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A Study on Quality Infrastructure Support in 4G Networks

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ABSTRACT:

4G-great interest especially for the wireless telecom industry. It can "connect anytime, anywhere, anyhow" providing ubiquitous network access at an high speed to the end users. For the growing user requirements of wireless broadband access and the limitations of the existing wireless communication system 4G seems to be a solution. The objective of this paper is to provide information on different aspects of 4G that include features, proposed architecture and key technological enablers. By discussing a security threat analysis model proposed by international telecommunication union (ITU) a special consideration has been given to the security concerns of 4G. A detailed analysis of threats to 4G and measures to count them can be performed.

KEYWORDS:

Achitecture,Secuity,Applications.

INTRODUCTION:

Wireless telecommunication system is the transfer of information between two or more points that are not connected by an electrical connector. The history of wireless telecommunication system has been classified into many generations of network. The telecommunication started with 1G in 1980 where analog radio signal is used and voice is the main traffic. Time division multiple access (TDMA), Frequency division multiple access (FDMA), Advance mobile phone system (AMPS), Nordic mobile telephone (NMT) are some of the standards of 1G. 1G is replaced by 2G which provide high voice quality and global mobility based on digital radio signal technology in 1990. Global system from mobile communications (GSM), General package radio system (GPRS) are the standards in 2G. In 2G voice is considered to be main traffic. Circuit switched technology is used in both 1G and 2G.

2G is replaced by 2.5G which is fragmentary between 2G and 3G. 2.5G use both circuit switched and packet switched technologies that provides low power consumption and high data rate. Global system for mobile communication (GSM) and Code division multiple access (CDMA) are used to provide services 2G was success.Now 2.5G is followed by 3G that contains standards of 2.5G and other technologies such as WIMAX (worldwide interoperability for microwave access). It provides high quality services to meet the demand of high data rate as it uses packet switching technology. It provides only few features of 2G and 3G was not as success as 2G.The idea of "connect anytime, anyhow, anywhere" is beyond imagination of ordinary mobile user. This can be achieved by integrating the available and new networks using a core ip based network layer this is called as 4th generation perception of communication.

APPLICATION OF 4G:

Virtual pressure: 4G provides user services at all times even if the user is away from the situation.

Virtual navigation:

It requires high speed data transmission where the user can access database of the streets buildings of large cities.

Tele-medicine:

If the user want to go to hospital instead of going user can get video conference assistance for a doctor at anytime and anywhere. It supports remote health monitoring of patients.

Tele-geo processing applications:

Here the user can get the location by querying. It is the combination of GIS (Geographical information system) and GPS (Global positioning system).

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Crisis management: If there is breakdown in communication systems due to natural disasters, it takes days or weeks to restore the system. In 4G we restore such crisis issues in few hours.

Education:
4G provides a good opportunity for people who are interested in lifelong education. People can continue their education through online in a cost effective manner anywhere in the world.

Features:
These are features f 4G that make the technology explained above.

High performance:
The advantages of rich multimedia connect across wireless networks with 3G will not be taken by the users. In difference to this 4G have high video quality compared to HD (High definition) TV. The downloads are taken place at a speed of 100mbps which is 50 times of 3G.

Interoperability and Easy Roaming:
It is difficult to roam and interoperate across various networks due to pressure of multiple standards in 3G. In 4G a global mobility is provided by the global standard. 4G will encircle various types of terminals that provide common services independently of their capabilities.

Low cost:
4G is very cheaper than 3G, as it can built a top existing networks and won't require operators to completely replace and won't require carriers to purchase costly extra spectrum 4G supports backward compatibility with 2G and 3G devices. These factors are responsible for 4G being much cheaper than the current generation networks.

Scalability:
Scalability is the ability to handle ever increasing number of users and services. In order to prove this 4G is using ipv6 addressing scheme which support large number of wireless devises that eliminates the need of network address translation. NAT is a technique which shares limited number of addresses among large number of devices. The use of IP as core network layer will make 4G scalable easily.

Lower power consumption:
Battery drain is a continuous problem of wireless devices. 2G require one battery where 3G requires two batteries 4G breaks this directly proportional rule. Shorter communication links is one of the solutions proposed to satisfy this requirement.

