

Annexure A

Network Topology and Network Infrastructure Design

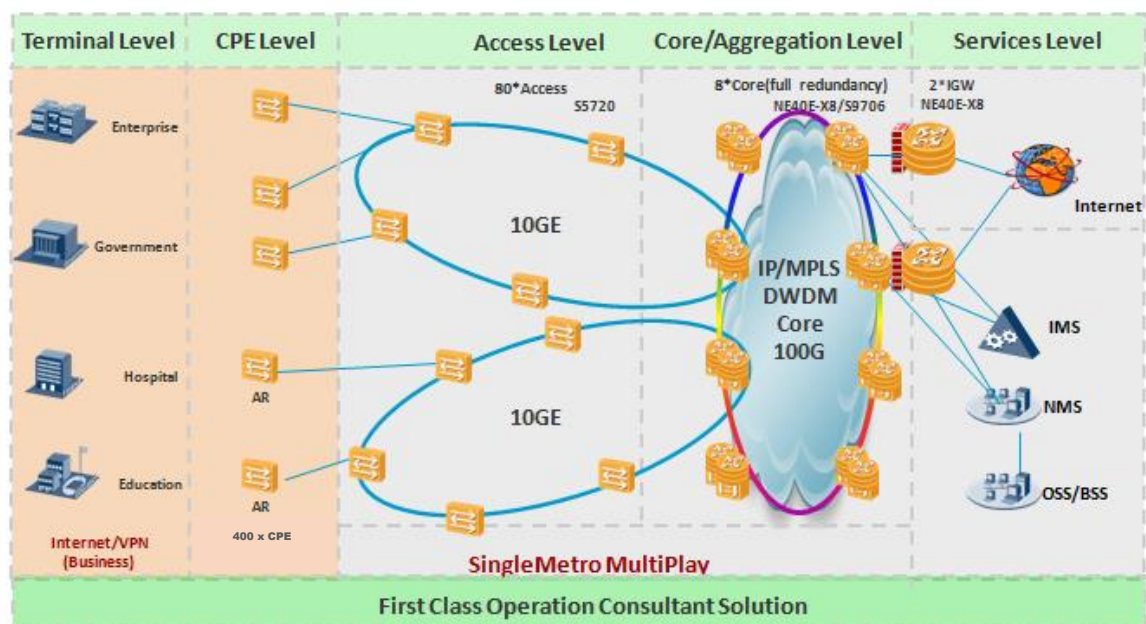
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1 COT Broadband Network Design

The proposed architecture shown below demonstrates the end-to-end Tshwane broadband network solution.

The Tshwane Broadband Network Overview Solution Overview for Tshwane Broadband network



Total solution configuration:

- 400 AR2220 CPE devices will be installed. The CPE device is the handover point to Tshwane. Tshwane will connect their LAN network to the CPE.
- 1500 km of Optical fiber transmission network will be built to cover agreed Tshwane areas. The route will consist of both core and access network fibre. Two capacities of fibre will be deployed: Type A (high capacity – 144 pair cable using 2 micro ducts) and Type B (standard capacity – 72 pair cable, 4 ducts). The proportion of Type A versus Type B will be at the election of the Service Provider based on the effectiveness of the deployment.
- IGW Routers will be deployed as Internet Gateways with a 1GE interface connection to the Internet Services Provider (ISP). COT is wholly responsible for the ISP connection on the Existing Network. The Service Provider will provide internet connection for the commercialisation of the Network.
- 8 Core locations will be equipped with Redundant Core Routers, each with 100GbE (10x10GE) interfaces to the DWDM (fiber network connection) equipment. The bandwidth capacity between Core sites will be 100GbE.

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- The 8 core sites will be equipped with Aggregation Switches with 10G interfaces for the access rings.
- 80 Access switches will be deployed to provide full fiber coverage in the Tshwane area. 10GE interfaces on the access rings and 1GE interfaces for the 400 (AR 2220) CPE devices. The CPE device will be known as the customer edge device and Tshwane will connect the COT LAN equipment to this CPE device
- Each Core will have multiple access rings connected to the aggregation switch.
- The solution will provide voice and data service for government employees in Tshwane.
- The proposal include the 400 AR 2220 CPE access point devices where the COT LAN will connect to.
- E2E network management solution enables network surveillance and management

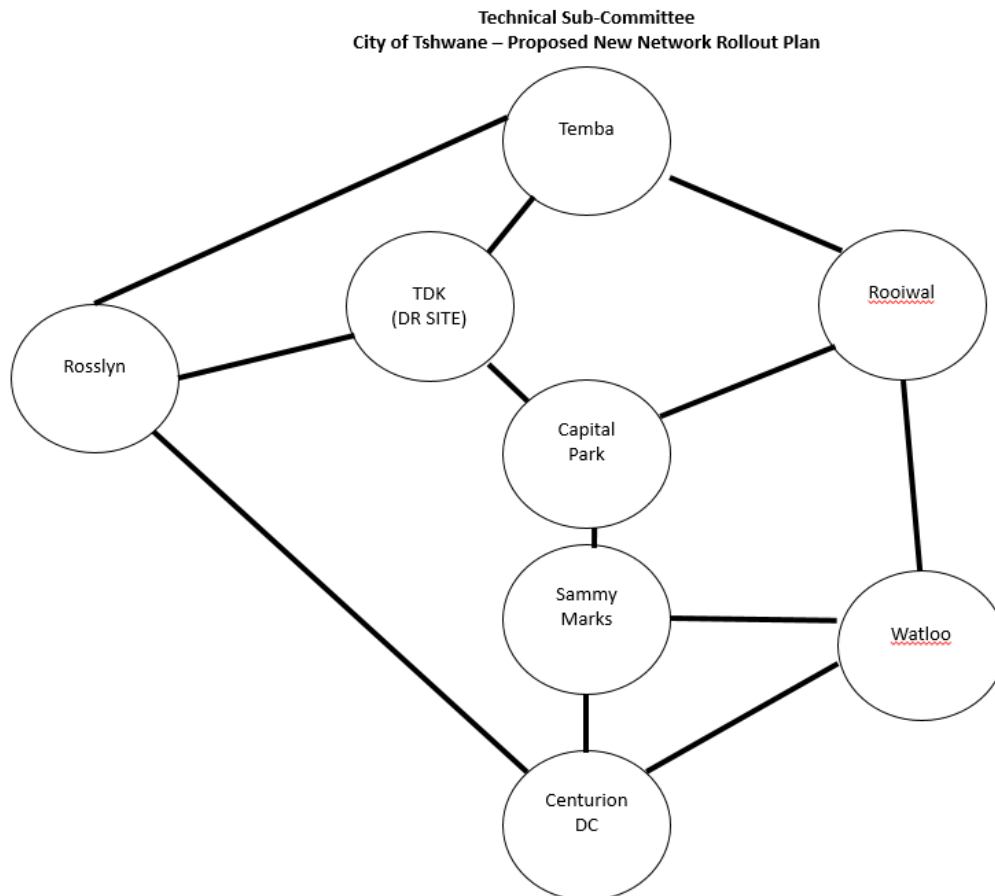
Network Equipment:

