Migration of Telecom Networks and Assets in Power Utilities

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Abstract: ***Power utility communication networks are critical infrastructure that provides important services that are essential for business excellence and continuity. It is observed that stakeholder requirements in the past years are rising to cover expansion of the power network and area of business in power utilities. Telecom departments need to keep pace with the development of technologies and expansion of networks in order to meet these requirements. Migration is a critical process that needs keen attention from the telecom department to meet stakeholder requirements since new services might require new technologies or even new networks. This study focuses on the optimum migration process including the main factors affecting it. The study is based on several challenges and studies done on utilities telecom network. The study recommends that proper plans and studies are followed in order to achieve the desired goal of migration.***

Keywords: Utility, Telecommunication, Migration, Asset Management, Network Management System

1. Introduction

Communication networks play an important role in any electric power utility since they carry critical applications and services essential for its secure and efficient functioning. Diversity in technologies and assets is very common in the electric power utility communication ecosystem. It ranges from TDM (Time division multiplexing) multiplexers and IP (Internet Protocol) devices to optical media assets, wireless assets and network management systems

The utility communication field is considered dynamic, which means that improvements are continuous on either the assets or the technology. This is clearly shown while introducing fiber instead of pilot cables or SDH ((Synchronous Digital Hierarchy) technology instead of PDH (Plesiochronous Digital Hierarchy).

This speed of improvement is due to rapid adaptation of newer technologies by end users, who continue to request newer services. In addition, introducing automation and new technologies such as Artificial Intelligence and Big Data have forced faster evolution in communication systems.

In order to cope with these newer and continuous requirements of end users, telecommunication departments or teams will always require up-to-date migration strategies and plans since the old assets and networks might not serve the revised requirements from end users.

Understanding the concept of migration is necessary to ensure the smooth movement of existing services to new ones and to meet the requirement of new services. In addition, having the right approach for migration will save time and effort by minimizing the effect on the existing services, which might be critical for some users.

2. Migration definition

The term '**Migration'** is used in many fields. It can be related to people or animals when they move from one place to another. Migration usually refers to a total movement so that the original place is no longer visited.

Migration in the telecom field is close to the original definition; however, the focus area will be mainly the services running on the assets where it is transferred completely from one to another.

Migration in the telecom field – Network side - can be represented in three types. The first is **technology migration** where services are migrated from one technology to another, such as migration from PDH to SDH or from SDH to IP.

The second type is **asset migration** using the same technology meaning that the services are migrated from one asset to another.

The third type is **upgrade migration** where the services are migrated to an upgraded link such as migrating in SDH from STM-1 level to STM-4 level.

Migration need

The process of migration in the power utilities communication field is rather slow compared to the public telecommunication network. The reason is that the demand from users is not very dynamic. Even though power utilities seek for latest technologies adaptation, the retention rate of technologies in the power sector is on the higher side.

Migration from one technology to another is required due to the change in data communication requirement of end user. A change in communication media such as fiber or wireless will also support network technology migration.

Migration can be performed due to several reasons, taking into consideration the type of migration that will be done. In addition, many of these factors are interconnected with each other meaning that one factor can be a result of another, or one factor can lead to other factors.

The need for migration can be due to the following:

- **Meeting organization's vision and mission:**

Technologies and assets should support the organization's vision and mission; therefore, migration will be required in case technologies or assets are affecting or not meeting the vision and mission.

- **Recommendations from vendors and suppliers**:

Due to market changes and introduction of modern technologies, telecom vendors or suppliers will recommend using new assets with new technologies; hence, the older versions and technologies will be gradually stopped.

- **Obsoleteness of the asset**:

Obsoleteness means that the asset is no longer produced or used. This can be due to several reasons such as introducing newer versions and technology obsoleteness. Once the asset is announced to be obsolete, it will be required to migrate the services to a new asset.

- **Lack of spare parts**:

Spare parts are important for the operation of the asset. Usually, the production of the spare parts will be reduced after the announcement of asset's end of life.

