensor Networks For Automation**

In this area, we clarify the open doors and difficulties of remote sensor systems (WSNs) and present outline goals and necessities of WSNs for electric framework automation applications. When all is said in done, remote sensor systems are made out of a substantial number of minimal effort, low power and multifunction nodes that are small in size and communicate un-fastened over short separations. The continually expanding abilities of these modest sensor [8] hubs empower catching different physical data, e.g., commotion level, temperature, vibration, radiation, and so forth, and in addition mapping such physical qualities of nature to quantitative estimations. The communitarian way of WSNs brings a few points of interest over customary detecting including more noteworthy adaptation to internal failure, enhanced precision, bigger scope range and extraction of restricted components. In this admiration, remote sensor systems empower ease and low power remote correspondence for electric framework computerization applications, particularly in urban regions. Besides, in the range of electric utility estimation frameworks, WSNs are utilized as a part of remote programmed meter perusing (WAMR) frameworks, which can decide ongoing vitality utilization of the clients precisely. WAMR frameworks are vital for electric utilities, since they can diminish operational expenses and

empower remotely controlled flexible administration frameworks in view of ongoing vitality utilization insights. Along these lines, WSNs give an option ongoing observing framework for electric utilities with the possibility to enhance business execution and specialized unwavering quality of different electric utility operations. In WSNs, the engineering of the system relies on upon the reason for the application. In light of the application necessities, the sensor hubs are scattered in a sensor field as appeared in Fig. 5. Each of these scattered sensor hubs has the capacity to gather information and course information back to the sink hub in a multi bounce way . In this engineering, the part of the sink hub is to screen the general system and to correspond with the undertaking chief, e.g., control focus in the force utility, keeping in mind the end goal to choose the suitable activities. The sink hub can speak with the assignment director by means of Internet or satellite.

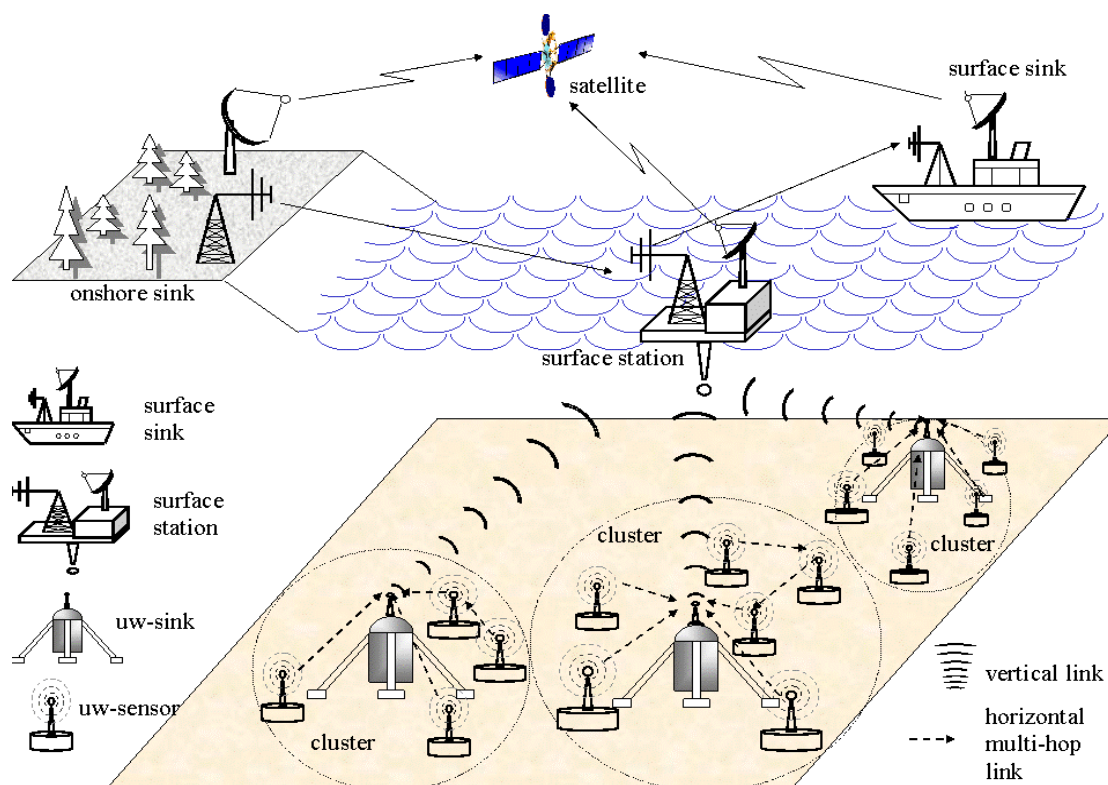


Fig.2. An illustrated architecture of wireless sensor networks [18].