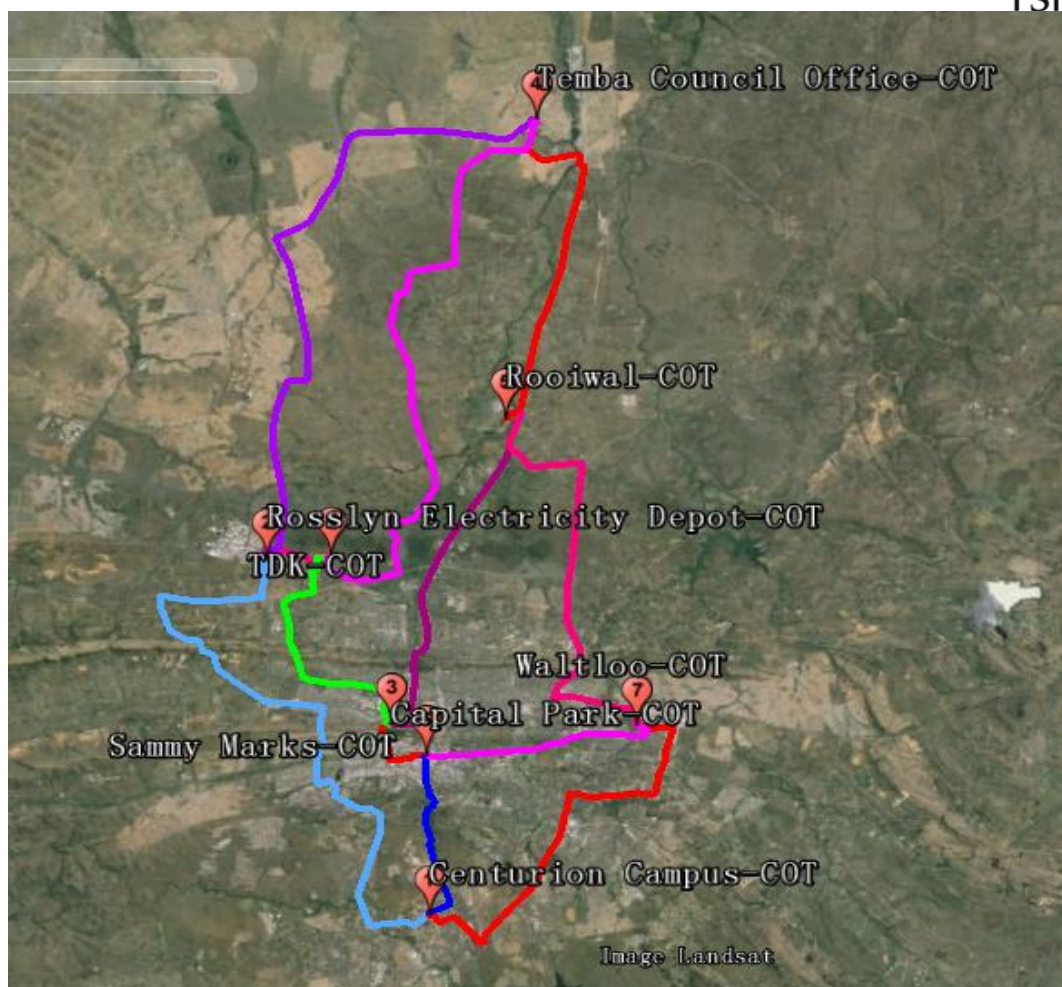
Solution	Equipment	Qty	Remark
BSS/OSS	BSS/OSS	1	Business Support System and Operational Support System
IMS - Voice	IMS+UMS	1	24,000 user P2P Voice & Voice mail Service Voice conference capability
DWDM	OSN8800-T16	8	100G
Core Router	NE40E-X8	16	100G
IGW Router	NE40E-X8	2	10G
Firewall	USG9560	2	20G
Aggregation Switch	S9706	16	10G
Access Switch	S5720	80	GE/10GE
CPE	AR2220	400	Voice/Data/Video
NMS	U2000	1	Equipment Management Software
OLS	N2510	1	Fiber monitor system Cover 25 selected sites, the monitoring and testing range is less than 30 dB(1625 nm, 20us).

Core Fiber Route

The Tshwane Broadband network backbone is designed based on the core site locations and connects to all the cores with 3 access routes to ensure route redundancy and high availability. The following were considered:

- 8 core sites.
- Transmission capacity between core sites is 100Gbps.





Distance between Core locations and Rollout Priorities:

Site A	Site B	Length(km)	Rollout
Waltloo	Centurion Campus	30	year 1
Centurion Campus	Sammy Marks	13	year 1
Sammy Marks	Capital Park	6	year 1
Capital Park			year 1
Capital Park	TDK	20	year 2
TDK	Rosslyn Electricity Depot	5	year 2
Rosslyn Electricity Depot	Centurion Campus	45	year 2
Temba Council Office	Rosslyn Electricity Depot	43	year 3
Temba Council Office	TDK	43	year 3
Temba Council Office	Rooiwal	25	year 3
Rooiwal	Capital Park	25	year 3
Rooiwal	Waltloo	30	year 3
Waltloo	Sammy Marks	15	year 3

Core Site Names

Region	Area Name	Core Locations
1	Akasia	Rosslyn (Year 2 build)
2	Hammanskraal	Temba (Year 3 build) Rooiwal (Year 3 build)
3	CBD 1 CBD 2	Sammy Marks (Year 1 build) Capital Park (Year 1 build)
4	Centurion	Centurion (Year 1 build)
5	Rayton	Waltloo (Year 1 build)
6	Mamelodi	
7	Bronkhorspruit	
	DR Site	TDK (Year 2 build)

A list of 524 Site locations were provided by COT. The respective locations of a maximum of 400 CPE devices will be agreed upon before 31 December 2015. The 400 locations will be required on such number of Sites as is necessary and which will be selected from the sites referred to below (the “**Sites**”) Even if more than one CPE device be required at a particular location the total number of CPE devices shall not exceed 400 CPE devices. The Sites will be selected from the list below.