- **Increased number of failures**:

Increasing number of failures for any asset will increase the cost on the organization either through purchasing and using more spare parts or through increased manpower utilization and time spent for these failures.

- **Security issues**:

In case any security threats are discovered in any asset which could not be treated, there could be risk on the entire network; therefore, it will be necessary to migrate the services to other secure assets.

- **Capacity limitation of existing infrastructure:**

Telecom network can contain bottlenecks or limitations that can be the point of failures or risks to the network; therefore, it might be required to introduce new assets in the network and migrate existing services to these new assets.

- **Vendor Monopoly:**

If the telecom network is built with one asset make through one vendor, it will be required to introduce new assets from other vendors in order to break the monopoly. That requires migration to be done from existing assets to others.

3. Process of evaluating new assets and technologies

An important process related to migration is evaluating new assets and technologies. This process ensures that any new assets or technologies proposed are suitable for use in the exiting telecom network and can be used for migration purposes.

The process includes the following:

- Verifying supplier's manpower, capabilities, experience, record for similar offered assets and technologies.
- Verifying the technical specification of the new assets or the technology.
- Conducting Factory Capability Study.
- Ensuring cyber security requirement.
- Testing the asset or the technology at factory.
- Testing the asset or the technology in a real environment (Proof of Concept).

4. Proof of Concept Process

Proof of Concept (PoC) is an important part of evaluating a new technology or asset for migration. It is a process performed to prove that the new asset or technology can work either with existing environment or with new one.

In order to start the PoC, the following main requirements must be available:

- General overview of the vendor's experience and capabilities.
- Technical details of the proposed assets or technologies.
- The duration, place, and method of testing.
- The expected results from PoC.
- Clear responsibilities of each stakeholder involved in PoC.

The place for conducting the PoC will depend on the nature of the asset / technology. The product can be tested in several places such as labs or testing environments.

In the case of conducting the test directly with a live system, the PoC should reflect the exact working conditions and confirm the interoperability of the asset with existing network. In addition, outage request approval, if needed, must be obtained from the concerned sections.

All output and observations from PoC must be recorded and documented with feedback from all stakeholders.

5. Migration process

The migration process differs based on the type of migration; however, the overall process will have similarity in many steps.

The process starts with the **planning stage,** which is essential in ensuring smoothness of the process with minimal deviations.

The planning process includes the following main steps:

- **Gathering the required information**: This includes information about the services on the existing assets, site conditions, material requirement, network outage requirement if needed.
- **Ensuring the availability of required tools and equipment** such as laptop with required software,

interface physical cables, standard installation toolbox and Multi-meter.

- **Preparing safety and risk analysis**: This includes preparation of risk assessment for the migration process, planning and conducting awareness program to all parties involved in the activity and ensuring that all safety protocols of the organization are followed.
- **Gathering the required approvals and permits** from all concerned stakeholders with clear justification of the migration purpose.
- In case of **an outside party involvement**, they should be provided with all plans and required information in addition tothe approval process.

After planning, **the preparation stage** is next. This stage includes the following points:

- Ensuring availability of all required materials that were identified in the planning stage.
- Conducting **site visits** to ensure the condition of the location and related assets.
- Confirming the **robustness of all existing services** with concerned stakeholders.
- Ensuring **back up** of existing configuration through extracting the exiting node back up and storing it into local drive.

The third stage is **the execution stage** where the actual job is carried out. This stage includes the following:

- **Migrating services to the new assets** including configuration and hardware parts.
- **Confirming the completion of the migration** through confirming the status of all services with concerned stakeholders, clearing all alarms and confirming the node reachability at the related network management system.

The final stage is preparing a **detailed report of the activity** with all steps conducted and observations sent to managers and all concerned engineers.

In case of introducing a new asset or technology, a **feasibility study** must be prepared by a team consisting of all stakeholders.

Migration Challenges

Multiple challenges can be expected during the migration process where each type of migration will have its own challenges.

The challenges can occur before, during or after the migration process. Each challenge will have its own risks; however, some challenges are related to each other.

