

Optical Fiber Monitoring Strategy in Oman Telecom Companies

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Abstract

Omantel is one of the leading mobile communication networks in Oman providing a long range of Fiber Optic network throughout Oman. Fiber Optic Cable network, being the fastest means of internet network, has an increasing rate of internet users every year. Considering the challenges that the future might bring towards its usage a proper network monitoring strategy is necessary. Though the current network monitoring strategy is effective, the increasing number of users may result in challenges like data traffic and network outages. The manual operation and maintenance system that is currently in use by Omantel might be obsolete in the aforementioned situation. The network outage can negatively impact customer satisfaction which will indirectly affect the revenue. The study uses exploratory research design to create appropriate research methodology. The study intends to explore the usage of automation in this area. A sensor will identify the error in case there is any and raises an alarm to indicate the technical team about the error. The technical team will try to solve the error and will send engineers to the field to fix the error. The feasibility of this automated Network monitoring strategy is positive towards the expected rise in the number of OFC users and effective management of OFC networks.

Key words: Monitor tools, framework Data analysis UTT and fiber watch.

I. INTRODUCTION

Optical fiber is the advancement related with data transmission using light beats going close by a long fiber which is for the most part made of plastic or glass. Metal wires are favored for transmission in optical fiber correspondence as

sign travels with fewer damages. Optical strands are in like manner unaffected by electromagnetic impedance. The fiber optical connection uses the usage of supreme internal impression of light. The fibers are organized with the ultimate objective that they support the multiplication of light along the optical fiber depending upon the need of power and partition of transmission. A single mode fiber is used for long-partition transmission while multimode fiber is used for shorter detachments. The outer cladding of these fibers needs ideal protection over metal wires [1].

The sorts of optical fibers depend upon the refractive record, materials used and strategy for multiplication of light. The request subject to the refractive record is as Step Index Fibers and Graded rundown strands. The former contains a middle material may be included by the cladding which has a lone uniform document of refraction. Wherever in Assessed Index Fibers, the refractive document of the optical fiber reduces as the extended great ways from the fiber rotate increases [2]. The course of action subject to the materials used is Plastic Optical Fibers and Glass Fibers. In the former polymethy methacrylate is used as a middle material for the transmission of the light. The later involves incredibly fine glass strands. The course of action subject to the strategy for spread of light is Single Mode Fibers and Multimode Fibers. These Single Mode Fibers are used for long-division transmission of signal. While the other fiber is used for short-detachment transmission of signal [3].

Optic Fiber Networks is one of the fastest means of internet network in the present era. Omantel Optical Fiber Network in one of the widest networks of internet service providers in Oman. The company has extensively laid over 20000 KMs of OFC (optical fiber cable) network interconnected within the country. Network

monitoring strategy is the key factor with which Omantel is able to monitor the issues in the Network system which is directly associated with network performance and rectify the issue with necessary steps. A network monitoring strategy includes the apparatuses and methods a business establishment's IT division uses to investigate and quantify network execution [4]. This strategy inspects how a venture screens and deciphers the presentation of a network. Normally, this incorporates what execution measurements you take a gander at and the moves your network group makes to build up execution related fixes. Each organization's strategy will be extraordinary, since a solid network and monitoring strategy will be custom fitted explicitly to your undertaking's network. Network monitoring, or the way toward estimating network status, is one of the numerous expert undertakings in the specialist co-op business process that is experiencing changes. These progressions are driven by the adjustments in innovation, administration cosmetics and service provider's strategic policies

The challenge for observing is the containing of its extension. The general term utilized in arrange the executives of FCAPS (Fault, Capacity, Accounting, Performance, and Security the board) recommends that checking may be associated with every one of these territories, a methodology that is in actuality taken by certain merchants [5]. Others see checking as absolutely deficiency the board, or as flaw and refusal the executives.

Network performance can be separated into a few unique measurements that assess explicit execution estimations. Every individual measurement will enlighten your endeavor something one of a kind concerning your network execution. In any case, only one out of every odd exhibition metric will be useful for your network group to break down. While making a network monitoring strategy, you have to know which execution measurements are the most supportive for deciding your network's exhibition levels. In this case Omantel might require their OFC network to execute as fast as could reasonably be expected while diminishing packet loss and latency. The chosen establishment for the investigation may likewise need to help an overwhelming measure of information traffic on a network while not going over most extreme bandwidth capacity because of growth of internet users day by day. The pace of web clients is developing at 40% consistently and this rate may

increment in the coming years. Whatever the case is, there will be a lot of measurements that the favored monitoring strategy ought to investigate [6].