Site Name	Site Name	Site Name	Site Name
AKASIA COMMUNITY LIBRARY	SAMMY MARKS SERVER ROOM	FOUNTAINS VALLEY SWIMMING POOL	CENTURION BLOCK-E SERVER ROOM
AKASIA MUNICIPAL OFF BLOCK A	SAMMY MARKS STREET SCAPE	FOUNTAINS VALLEY TOULOUSE OFF	CENTURION BLOCK-F CITY PLAN
AKASIA MUNICIPAL OFF BLOCK B	SAMMY MARKS SYNDICATE ROOMS	GALLERIA OFFICES (SAMMY MARKS)	CENTURION BLOCK-G METRO POLICE
GABLES BUILDING (AKASIA)	MUNITORIA BUILDING	GIOVANETTI SUBSTATION	CENTURION BLOCK-H ELECTRICITY
SPECTRUM BUILDING AKASIA	METRO POLICE HEADQUARTERS	GREYTREX METRO POLICE TRANSP	CENTURION BLOCK-I WATER + SAN
BKS BUILDING	RONDALIA BUILDING	GREYTREX MP LOGIST SERVICES	CENTURION BLOCK-J ELEC PRE PD
C DE WET ADMIN	1 VERMEULEN STR METRO POLICE	GROENKLOOF NATURE RESERVE	CENTURION BLOCK-K ELECTRICITY
C DE WET ADVICE CENTRE	1 VERMEULEN STREET CLIENT SERV	HATFIELD BUILDING MAINT TECHN	CENTURION BLOCK-L ENVIR HEALTH
C DE WET BUS DEPOT	1 VERMEULEN STREET POUND	HATFIELD BUILDING MAINTENANCE	CENTURION BLOCK-L BUILD MAINT
C DE WET CLEANING SERVICES	11 PROES STR CONFERENCE ROOM	HATFIELD FIRE STATION	CENTURION BLOCK-N ENVIR MNGMT
C DE WET COACH SHOP	11 PROES STREET	HAZELWOOD FIRE STATION	CENTURION BLOCK-N MECH WORK
C DE WET CREDITORS	11 PROES STREET STORE 23	HILLCREST SWIMMING POOL	CENTURION BLOCK-V RDS + STORM
C DE WET ELEC MAINTENANCE	11 PROES STREET TOOL STORE	INNER CITY OFFICE(SAMMY MARKS)	CENTURION BLOCK-W PARKS DEPOT
C DE WET OLD SERVER ROOM	11 SCHOEMAN STREET	INNEDAL FIRE STATION	CENCOL COMMUNITY LIBRARY
C DE WET STATIONARY STORE 4	125 BOOM STREET	ISIVUNO	CENTURION COURT
C DE WET STORE 42	125 BOOM STREET SECURITY	LOFT OFFICES	CENTURION DAM STORE
C DE WET TOP FLOOR	13 PROES STREET	LOFT OFFICES COUNCILORS	CENTURION FIRE AMBULANCE
C DE WET TRAINING	13 PROES STREET STORE	LOFTUS DEPOT	CENTURION FIRE INSPECTORS
C DE WET WORKSHOP FLEET MGMT	190 VOORTREKKER RD ELEC SERV	LOFTUS DEPOT PARKS	CENTURION FIRE OPERATIONS
PRINCES PARK ELEC BLOCK A	AUCTION YARD	LUCAS VAN DEN BERGE RECREATION	CENTURION FIRE STATION
PRINCES PARK ELEC BLOCK B	AUCTION YARD NEW BUILDING	MAYVILLE COMMUNITY LIBRARY	CENTURION HOUSE 6
PRINCES PARK ELEC CLINIC	AUSTIN ROBERTS BIRDS SANCTUARY	WAVERLY COMMUNITY LIBRARY	CENTURION HOUSING CRYSTAL PARK
PRINCES PARK ELEC STORE 3	BELLE OMBRE CLINIC	MELROSE HOUSE MUSEUM	CENTURION METRO POLICE REG 8
PRINCES PARK ELEC WORKSHOP	BELLE OMBRE FLEET MANAGEMENT	MOOT COMMUNITY LIBRARY	CENTURION PARKS DEPOT
PRINCES PARK ELECTRICITY GATE	BELLE OMBRE HOSTEL	MOREGLOED DEPOT	CENTURION RDS + STORM DEPOT
PRINCES PARK PARKS	BELLE OMBRE RDS + STORM DEPOT	NEDPARK SUNNYSIDE	CENTURION RDS + STORM STORE
PRINCES PARK PARKS ADM BUILD	BELLE OMBRE ROBOT SECTION	OLD LAW CHAMBER	CENTURION ROADS + STORMWATER
PRINCES PARK PARKS RANGERS	BELLE OMBRE STORE 21	OLD RAADSAAAL BUILDING	CENTURION SPORT PARK DEPOT
PRINCES PARK PARKS RANGERS 2	BITTS CENTRE NEDERLANDSCHE BNK	OPERA PLAZA	CENTURION TESTING CENTRE