Examples of migration challenges could include the following:

- **Outages**: In most cases, migration will require outages on the telecom assets and networks. Telecom outage means that the services will not be available for the operator, which can be risky since critical alarms or abnormalities may occur at this time. Another point related to this challenge is obtaining the approvals for services outage since there might be different stakeholders involved and each may request different information and have different polices.
- **Services Criticality**: There may be critical services on the planned telecom asset to be migrated that need to be available all the time due to many reasons. An outage on these services may not be accepted or it may have to be for a minimum duration only.
- **Interfaces, connectors or cables defectiveness**: This can occur during the migration process and can cause delay in the process. The whole activity may need to be cancelled, especially if the outage duration provided is not sufficient.
- **Incorrect data**: Some assets carry vast number of services and are connected to many other nodes. Using any incorrect data during the migration process may cause disturbance on the network especially after completing the process and during the health check of the services.
- **Unskilled manpower**: Performing migration requires skilled manpower. Examples of skills are configuration, testing, laying cables, asset installation…etc. Absence of any skill definitely affects the migration process or may delay it.
- **Security Challenges**: Security teams have their approvals and requirements for performing migration since there will be possibilities to affect the network. Getting these approvals may delay the migration process.
- **Telecom interconnected grids of multiple utilities**: Interconnected power utilities communicate through standard ICCP protocols (Inter-Control Center Communications Protocol). The utility will have to keep existing networks if the partner utility is not planning for a migration of technology.

Importance of database

One of the most important factors for the success of the migration process is the availability of the database. This database hasa great impact on the migration process, as it is used as a base before and during the migration.

The database is mainly the services of the existing asset, which has to be migrated to the new asset either completely or partially.

The required database should have **two main characteristics** to support the migration process:

- The database should be **up to date** meaning that it should contain the latest configurations and information related to the asset and the network.
- The database should be **healthy**, meaning that there should not be any security threats included in the configurations and information.

Part of the database, it is necessary to follow the right process to take the **backup** from the existing assets. This backup is important in case deviations occur during the migration process. The following steps must be followed for the backup:

- A safe, secure, and accessible for authorized people is the primary requisite.
- Configurations must be stored in the appropriate file format.

- Configurations must be stored in the proper location accessible by all authorized staff.
- Interconnection details are to be cross-checked by site visits and this will be the basis for new design drawings.

Example of migration

a) Migration from PDH to SDH (technology migration)

At the beginning of adopting optical fiber as a medium in the telecom network to replace copper cables, PDH technology was introduced as the premium technology for different communication services through installing PDH multiplexers. PDH technology was well suited for serial and telephone E&M communication.

Considering the criticality of power system communication, it was necessary to provide backup communication links for every service. With PDH technology, fulfilling this requirement was possible only by providing multiple pieces of equipment.

In addition, with the increasing number of power substations and demand for higher bandwidth, it was necessary to adopt another technology to fulfill this requirement. This marked the beginning of SDH technology and introducing SDH multiplexers in the telecom network.

SDH technology provided self-healing properties like SNCP (Sub network Connection Protection) and various other forms of network protection; whereas in PDH such protection mechanisms were achieved with a more complex table-based switching at time slot levels. All these made SDH a perfect transmission device.

b) Migration from SDH to IP (Technology migration)

SDH transmission plays an essential role in power utility communication. In the beginning, SDH was able to carry serial communication technologies, which was predominant in power system applications and later, it started accommodating Ethernet technologies. “Ref [1] [2]”

SDH provides point-to-point transmission with reliable and faster self-healing capability towards network outages; however, it does not provide switching and routing whereas IP technologies are based on packet switching and routing.

Migration from SDH to IP networks is easy as far as Ethernet services are concerned; however, it raises a major challenge in accommodating legacy interfaces like serial interfaces, E1 interfaces, and various telephony services, which are critical in a power utility environment.

In case the optical fiber media topology will follow power cables, there will be a challenge in implementing deterministic channel operation compared to its predecessor the SDH, where high deterministic and faster network convergence was available.