There are network monitoring devices that will analyze the OFC network's exhibition on various levels. It can search for and examine a few diverse exhibition measurements, at that point show the data outwardly by means of the monitoring dashboard. The instrument will likewise make caution to the network monitoring group when a performance metric is arriving at basic or unsustainable levels. In the event that the monitoring team notices that a specific measurement is continually dipping under anticipated levels, they can apply arrangements that address the issue solely [7].

Organizations are continually incorporating new advancements into their foundation. Innovations, for example, distributed computing, venture versatility, and the Internet of Things have changed the manner in which organizations consider network availability. As an ever increasing number of gadgets depend on a network to perform, network monitoring devices and methodologies must have the option to represent them. IoT gadgets, for instance, regularly have unmistakable setups that vary from basic network gadgets [8].

The OFC network monitoring strategy followed in Omantel uses a manual system where the customer finds if there is any issue with network as they receive it and they inform the client support system through call or mail. The client support forwards this issue to the technical team where the technical team looks into the issue and addresses it with proper solution. If there is any necessity, the technical team may have to send out field agents if it is necessary to make changes in the field and a FOC field team will be sent to the radio tower or the client location to resolve the issue. This manual monitoring system of OFC network outages and addressing the network issue can be graphically represented as:

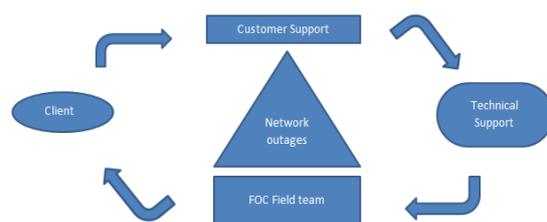


Figure 1: Workflow of FOC team

II. LITERATURE REVIEW:

There are various studies available in the research area that introduce the concept of network monitoring. There are various Fiber Monitoring systems available in the literature namely Fiber Watch, Fast Light, ONMSi, (Optical Network Monitoring System)

and NQMS (Network quality monitoring system) Fiber. Here ONMSi, Fast Light and NQMS fiber is the most appealing system that suits the needs of this project.

ONMSi – design and analysis:

The utilization of voice, video, and data anyplace and whenever implies that network service suppliers need steady accessibility and execution from their fiber optic network [9]. The capacity to give quad/triple play and inactive optical network (PON) structures with optical splitters has made fiber monitoring a significantly greater test.

ONMSi is a remote fiber test framework that outputs the fiber network day in and day out and consequently distinguishes and finds shortcomings without dispatching professionals in the field. In view of industry-driving Viavi optical advancements, an OTU coordinating an optical time area reflectometer (OTDR). What's more, an optical switch always thinks about data to a pattern and sends alerts if any fiber debasement happens [11]. Fiber monitoring application, for instance, quick issue area, precise area of little fiber changes, snappy set up let the company focus on ONMSi, meeting the requirements



Figure 2:ONMSi’s Comprehensive fiber monitoring solution

The ONMSi data model depends on spaces. The client can make an assortment of ONMSi items, for example, OUT (Optical transport unit), P2P network(Back Tp Back), PON (Passive Optical

Network), fiber connect, fiber segment and subdomains. A similar article can have a place with more than one space. Client authorizations can be made per area. For instance, a top-down provincial association may utilize local areas through a dull fiber supplier may utilize client or then again connect areas. Huge field-service support groups can make benefits with the goal that clients can get to all the OTUs existing in a network. With complex IT situations, incorporating a test framework is frequently a key achievement factor for a task. ONMSi can be furnished with two extraordinary interfaces [12].

Lightweight catalog gets to convention (LDAP) disentangles index the board by giving clients and applications in a venture with a solitary, well-characterized, standard interface to a solitary, extensible registry service. ONMSi mix with LDAP stay away from tedious data passage and guarantees that the present security strategy is regarded. ONMSi can be furnished with two servers for practically 100% accessibility. The database is copied between the two servers. However, just a single server is dynamic at any one time [13]. The server in backup mode always screens the dynamic server, and if a no-reaction circumstance happens, it will switch to turn into the dynamic server and run ONMSi. Thus, this study introduces the concept of network management and gives an outline to the study on how it works and what the necessities of network management.

