National Water Electricity Company

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Network (LAN/WAN) Infrastructure Upgrade

Background:

Over the past Seven years the NAWEC network has expanded from a small workgroup network for the administration to a full-blown multi-building Fast Ethernet network, with multiple branches. The current network has 1Gbps fiber between the buildings and 100Mbits Cat5 & Cat5e cabling to endpoints in buildings. The bulk of the fiber and copper cabling is between 5 and 15 years old.

1. The campus comprises of 14 buildings and 9 distribution frames:
2. IT department / Server Farm
3. Corporate Service Division.
4. Software Block
5. Metering
6. Stores
7. Administration / HR.
8. Procurement
9. Provincial
10. Internal Audit
11. Data Verification (newly added)
12. Commercial
13. Task force / Revenue protection unit.
14. Front office (Revenue collection Office)
15. Nasa (Nawec Staff Association)
16. Remote Branches across the country as mention below.

No.	Urban
1	Head office (Complexes)
2	Banjul
3	Bakau
4	Brusubi
5	Serrekunda London
6	Serrekunda Tank
7	Brufut
8	Sanyang
9	Gunjur
10	Brikama1
11	Brikama Misra
12	Yundum
13	Lamin
14	Sinchu
15	Latrikunda Sabiji
16	Tallinding
17	Barra/Essau
18	Kerewan
19	Salikenni
20	Farafenni
21	Kaur
22	Wassu

23	Janjangbureh / MacCarthy
24	Bansang
25	Gambisara
26	Basse
27	Taibatu
28	Fatoto
29	Soma
30	Bwiam
31	Sibanor
32	Mandinaba

The core of the network is located in IT Department in a secure room with sufficient power and cooling as well as a connection to a backup generator. There are fiber runs from core to each of the above listed block except the two stores, procurement, NASA building and newly added data verification building. The fiber is all multi-mode (62.5 micron) and every run cable have at least 2 pairs of fiber that are terminated between the core switches to each of the distribution / access switches.

Moreover, existing complexes such as

34	**Serrekunda Tank Complex**
35	T&D (Booster)
36	Kotu Power station

Will be added to the infrastructure. The above complexes core will be network using fiber. Each complex will have the core and distribution to serve the need and capacity need for the IMS/BOKA Software. As costing analysis is done at the above, most Engineers and administrators will need access away from office, as they can be called in odd hours.

Current Design and Use

Current Network Layout:

The current LAN is a classic hub-and-spoke Ethernet LAN with two core switches in the MDF Server room MDF (Network Core)

Two cisco WS-C4503-E (MPC8245) switches supporting 1Gbit fiber connections to IDFs, 1Gbit copper connections to servers, 100Mbit copper connections to other MDF switches, and 100Mbit connections to network endpoints in the building

To meet the demand for current data transmission, NAWEC is embarking on network restructure; this is however necessary to accommodate the concurrency of numerous users (LAN / remote

branches) access to resources. This will be achieve by setting up a stable data transmission solutions, A Propose Solution based network, that will require access to backhaul to maximized the many benefit of clean infrastructure.

For NAWEC, the proposed infrastructure can provide even voice and data communications, video monitoring and supervisory, and Control and data acquisition little or no issue.

To overcome current problems inherent in the current network / data communication, this Project will help design end to end solution purpose, built for the entire campus, remote branches/T&D / Water etc. and also eliminate bottlenecks between Nawec and partners.

However this will be able to coordinates traffic flow throughout the LAN networks in the following ways

- Eliminates disruptive collusions cause by self-interference to deliver superior performance with a deterministic quality of service.
- The Intelligent backup datacenter array will enable less downtime without sacrificing throughput and reliability.
- User interruptions in terms of medium / channels and addressing problem. It's a tradition in Nawec that almost everyone calls IT "***Demba! FLUSH! ME, I HAVE A YELLOW ICON***". This is cause by attenuation, cascades etc. this will be eliminated.

Moreover, this acquisitions/materials will enhance performance, including dynamics, optimization with variable problem isolation(VLAN), mesh wide management, high power levels for better penetration through obstacles that alternate transmission, support for none-line of sight operation, load balancing with automatic fail overs among gateways, comprehensive traffic management capabilities, robust security provision and more.

Each of the above require planning and one time cost (see below)

[Estimate costing

			Estimated Costing		Phase		
No.	**Item**	**QTY**	**cost (D'00)**	**Cost Effective**	**Phase 1**	**Phase 2**	Phase 3
	Cat 6E Data cable	20	333,500.00				
			161,000.00	333,500.00	333,500.00		
			180,000.00				
	Cisco WS 2960G-24TC-L Network switch	8					
			736,000.00				
			750,000.00	750,000.00		750,000.00	
	Network Points(Single / Double Plates)	1000					
	Double Plates	500	125,000.00				
			(125,000.00)	(125,000.00)	125,000.00		
	Double Plates	500	187,000.00				
	PVC Wall Box	1000	50,000.00				
			(187,050.00)	187,050.00	187,050.00		
	Cable caps		1,000.00	1,000.00	1,000.00		
	Cable Tite	1000	4,000.00	4,000.00	4,000.00		
			0.00				
			0.00				
	Screw Drilling Machine	1	17,300.00	17,300.00	17,300.00		
		1	3,500.00				
	Trunking	384	49,080.00	49,080.00	49,080.00		
			31,092.00				
	24 Port Patch panel	20	70,000.00				
			84,000.00	84,000.00			84,000.00
			80,000.00				
	Verizon Wi-Fi Router	12	96,600.00	96,600.00			96,600.00
			0.00				
			0.00				
	Wall mount Rack (4U / 6U)	12	74,000.00	74000.00			74,000.00
			72,000.00				
			0.00				
	Pipes/joins(T-connectors / Barrel and Elbow	100	10,000.00	10,000.00	10,000.00		
		1					
	Serrekunda Tank MPLS-VPN extension	1	***As per Nawec/Gamtel Contract***				
	Serrekunda Tank (Complex) LAN Fiber		62,550.00	62,550.00	62,550.00		