There are two methods available to achieve migration from SDH to IP. The first method is to implement an **intermediate technology platform**, which can accommodate both legacy and IP services and then later migrate the legacy users to pure IP. An example is MPLS-TP (Multiprotocol Label Switching - Transport Profile).

SDH is characterized by poor resource utilization since it reserves dedicated bandwidth for service protection. Network transformation is essential since there is a rapid migration of end users to packet based technology.

MPLS – TP is a technology which is similar to SDH but can handle packet services. This mode of network transformation is gradual with utilizing existing manpower and processes.

Power utility communications require capabilities to handle time sensitive applications. MPLS-TP devices are able to cater to this requirement, especially for power system protection related applications.

The advantage of this transformation is the utilization of existing processes and manpower. The disadvantage is that it is required to invest in an intermediate system, which will be decommissioned in the near future. Also, MPLS-TP does not provide routing and switching of packets.

The second method is to implement a **separate IP network** with SDH in parallel, migrate the legacy services to IP, and transfer to IP network as the migration of legacy progresses.

c) Migration of SDH STM-4 to STM-16 (upgrade migration)

As the requirement of end users is increasing, there will be a need for higher bandwidths to transfer required services; therefore, upgrading the STM levels is required either on backbone level or the interconnections among SDH multiplexers.

Upgrading STM links with small form factor pluggable (SFP) optical interfaces is not a major challenge. With SNCP protected,E1 links the service outages were minimal to zero.

By this time, Ethernet based SCADA protocols like IEC 104 and telephone services started gathering momentum in power utilities. SDH had to accommodate Ethernet services, this resulted in development and adaptation of Ethernet over SDH. Early models of IP over SDH equipment had separate controllers for mapping Ethernet frames over SDH and for Normal SDH functions. Later models were equipped with common controllers.

d) Migration of Network management systems

Network management systems are an essential part of any telecom network since all assets have management systems for monitoring and controlling.

A network management system (NMS) communicates with remote telecom devices through standard communication protocols. The application software displays the gathered information in graphical and text formats. These applications analyze data and make reports which aid in operational, maintenance and asset planning.

Any type of migration, either on asset or technology levels, will require a migration in the NMS as well. In fact, many of the migration process, especially the configuration and the testing parts, are done on the NMS; therefore, it is necessary to have a clear process for migration of either the existing NMS or in case of introducing a new NMS.

Network management systems include servers, workstations operating systems, web browsers, vendor specific application software, networking devices and various third-party applications. Migration of NMS is triggered by any migration in technology, vendors or obsoleteness.

e) Migration of PDH NMS to SDH NMS

In PDH technology, in band communication channels must be configured along with the traffic channels. These channels are separately connected to the management interface of the equipment. SDH differs primarily in the data communication channels. “Ref [3]”.

In comparison with PDH, SDH offers large in bandwidth for NMS communication; hence while migrating from PDH technology to SDH complete migration of the system is required.

Earlier PDH equipment was addressed through binary numbering and latest models with IP addressing. Hence, with any PDH migration the change in addressing mechanism warrants migration of PDH NMS as well.

f) Migration from one vendor to another

Although SNMP is a universal protocol, management information base differs for different vendors. This necessitates independent NMS for each different network.

We will consider two use cases under this category. The first case is that **only part of the telecom network** is replaced with new one.

While replacing a part of the network with a vendor different from existing, the new vendor will have different NMS. The primary challenge is the interworking of DCN (Data Communications Networks) channels of both equipment. Each equipment should be capable of tunneling the other’s DCN channels.

In this process, the DCN channels must be established and tested prior to connecting with the NMS. Attention should be taken to avoid mixing of DCN routes internal routers in each make of equipment.

The second case is that the**full network is replaced** with a new make. If the entire network is replaced with a new vendor, it is relatively easier since there is no mix of DCN channels.

NMS application software usually outlives server and workstation operating systems. Any upgrade in operating systems causes compatibility issues with the existing applications, hence quite often we need to keep the outdated operating systems running until the NMS vendor makes a compatible version.

This usually runs into cyber security compliance gaps; hence it is recommended to communicate with the vendor about their software product road map or to have a contract with the vendor to update their software along with upgrades in operating systems.