COMPARISION BETWEEN 3G AND 4G:

Data throughput:
In 3G it is up to 3.1mbps with an average speed range between 0.5 to 1.5mpbs.In 4G it is 2 to 12mbps but potential estimated at arrange of 100 to 300mbps. Peak upload rate: Peak upload rate in 3G is 5mbps where as in case of 4G it is 500mbps.

Switching technique:
In 3G only packet switching is used where as in 4G both packet switching and message switching are used.

Network Architecture:
3G architecture is wide area cell based where as the 4G network architecture is integration of wireless LAN and wide area.

Services and applications:
In 3G CDMA 2000, UMTS, EDGE etc are the services and applications where as in 4G WIMAX2 and LTE-advance.

Forward error correction:
3G turbo codes for error correction concatened codes are used for error corrections in 4G.

Peak download rate:
In 3G peak download rate is 100mbps where as in 4G it is 1gbps.

Frequency band:
Frequency band in 3G is between 1.8 to 2.5 GHZ. In 4G frequency band is between 2 to 8 GHZ.

SECURITY MANAGEMENT SYSTEM:
The aim of this reach is to design and implement a security management system that could detect an attack on a mobile in 4G heterogeneous networks also prevents the attacked mobile from being used because an attack tool which could harm the network.

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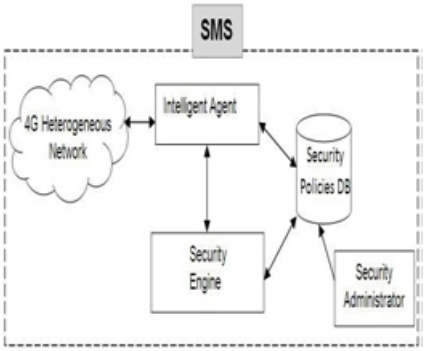
we describe the attack as any malignant user who tries to access the systems configuration files such as password file, the system log configuration file or the mail configuration file the specifications of TMN management M.3400 is to be followed. There are function sets that detects an attack on the mobile and preventing the attacked mobile from being used the function sets are customer security alarm, investigation of theft of service, software instruction audit, exception report action and theft of service action.



As explained above about the security threats in 4G heterogeneous network there is a clear requirement for security management system to identify the attacks on the end user device. Based on these considerations the security management system shows four main parts of the systems architecture which consists of

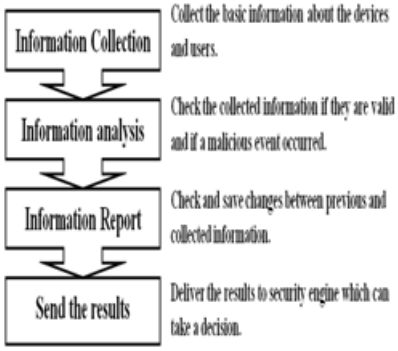
1. Intelligent agent
2. Security engine
3. Security policies database
4. Security administrator

These policies identify the attack and prevent damage to the network by removing the user's access and servicing the connection to the attacked mobile the system contains assurance functions. The intelligent agent collects information, policies are obtained by the intelligent agent from the security policies database. The intelligent agent sends the results to the security engine by analysing the information. Finally the security engine sends an instruction to execute the normal policy set declaring there is no attack. If there is an attack it stores a record in the database and follows the appropriate procedures.

INTELLIGENT AGENT:

The intelligent agent collects the basic information about the devices and users. Check the collected information whether they are valid and if a malicious event occurred.

Check and save the changes between previous and collected information. Deliver the results to security engine which can take a decision.



SECURITY ENGINE:

The security engine obtains information from the intelligent agent about the events and saves the information in the security policies database. The security management system deny the network access to the mobile device where the security engine receives event information that there is a violation based on the following factors the security engine makes the decisions such as type of attack; type of end user device; possible vunlerabilities in the same nodes; previous records in the security database. In order to generate a suitable security policy set the decision making process contains full of details.

SECURITY ADMINISTRATOR:

When the policies are fractured the security administrator updates them and generates new settings for the network the following are the security administrator roles.

1. Discovers the contradictions between the current network status and specified policies.

2. Verifies whether the policy rules, networks domain and network entities are working together in a proper way or not.

The security administrator generates a new configuration setting and forwards a report to the security management system when it identifies a policy violation (or) contradiction. Security engine will stop the mobile device from obtaining the network.