PRINCES PARK PARKS RED BUILD	BOTHONGO PLAZA EAST	PIETER DELPORT CENTRE	CENTURION VEHICLE TESTING CENT
PRINCES PARK PARKS STORE	BROOKLYN COMMUNITY LIBRARY	PIETER DELPORT TOWER	CENTURION WATER + SANITATION
9 BOSMAN STR BUILDING MAINTEN	CAFE RICHE	PRESIDENT CENTRE	CENTURION WATER TOWER
9 BOSMAN STR MOTOR VALUATION	CAPITAL PARK DEPOT BLOCK A	PRETORIA ART MUSEUM	CORNWALL HILL HIGHSITE
9 BOSMAN STREET ADMIN	CAPITAL PARK DEPOT BLOCK B	PRETORIA CEMETERY	ELDORAINNE COMMUNITY LIBRARY
9 BOSMAN STREET BATTERY STORE	CAPITAL PARK DEPOT BLOCK C	PRETORIA CENTRAL FIRE STATION	ERASMIA COMMUNITY LIBRARY
9 BOSMAN STREET CARPENTERS	CAPITAL PARK DEPOT TRAINING	PRETORIA CITY HALL	IRENE COMMUNITY LIBRARY
9 BOSMAN STREET OLD CLINIC	CHURCH SQUARE BUS COUPONS	PTA CENT FIRE STATION BLOCK T	IRENE DEPOT
9 BOSMAN STREET PLANNERS	CONTINENTAL BUILDING	SANAP INVESTIGATION UNIT	KRUGER AVENUE GARDEN REFUSE
9 BOSMAN STREET RED BUILDING	DASPOORT ADMIN BUILDING	SCHUBART PARK BUILDING	LAUDIUM AVM
SANLAM PLAZA EAST BUILDING	DASPOORT CHEMICAL LAB	SUNNYSIDE SWIMMING POOL	LAUDIUM CASHIERS
SANLAM PLAZA WEST BUILDING	DASPOORT SEWERAGE STORE 27	VILLIERIA ELEC TRAINING CENTRE	LAUDIUM CLINIC
HB PHILIPS BUILDING	DASPOORT WATER CARE WORKS	VILLIERIA SWIMMING POOL	LAUDIUM COMMUNITY LIBRARY
NOORDVAAL BUILDING	ESKIA MPHAHLELE COMM LIBRARY	WAVERLY COMMUNITY LIBRARY	LAUDIUM CUSTOMER CARE
SAAMBOU BUILDING	FF RIBEIRO CLINIC (SAMMY MARKS)	CENTURION BLOCK-A MUNI COURTS	LYTTTELTON ART GALLERY
SAMMY MARKS CONFERENCE CENTRE	FOLANG CLINIC (C DE WET)	CENTURION BLOCK-B CUST CARE	LYTTTELTON CLINIC
SAMMY MARKS HEALTH	FORT KLAPPERKOP	CENTURION BLOCK-D CUST SERVICE	LYTTTELTON COMMUNITY LIBRARY
SAMMY MARKS HEALTH 1	FOUNTAINS VALLEY GATE OFFICES	CENTURION BLOCK-D DATACENTER	OLIEVENHOUTBOSCH CENTRE
SAMMY MARKS LANDSCAPE	FOUNTAINS VALLEY ISLAND OFFICE	CENTURION BLOCK-D RATES + TAX	PIERRE VAN RYNEVELD CLINIC
SAMMY MARKS PABX ROOM - NO ACCESS	FOUNTAINS VALLEY RESTUARANT	CENTURION BLOCK-E CORP + SHARE	PIERRE VAN RYNEVELD COMM LIB

Site Name	Site Name	Site Name	Site Name
RIETVLEI NATURE RESERVE	MAMELODI METRO POLICE STORE	GA-RANKUWA WATER + SANITATION	RPS COAL PLANT WEIGH BRIDGE
RIETVLEI PARKS DEPOT	MAMELODI MINI MUNI AIDS CENTRE	GA-RANKUWA ZONE 1 OFFICES	RPS ELECTRICAL WORKSHOP
RIETVLEI WATER PURIFICA GATE	MAMELODI MINI MUNI CARETAKER	HAMMANSKRAAL CASHIERS	RPS PROCUREMENT (MAIN STORE)
RIETVLEI WATER PURIFICA LAB	MAMELODI MINI MUNI CASHIERS	HAMMANSKRAAL COMM LIB + RECREA	RPS SECURITY BUILDING
RIETVLEI WATER PURIFICA STORE	MAMELODI MINI MUNITORIA	HAMMANSKRAAL EDUCATION SERVICE	RPS WELDING WORKSHOP
RIETVLEI WATER PURIFICATION	MAMELODI MINI MUNITORIA AVM	HAMMANSKRAAL ENVIRONMENT DEPOT	SINOVILLE METRO POLICE REG 4
ROOIHUISKRAAL AVM	MAMELODI ROADS + STORMW LAB	HAMMANSKRAAL MP REGION 2	WONDERBOOM AIRPORT
ROOIHUISKRAAL CLINIC	MAMELODI ROADS + STORMWATER	HAMMANSKRAAL TOURISM	WONDERBOOM FIRE STATION
ROOIHUISKRAAL COMM LIBRARY	MAMELODI WEST CEMETERY	MABOPANE FIRE STATION	WONDERBOOM HIGH SITE
ROOIHUISKRAAL HISTOR TERRAIN	MAMELODI WEST CLINIC	MABOPANE ROADS + STORMWATER	WONDERBOOM NATURE RESERVE
SNYMAN DE JAGER ATTORNEYS CENT	MAMELODI WEST COMM LIBRARY	MABOPANE UNIT A	RAYTON
SUTHERLAND RIDGE WATER CARE	MAMELODI WEST COMMUNITY HALL	MABOPANE UNIT B	ROODEPLAAT
VALHALLA COMMUNITY LIBRARY	MAMELODI WEST SWIMMING POOL	MABOPANE UNIT X	BODIBENG CASHIERS
VALHALLA GARDEN REFUSE	MMAGOBATHO CRÊCHE	MABOPANE WATER + SANITATION	BODIBENG COMMUNITY LIBRARY
VODACOM HIGHVELD	MQOLISI CRÊCHE	ODI WATER + SANITATION	FALALA COMMUNITY CENTRE
ZWARTKOP RECREATION RESORT	NELLMAPIUS CLINIC	TIENDHLELELI CRÊCHE	HALALA COMM LIBRARY SOSHANGUVE
WALTLOO OLD SERVER ROOM	NELLMAPIUS COMMUNITY LIBRARY	HEATHERDALE CEMETERY	JABULANI FIRE STATION
BAVIAANSPOORT WATER CARE	NELLMAPIUS CUSTOMER CARE	KAREN PARK CLINIC	KLIKRUISFONTEIN COM CENTRE
MAMELODI WEST CLINIC	PERSEQUOR TECHNO PARK IS	ROSSLYN CLINIC	SOSHANGUVE BLOCK HH AVM
ALKANTRANT COMMUNITY LIBRARY	PETROLEUM DEPOT	ROSSLYN ELECTRICITY	SOSHANGUVE BLOCK HH RADIO
BAJABULILE COMM SCHOOL LIBRARY	PHAHAMENG CLINIC	ROSSLYN ELECTRICITY DEPOT	SOSHANGUVE BLOCK X
EAST LYNNE CLINIC	PRETORIUS PARK CLINIC	ROSSLYN ELECTRICITY STORE	SOSHANGUVE CEMETERY
EAST LYNNE COMMUNITY LIBRARY	PRETORIUS PARK ELECTRICITY	ROSSLYN FIRE STATION	SOSHANGUVE COMMUNITY CENTER
EERSTERUST AVM	PRETORIUS PARK MATERIAL STORE	ROSSLYN RDS + STORMWATER ADMIN	SOSHANGUVE COUNCILLOR OFFICE
EERSTERUST CEMETRY	PRETORIUS PARK OLD KITCHEN	ROSSLYN RDS + STORMWATER STORE	SOSHANGUVE ELEC PROJ OFFICES
EERSTERUST CLINIC	PRETORIUS PARK OVERHEADS	WONDERBOOM AIRPORT	SOSHANGUVE ELEC PROJ STORE
EERSTERUST COMMUNITY CENTRE	PRETORIUS PARK PARKS DEPOT	BON ACCORD ROADS + STORMWATER	SOSHANGUVE ELEC TOOL STORE
EERSTERUST COMMUNITY LIBRARY	PRETORIUS PARK PLANNERS	CESSNA ELECTRICAL SUBSTATION	SOSHANGUVE ELECTRICITY
EERSTERUST GARDEN REFUSE SITE	RETHABILE COMMUNITY HALL	CLUB RENDEZVOUS HEALTH CARE	SOSHANGUVE ELECTRICITY INSPECT
EERSTERUST STADIUM	SILVERTON CEMETERY	CLUB RENDEZVOUS SPORT + RECREA	SOSHANGUVE GEOMATICS