An overview of Fast Light:

It is important to understand the credibility of the Network monitoring system to really estimate the complete efficiency of the system. An ideal Network Test System is introduced in the literature by Otton, 2017 that is also known as Fast light. This OTDR (Optical Time Domain Reflectometer) based testing system is one of a kind testing framework for optical fiber networks [14]. The framework utilizes a propelled test head that can be utilized on a network right now sent frame get to networks utilizing PON innovation to long separation transport frameworks [15]. The presented Test System is comprised of numerous segments; each part is accessible as a standalone thing and can be blended in with other equipment or consolidated into a client’s claim working

framework [16]. The framework requires one principle server to run the Fast Light application. An extra server can be conveyed as a reserve machine and the situating of this machine is controlled by the client's fiasco recuperation as well as alternate courses of action. Further servers might be sent if the client wishes to utilize an outsider mapping framework or an independent mail server. These alternatives are altogether factor and reliant on the client's necessities.

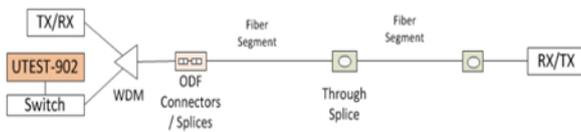


Figure 3:Passive network structure

The OTDR test has been explicitly created to empower the practical focal office testing of fiber link frameworks both point to point and point to Multipoint [17]. The essential OTDR follow is additionally upgraded and carefully cleaned of clamor utilizing progressed scientific handling procedures. This empowers the OTDR to unmistakably see reflections from ONT's on the PON network. The OTDR with its high unique range is perfect for monitoring long removes strands, giving clear exact fault areas, in addition to likewise powerful debasement data to permit deterrent support [18].

Perceived feasibility of NQMS Fiber and exploitation of its applications:

The NQMS Fiber Element Management Server is the NQMS fiber's focal server arrangement (Telecom test and measurement, 2017). The application programming is a Web application and database server. The server application stores and recovers alphanumeric data and OTDR records related the optical RFTS (Remote fiber test system) [14]. It likewise stores all logs identified with segment status changes, framework part properties, estimation results and records (Marchi et al, 2017). The data Can be accessed, seen or altered from any PC with a Web browser. The management server mainly functions on two basis; namely, fault management and alarm management. The former identifies the type of error encountered in the Network Systems and the later notifies with an alarm. The server distinct faults into two distinct sorts: corruption or

calamitous disappointment also called as disruptions (Morioka et al., 2016). In light of fault type, framework executive can choose with various seriousness levels and cautioning situations. Best fault position is given as the area of new occasion or existing one. A fault position resistance is given which permits an administrator to rapidly check if fault position exactness is sufficient before proceeding onward to finding all the more decisively or report the fault in a difficult situation ticket or work request. A fault could conceivably make an alarm – however a fault consistently makes a "result" which is put away in the database. Framework overseer or the network support chief has the adaptability to characterize which faults ought to make alarms dependent on one or different fault related fields just as different properties connected to the outcome like test set-up type [15]. One off chance that a fault meets an alarm condition, different procedures happen, for example, make alarm occasion locally to a client, update the network topology see and demonstrate alarm source, update the alarm see list, send an alarm occasion to clients. From this study it is understood that with the help of NQMS fiber element management server the OFC network can be equipped with fault management system that identifies the fault and the alarm management system that helps raise an alarm notifying the respective official to take action on the issue.

Exploiting the use of Automation in OFC network monitoring system:

Irrespective of the involvement of fault management system and alarm management system, the process of identifying and fixing the issue is carried manually. This process is carried through a series of employees to reach the technicians. That increases the response time of the service provider which ultimately affects the service quality. Since the applications of automations are not limited to any particular industry, its application in the telecommunication industry must be exploited [12]. To reduce the response time that it takes in rectifying the error in OFC network an automated Network Monitoring System will help improve the service quality of the service provider.