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By using network topology, the configuration state and previous records about the network the security administrator validates the policies. The security policies levels are of two types they are:

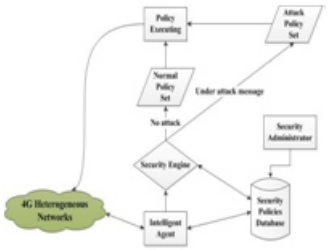
1. Normal level

2. Danger level

The security management system works on normal level when there is no attack when an attack occurs the security management system works on danger level. Depending on the analysis and policies the security engine should take a procedure from the security policies. The security management system moves the security policies level to normal level and keeps record in database when security management system recovers from attack.

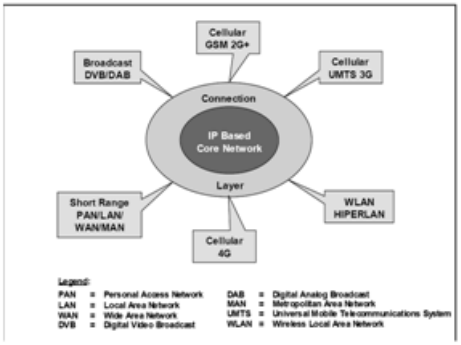
JUSTIFICATION FOR USING AN AUTOMATED SECURITY ADMINISTRATOR:

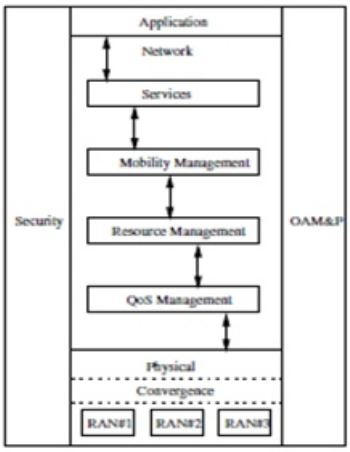
The human capabilities cannot match the rapid movements in network management due to the network and topology changes in wireless networks. In order to prevent any malicious access to the network the security policy management needs to be automated. There is a demand for dynamic policies are well known dynamic policy is responsive to the changes robustness and automation of policies can be offered by separating policy specification from policy management.



4G NETWORK ARCHITECTURE:

This architecture is based on internet protocol version 6 (ipv6). It operates at the transport layer enabling communication across various heterogeneous networks. It is based on the key factors such as mobility, quality service and efficient resource management schemes. The following are the functionalities provided by each layer and module.





APPLICATION:

Application layer is composed of various third party applications they provide value added services to its subscribers.

NETWORK:

Network layer consists of sub layers they are described below.

SERVICES:

The interaction between various value added services and networks is managed by this layer.

MOBILITY MANAGEMENT:

Mobility management layer provides quality and uniform services to the stationary terminal across various heterogeneous networks. Low hand over latency and packet loss during the provision of real time and non real time services to the end user moving across different networks these are the features provided by this layer. In order to achieve all these it is performing tasks such as binding update, location management common control signalling address assignment handover control mechanism and so forth.

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RESOURSE MANAGEMENT:

The functionalities of allocation, de allocation and reallocation of the network resources. That are acquired during the communication sessions within the same or different network domains are incorporated in this layer. During or before the communication activity this activity is to be performed. The task of congestion control, packet scheduling and packet classification performed by this layer.

QUALITY SERVICE MANAGEMENT:

Best optimal utilization of the available resources is provided by this layer. It provides an option to the applications to choose between high overall throughput and low end to end delay in scenarios. Where the network resources are limited depending on the applications preference it provides the best trade off mechanisms. It contains several activities such as link utilization control bandwidth control and so forth.

PHYSICAL:

Physical layer consist of ipv6 network of and heterogeneous networks such as GSM(Global system for mobile communications) CDMA(code division multiple access) and WLAN in their physical view. This layer consists of two sub layers namely:

CONVERGENCE LAYER:

Convergence layer provides common control signalling mechanism across the core and other heterogeneous networks at physical level. To transparently use the independent network services such as mobility management resource management and qos management different radio access networks are allowed by this layer.

DIFFERENT RAN:

This layer consists of several radio access networks communicating with each other at the physical level.