In case of introducing new assets or technologies, new NMS is also introduced. It is recommendable to commission the new NMS prior to establishment of the new equipment network. This will support having control over the installation and configuration of the networks.

A predefined set of tests are to be agreed upon with the vendor before commissioning the new NMS. DCN channels convergence must to be tested during network disturbances. Security functions and network operational features and configurations should also be tested.

New generation NMS include features which will enable them to communicate with higher-level management and corporate network infrastructure through north bound interfaces. It is common to connect these NMS with SMTP (Simple Mail Transfer Protocol) servers to push alarms and events as emails. During migration, all these functions must be tested.

In case of migrating from one asset to another within the same brand, the migration in the NMS will focus on the configuration part, followed by testing and ensuring that all services are available.

g) Role of asset management in migration

Asset management has a critical role in the migration process. It plays a key role in network availability, reliability and security through proper handling of assets systems. Besides, it ensures optimization of assets systems risk, cost and performance.“Ref[4]”.

Asset management has the full data of the asset such as manufacturing dates, commissioning dates, history of the alarms and failures, frequency of maintenance performed on the asset and the asset’s end life. Asset information holds complete, current and accurate information throughout asset life cycle phases(acquire, create, utilize, maintain, dispose) to support assets, asset management and asset management system decisions.

Analyzing all these data with their associated performance, risks and expenditure over the asset life cycles can provide a trigger for migrating the current asset to a new one so that negative impacts can be avoided.

One important factor that affects migration planning is the **asset criticality**, which is the relative importance of an asset or asset system to meet the organization’s reliability, availability, adequacy and other objectives and standards. As the asset criticality is higher, more attention needs to be provided to the asset and it might need to be migrated faster than other assets in case of occurrence of any migration needs.

Another important role of asset management is to liaise with other core business areas inside the utility such as projects, engineering and operations. It is considered as an apex body, which can study road maps of these departments and finalize the telecom requirements based on these requirements.

h) Converging IT and OT networks

From a simple comparison of IT and OT network requirements, it is evident that both these segments have distinct characteristics. Merging them in power utilities may not be the future of migration. Considering the criticalities of the services, OT has to be maintained separately for commercial as well as technical efficacy.

However, adopting various management principles of IT in OT is necessary as more and more OT services are migrated into IP based networks.

The below table compares characteristics of IT and OT systems

Table I: Comparison of OT and IT characteristics

Requirements	Utility operational communication	Enterprise data communication
Legacy services	Legacy systems need to carry IP based traffic	Services are exclusively IP
Structure and traffic	Large number of sites (High Voltage substations) with small volume of data	Small number of sites (utility corporate and regional offices)but high volume of data
Quality focus	Delay and service continuity	Throughput, flexibility cost and efficiency
Communication peers	Mostly pre-determined peers	Any to any
Life cycle	Need service stability	Need frequent updates; evolves with IT evolution
Network operations management	Need fast fault recovery and continuous monitoring	Need frequent service provisioning and configuration change
Outsourcing	Mainly utility owns network infrastructure in house operation	External service provisioning and outsourced O&M is common
Security Focus	Confidentiality, integrity and availability	Confidentiality, integrity and availability

i) Migration of Telecom technology to enable digital transformation in power utility

Electric power utilities are trending towards digital transformation by employing digital technologies and data analytics to improve efficiency, reliability, and sustainability in their operations. The main enablers for this are deployment of smart grids, data analytics, energy storage, and various other emerging technologies. Elevated customer engagement is also critical in this race.

On the other hand, share of renewables are increasing in utility generation mix. Smart grids connect these renewables which are scattered geographically.

Thus, for the success of digital transformation telecommunication technologies play a vital role by handling this enormous volume of data.

Transferring high volume data streams through the last mile and back haul to cloud will not be efficient unless a combination of latest last mile communication technologies and edge computing are employed.