III. A DISCUSSION ON THE METHODOLOGIES INVOLVE WITH THE NOVEL FOC MONITORING SYSTEM;

The research follows Positivism as its research philosophy based on the assumption that the research will be given a quantitative approach. The purpose of the research is to device a Network Monitoring strategy for Omantel which is completely quantitative and that justifies the quantitative approach initiated by the researcher. It is important to identify the metrics through an extensive literature review and identifying the factors enhancing the performance is essential before going through the analysis. It requires a quantitative analysis that measures the parameters of the OFC Network Monitoring System revealing the efficiency of the Fiber optics network. The research idea enhances the exploitation of the automation in the telecommunication industry especially in the Network monitoring system. This is a novel way of breaking the existing methods to improve the efficiency. Thus, an exploratory research methodology is followed in this study that explores the various grounds for the application of automation. The data required for the analysis is collected from the close ended questionnaire that forms the primary data for this research. The research group consists of a population who uses the Omantel OFC network from Muscat for a considerable period, per se more than 6 months. The sampling method in this research follows cluster random sampling. The sampling comes around 232, a sizable proportion of the actual users of Omantel services. The respondents consist of 116 men and 116 women participants to ensure parity of analysis based on gender. The respondents belong to the age group 15 to 45, as people who fall into this age group will be exposed to OFC network usage one way or other. The data retrieved from the company website and previous researches conducted in this field will form the secondary data. This secondary data comes handy when the statistical results are determined and discussion on those results is necessary.

IV. STUDY ON EXISTING SYSTEM

To identify the issues with the existing FOC (Fiber Optical Cable) network monitoring strategy it is necessary to conduct a thorough analysis in Omantel's FOC network. According to current practices the fiber optics monitoring team is

always in reactive mode. The team reacts to the situation based on call or notification received from NOC or any verbal complaint received within different departments in Omantel. This leads to long MTTR. (Mean Time to Repair).The following diagram indicates precisely of how FOC is in receiving mode and act accordingly based on the complaints registered.The image describes four types of scenarios that describe how the FOC team receives notification from various sources and how appropriate action is taken with reactive mode.

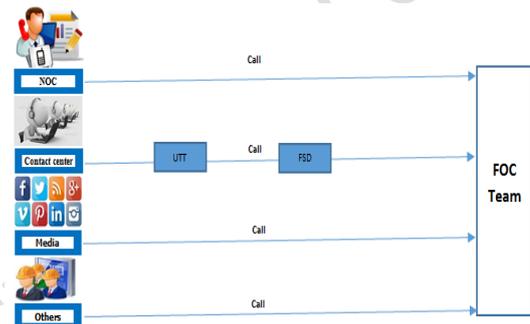


Figure 4: scenarios dealt by FOC team while receiving complaints

In the first scenario, the FOC Team receives call from NOC in case of any incident where NOC suspect fiber might be the cause of the outages. FOC team once receiving the call goes reactive and starts taking action. These chains of passing the complaint may cause delay in fixing the faults and may result in prolonged outages. In the second scenario, the Contact center receives complaint from customer, converts the complaint into trouble ticket with the help of UTI (Unfit Trouble Ticketing) and forward the trouble ticket to FSD (Fixed Service Delivery) team. Then FSD team makes an analysis on the issue and post analysis would inform FOC team for their actions. The issue with this process is that this entire process is time consuming and may also lead to long service outages. This will have a negative impact on customer's perception on Omantel service quality that ultimately leads to customer dissatisfaction.

In the third scenario, the Customer would look for assistance through social media for the issues that the Customer observed in the fiber cable such as missing hand whole cover, Fiber being exposed and fiber cuts etc. Omantel Media in turn calls FOC team to act on the Customer’s notification of the error and fix the issue with the issue with whatever means and resources necessary. This process also consumes lot of time. In the last scenario the FOC team might receive call from any other department within Omantel about the issues reported to that particular department and act accordingly so that the issue gets fixed with proper actions. For example, a person who knows FOC team in person may raise issue with FOC team so that they can act based on the complaint.

In the four described scenarios the source of being notified is unique yet all the sources are external source for FOC team and because of that a lot of time is consumed to solve the issue causing prolonged outages. Here, a person or team outside the FOC team is notified with the issue with the monitoring strategy and FOC team takes action in reaction to the notification. Taking actions with respect to an external source of notification will increase the main time to respond. Decreasing the time to respond will lead to better service quality. This is the area where the turf of automation needs to be exploited.

V. FRAMEWORK PROPOSED IN THE STUDY:

This paper comes up with a new network monitoring strategy for FOC network that uses automated system namely ONMS to ensure better service quality. The feasibility of this system is reviewed using survey tool. A questionnaire is prepared about the feasibility of this system and is distributed among research group consisting of employee, customer and management.