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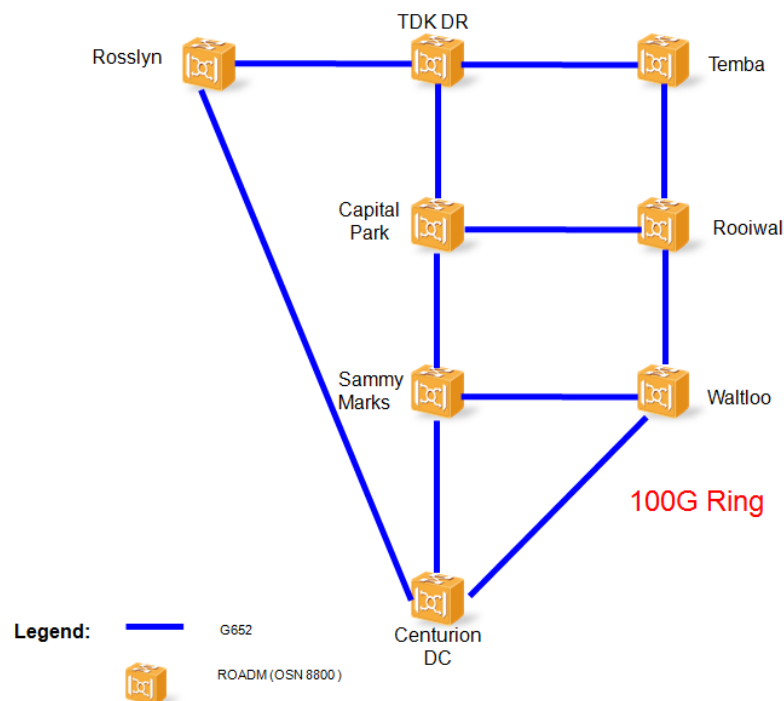
EERSTERUST SWIMMING POOL	SILVERTON CLINIC	DERDEPOORT GARDEN REFUSE	SOSHANGUVE HIGH SITE
EERSTERUST WASTE MANAGEMENT	SILVERTON COMM LIB + RECREAT	DERDEPOORT RESORT	SOSHANGUVE HOUSING
ERASMUSKLOOF FIRE STA CONFEREN	SILVERTON FIRE STATION	DORANDIA GARDEN REFUSE	SOSHANGUVE OCCUPATIONAL HEALTH
ERASMUSKLOOF FIRE STA TRAINING	SILVERTON FIRE STATION OFFICER	KUDU BUILDING	SOSHANGUVE PARKS OFFICES
ERASMUSKLOOF FIRE STATION	SILVERTON PARKS DEPOT	MAGALIESKRUIN GARDEN REFUSE	SOSHANGUVE RDS + STORM STORE
FAERIE GLEN NATURE RESERVE	STANZA BOPAPE CLINIC 2	MAYVILLE DEPOT PARKS	SOSHANGUVE ROADS + STORMWATER
GARSFONTEIN CEMETERY	STANZA BOPAPE COMMUNITY CENTRE	OVERKRUIN COMMUNITY LIBRARY	SOSHANGUVE WATER + SANITATION
GARSTKLOOF GARDEN REFUSE	WALTLOO CUSTOMER CARE	PRETORIA NORTH BUS DEPOT	BABELEGI ELECTRICITY
GATANG COMM SCHOOL LIBRARY	WALTLOO DEPOT ELECTRICITY	PRETORIA NORTH CEMETERY	STINKWATER WASTE MANAGEMENT
GLENSTANTIA COMMUNITY LIBRARY	WALTLOO ELEC MECH WORKSHOP	PRETORIA NORTH COMM LIBRARY	TEMBA COMMUNITY LIBRARY
IKAGENG COMMUNITY HALL	WALTLOO ELECTRICITY STORES	PYRAMID CLINIC	TEMBA COUNCIL OFFICE
ITIRELENG CRÊCHE	WALTLOO GARDEN REFUSE SITE	PYRAMID COMMUNITY CENTRE	TEMBA FIRE STATION
JAN NIEMAND PARK BUS DEPOT	WALTLOO LICENSING	ROOIWAL POWER STATION	TEMBA HIGH SITE
KINGSLEY HOSTEL	WALTLOO METRO POLICE	ROOIWAL WAT + SAN ADMIN EAST	TEMBA ROADS + STORMWATER
MAHLESEDI MASANA COM SCH LIB	WALTLOO TESTING CENTRE	ROOIWAL WAT + SAN ADMIN NORTH	WALTLOO OCCUPATIONAL HEALTH
MAHLATSI CRÊCHE	GA-RANKUWA COMMUNITY CENTRE	ROOIWAL WAT + SAN ADMIN WEST	1 VON WIELLIGH STREET
MAMELODI FIRE STATION	GA-RANKUWA COUNCIL OFFICE ZONE	ROOIWAL WAT + SAN BLOWER BUILD	ATTERIDGEVILLE CEMETERY
MAMELODI METRO POLICE ADMIN	GA-RANKUWA FIRE STATION	ROOIWAL WAT + SAN WORKSHOP	ATTERIDGEVILLE CLINIC
MAMELODI METRO POLICE REGION 7	GA-RANKUWA ROADS + STORMWATER	RPS BOILER CONTROL ROOM 3	ATTERIDGEVILLE COMMUN LIBRARY
Site Name	Site Name	Site Name	
ATTERIDGEVILLE COMMUNITY CENTR	JABULANI CRÊCHE	TDK DISASTER MANAGEMENT	
ATTERIDGEVILLE COURTS	JOOS BECKER CARAVAN PARK	TDK ELECTRICITY ESKOM	
ATTERIDGEVILLE ELEC ENQUIRIES	KWAGGASRAND LANDFILL SITE	TDK IT	
ATTERIDGEVILLE ELEC INSPECTORS	LOTUS GARDENS CLINIC	TDK MECHANICAL WORKSHOP	
ATTERIDGEVILLE ELEC PLANNERS	MBOLWEKA SPORTS COMPLEX	TDK OLD FARM HOUSE	
ATTERIDGEVILLE ELEC STORE	MMINASOGA CRÊCHE	TDK PARKS	
ATTERIDGEVILLE ELECTRICITY	MOLAMBO COMMUNITY CENTER	TDK STORES 70	
ATTERIDGEVILLE FIRE STATION	MOUNTAIN VIEW COMM LIBRARY	TDK WASTE MANAGEMENT	
ATTERIDGEVILLE MINI MUNI AVM	MOUNTAIN VIEW GARDEN REFUSE	WINTERVELD COMMUNITY CENTRE	
ATTERIDGEVILLE MINI MUNITORIA	NKHENSANI CRÊCHE	WINTERVELD COMMUNITY LIBRARY	
ATTERIDGEVILLE OLD AGE HOME	PHILIP NEL PARK FIRE STATION	WINTERVELD COUNCIL OFFICES	
ATTERIDGEVILLE OLD MAYOR OFFIC	PHILIP NEL PARK GARDEN REFUSE	WINTERVELD HIGH SITE	
ATTERIDGEVILLE ROADS + STORM	PHILIP NEL PARK METRO POLICE	MUNIFORUM BUILDING	
ATTERIDGEVILLE SUPER STADIUM	PHILIP NEL PARK STATION COMMAN	NOKENG TSA TAEMANE	
ATTVILLE ELECT CABLES + SUBST	PHOMOLONG CLINIC	METSWEDING	
ATTVILLE MINI MUNI AIDS UNIT	PILDITCH STADIUM	WINTERVELD WATER + SANITATION	
ATTVILLE MINI MUNI CUST CARE	PREMOS ACADEMY + SHOOTING RANG	RETHABISENG	
ATTVILLE MINI MUNI HOUSING	PREMOS ADMIN	EKANDUSTRIA	
ATTVILLE MINI MUNI SERVER ROOM	PREMOS CAFETERIA	ZITHOBENI	
BOIKANYO CRÊCHE	PREMOS COMPUTER TRAINING	CULTURA PARK	
BOOYSEN NURSERY	PREMOS LECTURE HALLS	VLAKFONTEIN	
DANVILLE CLINIC	PREMOS RECREATION BLOCK	TWEEFONTEIN	
DANVILLE COMMUNITY SCHOOL LIBR	PREMOS SAP	ERASMUS	
FORTSIG DEPOT	PREMOS SERVER ROOM	RIAMARPARK	
FORTSIG ELECTRICITY	PREMOS WORKSHOP 1	BRONKHORSPRUIT	
FORTSIG MECHANICAL WORKSHOP	PREMOS WORKSHOP 2-3-4	EKANGALA	
FPM CONSIGNMENT CONTROL	PRETORIA WEST MP REGION 5	KUNGWINI	
FPM WATERMELON CASHIERS	PRETORIA WEST POWER STATION	CULLINAN	
FPM WATERMELON SECTION	PTA WEST POW STAT BOILER SHOP	REFILWE	
FRESH PROD MARK NEW COLD ROOM	PTA WEST POW STAT MACHINE SHOP	DOORNKLOOF	
FRESH PROD MARK OLD COLD ROOM	PTA WEST POW STAT TRAINING	HARTEBEEFONTEIN	
FRESH PRODUCE MARKET ADMIN	PTA WEST POW STATION ELEC SHOP	RIEFONTEIN	
FRESH PRODUCE MARKET AGENTS	PTA WEST POW STATION ENG ROOM	LEEUFWONTEIN	
FRESH PRODUCE MARKET BANANA	PTA WEST POWER STATION CLINIC		
FRESH PRODUCE MARKET HALL A	PTA WEST POWER STATION STORE 5		
FRESH PRODUCE MARKET HALL B	RAMUSHU HALL		
FRESH PRODUCE MARKET SEC GATE	REBECCA STREET CEMETERY		
FRESH PRODUCE MARKET SEC OFF	REBECCA STREET CREMATORIUM		