[Estimate costing

	HQ Trunk Link(Metering to Server Room)	2	55,235.00	55,235.00	55,235.00		
	Booster (Complex) LAN Fiber	4	112,000.00	112,000.00	112,000.00		
	Booster Fajara MPLS-VPN / IPSEC VPN	1	***As per Nawec/Gamtel Contract***				
Total				1,961,315.00	956715.00	750,000.00	254600.00

Notice that "Serrekunda Tank MPLS-VPN extension" may not be included as it may be service by previous cost that may be available.

Also note that, at the time of putting all these pieces together, Gamtel could not be available for the following costing on time.

	Serrekunda Tank MPLS-VPN extension
	Serrekunda Tank (Complex) LAN Fiber
	HQ Trunk Link(Metering to Server Room)
	Booster (Complex) LAN Fiber
	Booster Fajara MPLS-VPN / IPSEC VPN
	Total

Risk Assessment:

For every major change to an infrastructure especially network (connectivity), must have side effect to the existing users, data transmission and other disruptions to services.

Well, customer base systems (Cash power / Galatee) is looked into, and concluded that disruptions of services during work (restructure) will not be affected.

This will be done by allowing continuous access for Galatee/Suprima user. Job will be done in parallel with current infrastructure there by allowing continuous or normal services.

After completion, service will still be running until switch to new infrastructure, that will be a matter users using their existing jumper cables from wall data socket to their Nodes(computers / printers etc.), then old Trunkings/ connections can be repaired otherwise remove completely.

In conclusion, there is minimal risk.

The Solution Summarized features

- Dynamistic Protocol provides low latency &jitter
- Dynamic, continuous optimization of routes and modulation rates
- Maximizes system capacity &performances
- Can Support QOS application like VoIP, video ,& different

- Self-healing , fault tolerant network for high availability

Element Management System

IMS: Provision

- Network –wide configuration & provision
- Distributed server infrastructure, managed centrally

IMS Control

- Fault Management
- Performance monitoring
- Active Monitoring and Management of Network performance and usage.
- SNMP-Based (standard & private MIBS *Management Information Base*)

High availability

Perimeter /Gate ways redundancy

- Multiple Gateways provides redundancy connections
- Wireless links redundancy (b/w power plants, T&D)
- Backup paths provide alternative routing in case of link degradation or failure
- Self- healing through Dynamic failovers
  Intelligent protocol dynamically re –optimizes upon failure

Reliable coverage

- No Bounce signal off obstructions / attenuation ("Commonly known as 'Yellow ICON ' ")
- Introduce policy base routing, if there exist multiple path to the same destination.
- Intrinsic multi –path capabilities of OFDM enables signals to bounce off buildings
- Power through obstructions High speed transmission coupled with high gain antennas.
- Route around obstructions Uses multi-hop mesh to extends around obstacles

Guaranteed Quality of services

Traffic shaping /QOS

- Latency sensitive traffic prioritized ahead of other traffic

Deterministic protocol

- Time –Division Duplex (TDD) guarantees bandwidth

Low latency

- 8-10 ms round-trip latency per hop
- 5 hops still less than 50 ms to meet huge data transmission

Low jitter

- 3-4 ms jitter

Robust traffic Management

- Traffic shaping
- Traffic filtering
- Virtual LANs /vrfs
- Traffic prioritization
- Air tight Security for backup LAN links
- Encrypted meshes backhaul
- All backhauls link encrypted with 128 – bit AES
- Certificate- based mesh Authentic
- Only permit validated mesh nodes on the network.

Scalable Performance & Capacity

Scalability is the capability of a system, network or its potential to be enlarged to accommodate that growth.

A system is considered scalable if it is capable of increasing its total output under an increased load when resources (typically hardware) are added.

Scalability, as a property of systems, networks, is generally difficult to define and in any particular case it is necessary to define the specific requirements for scalability on those dimensions that are deemed important. It is a highly significant issue in routers, and networking. A system, whose performance improves after adding hardware, proportionally to the capacity added, is said to be a *scalable system*.

Note that Scalability of Network can be measured in various dimensions, such as:

- *Administrative scalability*: The ability for an increasing number of organizations or users to easily share a single distributed system.
- *Functional scalability*: The ability to enhance the system by adding new functionality at minimal effort.
- *Geographic scalability*: The ability to maintain performance, usefulness, or usability regardless of expansion from concentration in a local area to a more distributed geographic pattern.
- *Load scalability*: The ability for a system to easily expand and contract its resource pool to accommodate heavier or lighter loads or number of inputs. Alternatively, the ease with which a system or component can be modified, added, or removed, to accommodate changing load.
    - For example Incredible modulation rules
    - Higher end routers and switches used to increase performance throughout network
    - Scalable network capacity
    - Add Gateways data centers branches etc. to scale network capacity
    - Load Balancing and traffic segmentation (Such as vlan / VRFs etc)
    - Additional Gateways load balance traffic between them