CHALLENGES IN 4G:

The following are the challenges faced in the migration to 4G into three different aspects.

MOBILE STATION:MULTIMODE USER TERMINAL:

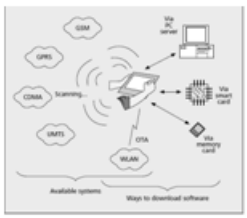
It is a device working in different modes. A wide variety of 4G services and wireless networks by recontiguring themselves to adapt to different wireless networks are supported by this device. Several design issues such as limitations in the device size, cost, power consumption and backward compatibility to systems are being encountered by them. The use of SDR which adapts itself to the wireless interface of the network is one of the possible solutions.

WIRELESSNETWORK DISCOVERY:

The multimedia user terminal is required by the 4G services in order to discover and select the preferred wireless network. Because of the networks and their access protocols 4g will be much more challenging than 3g. To counter this challenge SDR approach has been proposed. SDRwill scan for the available networks and download the software required to interface with the selected network. It can be downloaded from pc server, smart card or from over the air (OTA).

WIRELESS NETWORK SELECTION:

Wireless network providing optimized performance and high QOS for a particular place, time and desired service is provided by 4G to users as a choice to select. To make the network selection procedure efficient and transparent to the end user high QOS and optimized performance at particular instant needs to be clearly defined possible considerations may be available network resources network supported service types and cost designing the correct hand off time, correct hand off latency, increased system load are faced by hand off process.



NETWORK INFRASRTUCTURE OF QOS SUPPORT:

4G is an integration of IP and non IP based system unlike previous generations.

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In 4G networks QOS designs should consider the integration of different wireless networks to guarantee QOS for the end to end services.

SECURITY:

For specific services only encryption/decryption protocols of the current generation network were designed. They are very inflexible to be used across the heterogeneous architecture of 4g which is dynamically reconfigurable, adaptive and light weight security mechanism.

FAULT TOLERANCE:

Tree like topology is the characteristic of wireless networks. It will affect all the network elements at the levels below if there is any failure in one of the levels. Because of the multiple tree topologies this problem can be further aggrauated. A strategy for fault tolerance in wireless networks adequate research work is required.

SERVICES MULTIPLE OPERATORS AND BILLING SYSTEM:

Based on the call duration, services used etc. each operator has its own billing scheme in the current era of 2G and 3G. User can avail to different services made available by different operators in 4G. For both the service providers and end users would complicate the billing system. This asks for a unified billing system for all the services of the 4G network. Based on the requirements of scalability, flexibility, accuracy and usability several frameworks are being studied.

PERSONAL MOBILITY:

The movement of the user is considered by the terminal mobility, personal mobility. It emphasizes on provision of personal communication making sure the message delivery to the user irrespective of his location and the terminal he is using and personalized operating environment adapting the message display as per the characteristics of user terminal.

TECHNOLOGY USED:

International telecommunications union radio communications sector specified a set of requirements for 4G standards in March 2008.

International mobile telecommunications advanced (IMT-advanced) specification, setting peak speed requirements for 4G service at 100 megabits per second for high mobility communication. As the above mentioned first release versions of mobile WIMAX and LTE support much less than 1GB/s peak bit rate, they are not fully IMT-advanced compliant, but are often branded 4G by service providers on December6, 2010, ITU-R recognized that these two technologies, as well as other beyond-3G technologies that do not full fill the IMT-advanced requirements, could not considered "4G".

4G system does not support traditional circuit-switched telephony services as opposed to earlier generations but all Internet protocol based communication such as IP telephony. The spread spectrum radio technology used in 3G systems is more in all 4G candidate systems and replaced by OFDMA multi-carrier transmission and other frequency-domain equalization (FDE) schemes, despite extensive multi-path radio propagation making it possible to transfer very high bit rates. The peak bit rate is further improved by smart antenna arrays for multiple input multiple-output (MIMO) communications.

CONCLUSION:

4G will revolutionize the field of telecommunication domain bringing the wireless experience to a completely new level. 4G will provide plenty of features and services making the world smaller place to live. It can be used as a reference framework for future research. But still comprehensive research work is required in the field of network security to tackle potential security threats because a ubiquitous "secured" heterogeneous network will appeal more to the today's consumers.

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