FRESH PRODUCE MARKET SECURITY	SAULSVILLE CEMETERY
GA-MOTHAKGA RECREATION RESORT	SAULSVILLE CLINIC
HERCULES CLINIC	SAULSVILLE COMMUNITY LIBRARY
HERCULES COMMUNITY LIBRARY	SAULSVILLE HOSTELS
HERCULES STORES	SAULSVILLE SPORTS ARENA
ISCOR CLUB GATE	WEST DEPOT PARKS
ISCOR CLUB IT OFFICE	WEST PARK COMM SCHOOL LIBRARY
ISCOR CLUB METRO POLICE HQ	ZANDFONTEIN CEMETERY
ISCOR CLUB MMC OFFICE	STATION SQUARE COURTS
ISCOR CLUB RECEPTION	STATION SQUARE LICENSING
ITUMELENG CRËCHE	STATION SQUARE METRO POLICE

1.1 DWDM Transmission Network Solution

1.1.1 Network Structure

In the core layer the DWDM equipment supports a 100G line rate with long distance fiber and includes eight FOADM stations. The transmission network topology is shown below.



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1.1.2 Network Fiber Attenuation

The following table shows the attenuation values that were used in the system design.

System capacity	DWDM 40 X 100Gbps
Attenuation Coefficient	0.275dB/km (Including attenuation of fiber and splice)
Polarization Mode Dispersion	16.887 ps/nm.km
Maximum Loss per Connector	0.25dB/connector
Middle Joint Connection Loss	0.5dB/joint
FIU Insert Loss	1dB/pair
Section Total Optical Fiber Losses	Distance (km) × Attenuation Coefficient + Loss of Connector (0.5dB × 2) + Middle Joint Connection Loss (1dB/joint × quantity of joint) + Fiber Margin + FIU Loss (1dB/pair)

1.1.3 Network Configuration

The capacity between Core sites is planned to be 100Gbps.