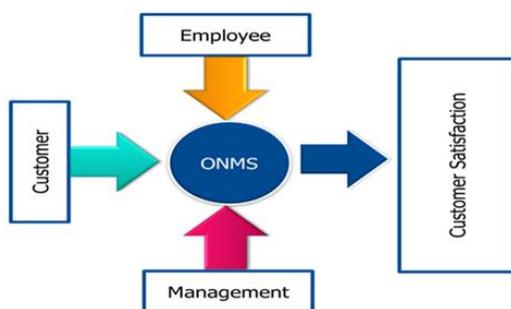


Figure 5: OMNS framework proposed for better service quality

In this framework, the OMNS forms the core of the process that comes in between management, employee and customer. Because of *this automated system if there is a problem with the FOC that causes network outages a sensor in the network identifies the problem and sets up an alarm to the FOC team so that the team can react accordingly. This system reduces the length of MTTR. Thus, this system eliminates the chance for customer to inform about the outages by taking care of it prior to the outages. This system also eliminates the need for other teams within Omantel to inform FOC team about their network outages. Thus, by creating a better platform between customer, employee and management, ONMS is proven feasible in completing its prime purpose.*

VI. ANALYSIS OF THE OBTAINED RESULTS:

The data collected through the survey tool regarding its questionnaire is analyzed using data analysis tools. The result of the analysis report suggests the feasibility of the project in industrial levels.

Features	customer	employee	Management
Knowledge ONMS System	x	√	√
performance Monitoring system	x	√	√
system data collection	√	√	x
performance Tracking	x	√	√
OFC MTTR	x	√	√
knowledge about the fiber technology	√	√	√
OFC Network Automation	x	√	√
service Quality	√	√	√
OFC Network framework	x	√	√
performance and customers satisfaction	√	√	√
Omantel UTT & Monitoring system framework	x	√	√

Table 1: Analysis report

The aforementioned table is based on an investigation involving certain aspects of the ONMS system. The first of the aspects will be the knowledge on the ONMS system and the client's response to this aspect is not very satisfactory considering the light shown on ONMS in customer's perspective. But the employee and management are very much satisfied with the feasibility of the ONMS program. Then the questionnaire investigates the performance monitoring system. In this aspect, also, the customer's perception does not show much light so that the customer is not informed of the performance monitoring system.

The employee and management are aware of the performance management system and witness a change in the service quality due to that change in the performance monitoring system. The primary data collection required for this system is collected from customer and employee. Management does is not involved in this part of the research. For performance tracking customer has no involvement where employee and management made their effort and witnessed result. Regarding the reduction of the length of FOC team's MTTR the customer has no involvement where the employee and management are responsible for the reduction of MTTR length. This is because ONMS eliminated the interference of customer in notifying and acting on network outages. The customer, employee, and management are aware of the knowledge on fiber technology as one of the fastest internet network available in the market. OFC network's automation usage being exploited is new in this industry. The customer is unaware of this automation technology and is not satisfied with its usage in the industry. On the other hand, employees and the Omantel management are well aware of this automation technology. Improving Omantel service quality will have positive impact on customer satisfaction and this is well known factor with all the three criteria mentioned in the table. The applied framework is not familiar with customer since it eliminated the customer's interference during registering for complaints. As per the table performance and customer satisfaction is directly associated to each other and the opinion of the all three criteria stand united in this aspect. Omantel UTT and monitoring system framework are feasible and both client and management stand witness to this phenomenon.

VII. CONCLUSION

The investigation conducted in the beginning of this paper emphasizes the need for increased service quality through a faster response over the complaint made on Fiber Optic Cable. This factor supports the fact that there is a need for automated monitoring system in Omantel FOC monitoring system. The study proposed an automated network monitoring system called as ONMS and its feasibility is examined through a questionnaire. The feasibility analysis stands proof that the automation system introduced in this study is good to its purpose and it eventually reduces the length of MTTR. Reducing the length of MTTR while acting on the complaint will provide faster solution. This change in the network monitoring strategy could improve the performance of the network. Improving the network performance will have a high level of positive impact on service quality. This impact on service quality is directly proportional to customer satisfaction because service quality and price are the two factors that drive customer satisfaction. Improving service quality will improve customer satisfaction and improved customer satisfaction will result in increased revenue for the company.

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