Edge computing refers to a distributed computing paradigm in which data is processed near the source of data, instead of being transmitted to a centralized data center or cloud. The term "edge" refers to the edge of a network, such as a sensor or a device, where data is generated. This may be in local servers located close to the edge. Edge computing also reduces the amount of data that needs to be transmitted to a centralized data center, which can help reduce network congestion and lower the costs associated with transmitting large amounts of data over long distances.

j) Migration from traditional last mile communication technologies

Electric power utilities have been employing last mile technologies like Pilot cables, Power line carrier, narrow band radio, etc... since the beginning of power system monitoring and automation.“Ref[7][8]”

Once 5GTelecom starts rolling out, edge computing will be leading the digitalization drive in electric power utility. The migration from pilot cables and radio links to 5G for the last mile will become inevitable.

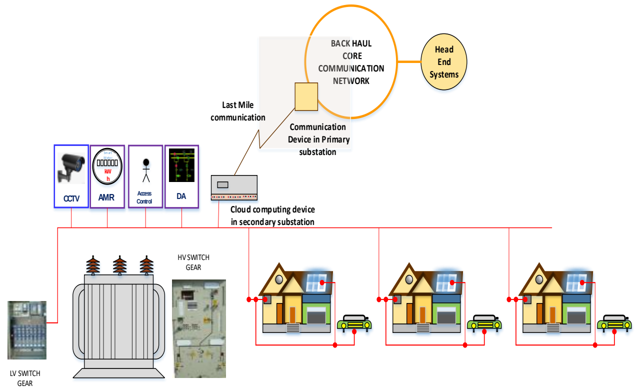

Figure I: Last mile to head end communication scheme

The above figure represents an overall connectivity of services from the last mile up to the head end. Secondary or medium voltage substations will house an edge-computing device, which will gather data locally and through 5Gfrom home installations like home area networking. Cloud computing devices will communicate with head end systems through last mile 5G networks via the primary substations.

k) Enterprise Architecture and migration

A good enterprise architecture brings balance in maintaining operational efficiency and business transformation. Therefore, any planned technology migration directly connected with the business objectives of the organization, must go through the process of development of enterprise architecture.“Ref [5][6]”

The below figure shows the process of developing an enterprise architecture according to TOGAF 9.2 architecture standard.

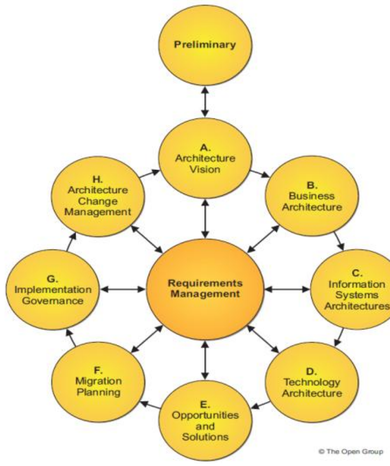

Figure II: Stages in the development of architecture

The figure shows different phases for development of enterprise architecture as follows:

Preliminary Phase: Prepares the organization for a successful architecture project.

Requirements Management: Every stage of the project should be based on and validate business requirement:

- **Phase A**: Set the scope, constraints and expectations for the project. Validate the business context and create the Statement of Architecture Work.
- **Phase B**: Develop Business Architecture. Develop baseline "as is" and target "to be" and analyze the gaps.
- **Phase C**: Develop Information Systems Architectures. Develop baseline "as is" and target "to be" and analyze the gaps.
- **Phase D**: Develop Technology Architecture. Develop baseline "as is" and target "to be" and analyze the gaps.
- **Phase E**: Identify Major Implementation Projects.
- **Phase F**: Analyze the costs, benefits and risks. Produce an implementation roadmap,
- **Phase G**: Ensure that the implementation project conforms to the architecture.
- **Phase H**: Ensure that the architecture responds to the needs of the enterprise as changes arise.

We will focus on **Phase F** where the migration from baseline to a targeted enterprise architecture occurs. During this phase, we will finalize the architecture roadmap and the implementation and migration plan, in alignment with the enterprise's approach to manage and implement change in the enterprise's overall change portfolio. We will also ensure that the business value and cost of transition is understood by key stakeholders.