1.1.4 Network Wavelength Design

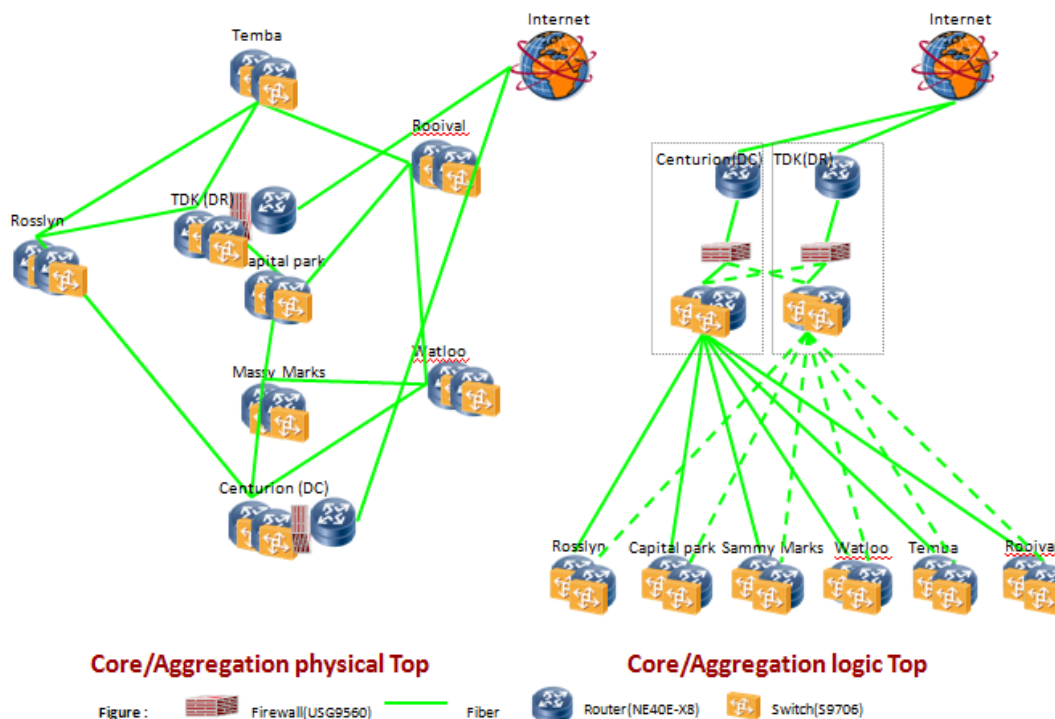
Centurion & TDK will be utilized as the Main Datacenter & Disaster Recovery site with Internet breakouts. All the core nodes will be connected via a 100Gbps backbone link to the MPLS Core routers. Each core site will have a 100Gbps Link to Centurion and TDK nodes. All the services are designed with protection route capabilities to minimize service interruption.

1.2 IP Network Solution

The IP network connects 8 Core sites, 80 access Switches (S5720) and 400 - AR2220 CPE devices.

The IP logical network design for the Tshwane Broadband project has three levels; Core level, Aggregation level and Access level.

Core/Aggregation level Design:



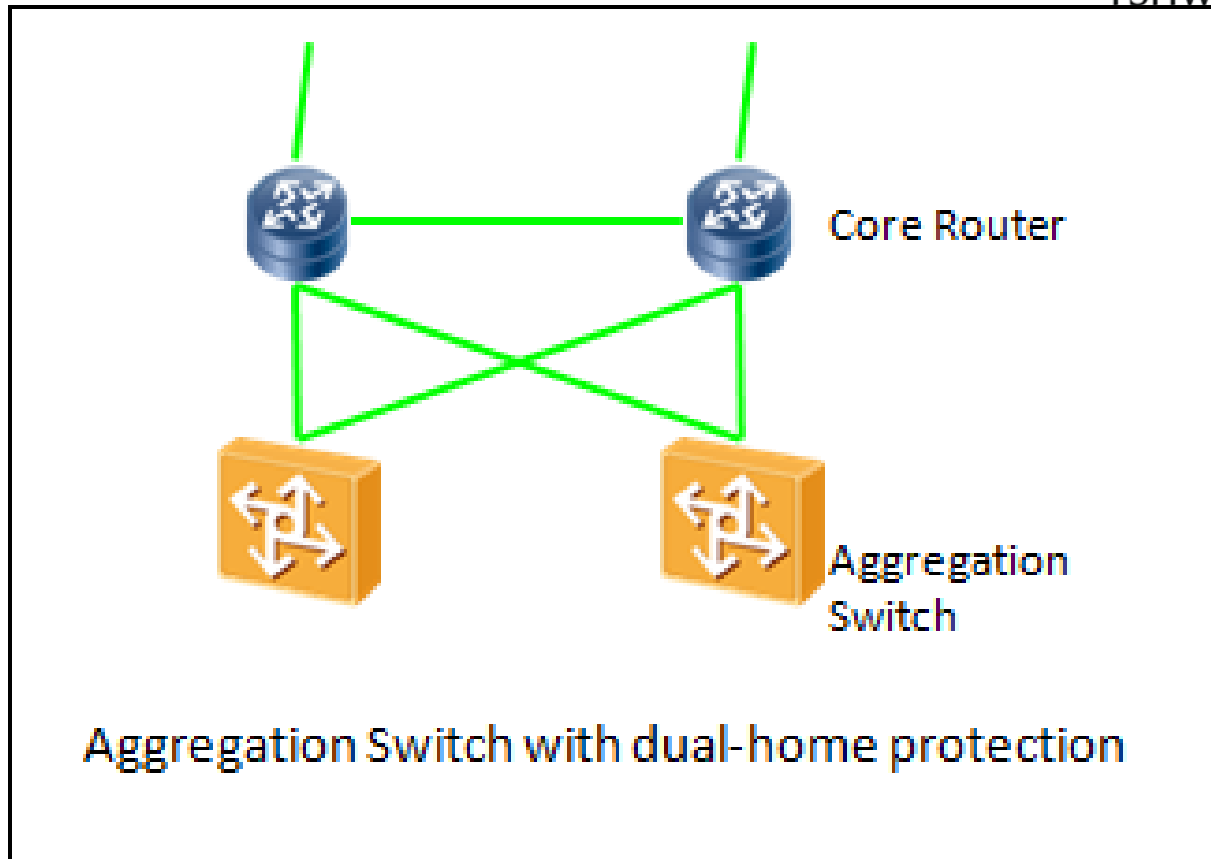
The core network comprises of 8 sites which includes 2 IGW routers, 16 Core Routers, and 16 Aggregation Switches.