#### Advantages of Wireless Sensor Networks for Automation

Wireless Sensor Network (WSN) innovation has made new correspondence ideal models for continuous and dependable checking necessity of the electric frameworks. A portion of the benefits that can be accomplished utilizing WSN innovations are highlighted as takes after:

- **Monitoring in cruel situations:** The sensors in WSNs are rough, solid, self configurable and unaffected by great surrounding conditions, e.g., temperature, weight, and so forth. In this manner, WSNs can work even in brutal situations and dispose of the cabling necessity in electric frameworks.
- **Large scope:** WSNs can contain countless isolated sensor hubs that don't require human mediation. In spite of the fact that the scope of a solitary sensor hub is little, thickly appropriated sensor hubs can work all the while and cooperatively so that the coverage of the whole network is extended. Therefore, the scope constraints of conventional detecting frameworks can be tended to efficiently.
- **Greater fault to clearance:** The dense deployment of sensor hubs prompts high connection in the detected information. The associated information from neighboring sensor hubs in a given arrangement territory makes WSNs more blame tolerant than ordinary sensor frameworks. Because of information repetition and the circulated way of WSNs, sufficient checking data can be transported to the remote control focus even on account of sensor and course disappointments.
- **Improved exactness:** The aggregate exertion of sensor hubs empowers precise perception of the physical marvel contrasted with customary checking frameworks. Also, different sensor sorts in WSNs give the capacity of observing different physical marvels in the electric framework.
- **Efficient correspondence:** Instead of sending the crude information to the remote control focus specifically, sensors hubs can locally filter the detected information as indicated by the application necessities and transmit



just the handled information. In this way, just essential data is transported to the remote control focus and correspondence overhead can be significantly lessened.

- **Self configuration and association:** The sensor hubs in WSNs can be quickly sent and progressively reconfigured in view of the self configuration capacity of the sensor hubs. The specially appointed engineering of WSNs likewise conquers the difficulties raised from the foreordained foundation prerequisites of customary correspondence systems. All the more specifically, new sensor hubs can be added to supplant fizzled sensor hubs in the arrangement field and existing hubs can likewise be expelled from the framework without influencing the general target of the observing arrangement of the electric utility.
- **Lower cost:** WSNs are relied upon to be less costly than ordinary observing frameworks, on account of their little size and lower cost and in addition the simplicity of their organization.

## VI. Wimax And Wireless Mesh Networks For Automation

Review that the proposed half and half system design comprises of different sorts of systems including Internet VPN, remote sensor systems, WiMAX and remote cross section systems. In the past segments, we depicted the points of interest of Internet VPN advancements and remote sensor systems for electric utilities. In this area, we concentrate on remote cross section systems and WiMAX innovation for electric framework computerization applications. In, a delineation of the half and half system engineering using WiMAX innovation and remote cross section systems is appeared. In this half and half engineering, an arrangement of electric utility supporters is grouped into remote cross section areas, where every space has a littler measurement contrasted with the worldwide system. Henceforth, every remote lattice space can be effortlessly overseen by the incorporated correspondence elements, which are called as nearby control focuses. Moreover, in this engineering, every remote lattice bunch is checked by a remote control focus utilizing WiMAX. In this way, with the reconciliation of remote lattice systems and WiMAX, electric utilities can completely abuse the benefits of different remote systems. The primary parts of the proposed half and half system design are briefly depicted as takes after:

- **Wireless Mesh [1] Domains:** In the proposed crossover system engineering, remote lattice spaces constitute a completely associated remote system among every electric