While establishing and assigning business value to each of the actions during this phase, we will set different criteria such as:

- **Performance Evaluation** criteria to monitor the progress of architecture transformation.
- **Return-on-Investment** criteria which must be detailed and signed off by the various executive stakeholders.
- **Business Value** must be defined, as well as techniques, such as the value chain, which are to be used to illustrate the role in achieving tangible business outcomes. Business value will be used by portfolio and capability managers to allocate resources.

Critical Success Factors (CSFs) should be established to define success for a migration project. These parameters will provide managers and implementers with a gauge as to what constitutes a successful implementation of migration.

l) Statistical and technical evaluation of communication technology for Electrical power utilities

In the process of migrating or adopting a new telecommunication technology, research methodologies can be employed to support decision making. "Ref: [9] [10]".

Although selecting a technology will usually depend on clear requirement and specifications, research methodologies can be used if the data on user requirements, capabilities and performance of the technology are of substantial size and complexity.

The testing begins with an assumption, called hypothesis that we make about a population parameter wherein we assume a certain value for the population parameter.

To test the validity of our assumption, we gather sample data and determine the difference between the hypothesized value and the actual value of the sample statistic. Then we judge whether the difference is significant. The smaller the difference, the greater the likelihood that our hypothesized value for the parameter is correct. The larger the difference, the smaller the likelihood that our hypothesized value for the parameter is correct.

For example, if we consider the feasibility of using GPON as a communication technology for various smart grid applications, the approach for research methodology will be as follows:

1) Decide on Two hypotheses.
   a) GPON is suitable for smart grid communication.
   b) GPON is not suitable for smart grid communication.
2) Select the technical parameters.
3) Gather data about the telecom parameter values like latency, throughput, frame loss, etc. from industry experts and systems for each components' services of smart grid.
4) The approach is to list the communication performance parameter requirement for various services. Telecom requirements demand response in distribution system is as shown below.

Parameters	Control Protection Data	Monitoring/ Management data
Data occurrence interval	Minutes High	Minutes / Hours
Method of Communication	Multicast/ Broadcast/ Unicast	Unicast / Multicast
Data security	High	High
Data volume	Bytes/Kilobytes	Kilobytes/ Megabytes
Reliability	High	Medium
Priority	High	Medium
Latency	20 - 100 milliseconds	5 – 10 Minutes

5) Test the technology using appropriate testing methods like RFC tests, BER tests, Data analyzers etc.

6) Tabulate the results to find the standard deviation from the actual values and gathered values.
7) Finalize if the actual value is within the acceptable values range using Z value tests.

Sample Calculation

Latency for Advanced metering infrastructure (AMI)
Maximum Latency requirement for AMI = 25 ms
Mean of sample = 21.28 ms

Standard deviation = 1.02573
$Z = (\bar{X} - \mu) / \sigma / \sqrt{n}$
$= (21.28 - 25) / 1.02573 / \sqrt{100}$
$= -37.2$

From the Z table for $\alpha = 0.05$
$= -1.645$

This implies that there is no reason for null hypothesis to be accepted. The calculated Z value lies in the rejection area of the probability density function curve.

6. Conclusion

In conclusion, the following recommendations can be listed:

- Any migration process should follow a proper plan in order to gain the desired results.
- Critical factors must be considered for adapting any new system and technology for migration such as cost benefit analysis, technology forecast, market conditions, geographical conditions, vendor roadmaps, vendor past performance, cost of ownership and lifecycle costing are.
- Engagement and participation of all internal and external stakeholders as per approved requirements and responsibility accountability matrix are necessary to ensure the success of any migration process.
- Any technology or systems must undergo Proof of Concept testing and validation process.
- Requesting the road map for any new product or technology must be part of any approval process since it is an important input for migration plans.
- Following a checklist for any migration process is necessary to ensure the proper execution of the process.
- Automation of some migration process stages can be a great opportunity for developers in order to save time.
- Data plays an important role in any migration process; therefore, it should be taken care of before and during the migration process.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

This paper is completely prepared by the authors in terms of gathering the data, analyzing and writing the final version.

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