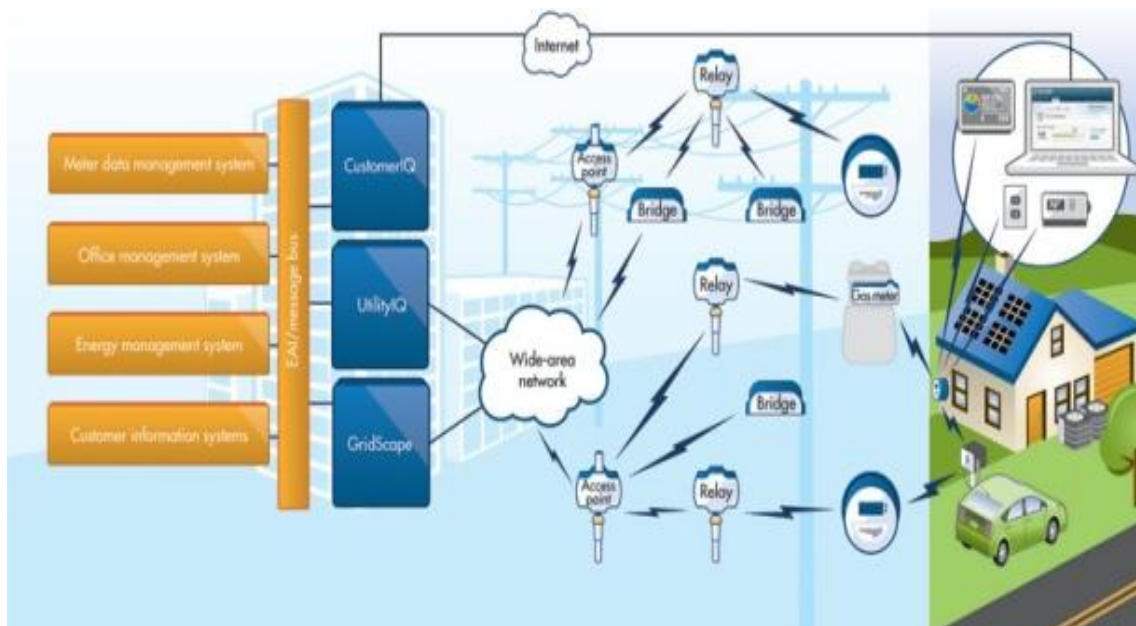


Fig. 3.A delineation of crossover system design utilizing WiMAX and remote lattice systems.

**Utility supporter.** Unique in relation to conventional remote systems, every remote cross section space is progressively self-organized and self-configured. At the end of the day, the hubs in the cross section arrange consequently set up and keep up system availability. This element brings numerous focal points for electric utilities, for example, low in advance cost, simple system support, power, and dependable administration scope. What's more, with the utilization of cutting edge radio advancements, e.g., various radio interfaces and keen reception apparatuses, system limit can be expanded significantly. In addition, the portal and extension functionalities in cross section switches empower the coordination of remote lattice spaces with different existing remote systems, for example, remote sensor systems, remote fidelity, and WiMAX. Subsequently, through a coordinated remote lattice system, electric utilities can exploit numerous remote systems.

• **WiMAX Backbone:** The essential long separation correspondence between neighborhood control focuses and a remote control focus is given using overall between operability to microwave access (WiMAX) innovation. With the coordination of WiMAX innovation, the limit of the system spine can be expanded up to 75 Mbps. What's more, WiMAX offers an institutionalized correspondence innovation for point-to-multipoint remote systems, i.e., IEEE 802.16 standard. This empowers interoperability between various seller items, which is another imperative sympathy toward electric utilities. Moreover, not quite the same as customary point-to-multipoint systems, WiMAX innovation additionally bolsters non-observable pathway correspondence. Subsequently, electric frameworks experiencing ecological impediments can benefit from WiMAX innovation to enhance the execution of their correspondence framework. WiMAX innovation, especially the IEEE 802.16e standard, likewise concentrates on low inactivity handoff administration, which is essential for correspondences with clients moving at vehicular paces.

## VII. Conclusion

The outline of practical and dependable system engineering is critical. As the individual correspondence capacities and areas of electric frameworks are considered, it is fitting to consider the general correspondence foundation as cross breed network architecture. This hybrid network architecture consists of different sorts of systems, for example, Internet, remote sensor systems, WiMAX and remote lattice systems. In this mixture engineering, the correspondence system can be powerfully self-configured. This brings significant favorable circumstances for electric utilities, for example, low in advance cost, simple system upkeep, strength, and solid administration scope. Moreover, with the reconciliation of various systems, electric utilities can completely abuse the upsides of different remote systems. For instance, while low power and low range remote sensor systems can be used for urban regions, WiMAX innovation, which empowers dependable long separation correspondence, can be utilized for country zones. Thus, the proposed half and half system engineering empowers a completely associated correspondence system for electric framework automation applications, for example, continuous lattice and hardware checking and remote programmed meter perusing frameworks. In this paper, the open doors and difficulties of cross breed system design are talked about for electric framework mechanization applications. All the more specifically, Internet based Virtual Private Networks, power line correspondences, satellite interchanges and remote interchanges are portrayed in point of interest. The inspiration of this paper is to give a superior comprehension of the cross breed system engineering that can give heterogeneous electric framework automation application prerequisites. Thus, our point is to display an organized structure for electric utilities who plan to use new correspondence advancements for automation and consequently, to settle on the choice making prepare more compelling and direct.

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