The Core Routers will be connected to each other through DWDM equipment with ring protection. Two high-end security gateways will be deployed at Centurion and TDK sites.

Two Internet Gateways (IGWs) will be deployed at Centurion and TDK sites. They will enable internet connection and connection to other ISPs. COT will be responsible for the connection and associated installation and rental cost of the Internet Provider (bandwidth)

Aggregation level:

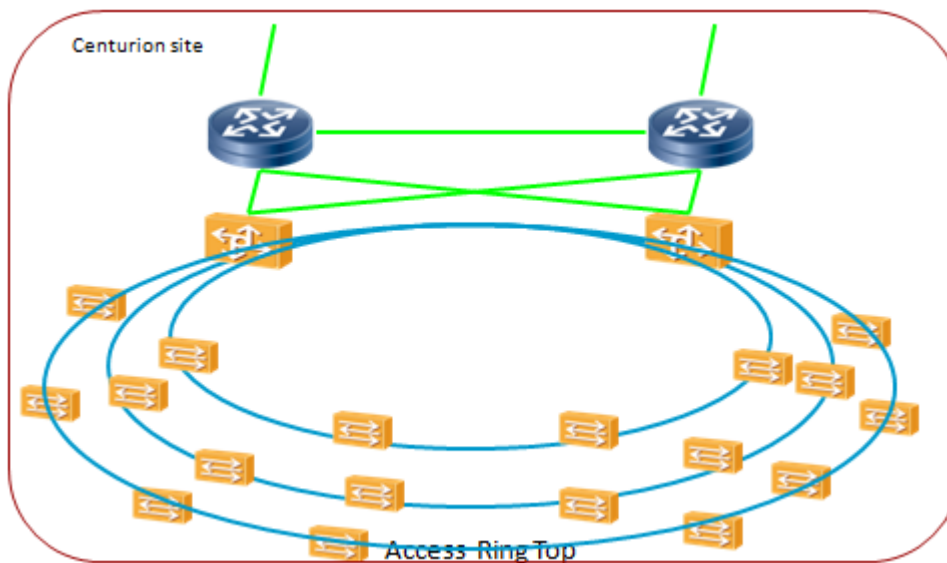
Below is the detail IP Aggregation level network topology. The following diagram shows the network connection at one core location.



Redundancy protocol is enabled to enable link protection.

Access level:

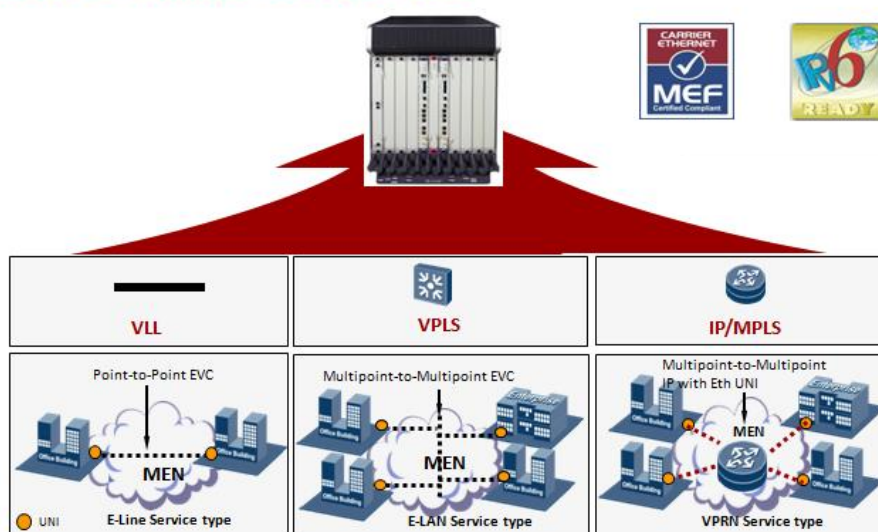
The diagram below indicates the detail IP Access level network topology on the access layer. Fibre will connect to all the access switches with ring topology.



The 400 - AR 2220 CPE will connect to the access Switches via Fiber or cable (dependent on distance) to enable service connection. The CPE device is also called the customer edge. The COT LAN equipment will be connected to the CPE device.

Multi & Flexible VPN Services:

Multi & Flexible VPN Service



The Core Network devices (NE40E-X8) will enable VPN services. The Router supports Layer 2 connecting and Layer 3 VPN services.

1.3 AR 2220 CPE Solution

400 - AR 2220 series CPE devices will be deployed in this network.

Amount of Routers	Router Type	Ports	Max Capacity per user	Max Capacity per CPE
400	AR 2220	24	20Mbps	400Mbps

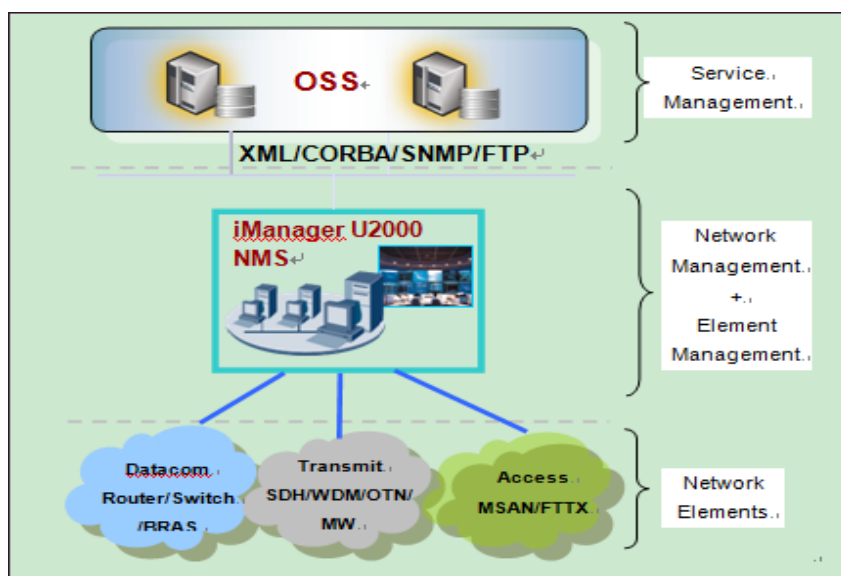


1.4 Network Management System

1.4.1 Network Management System Overview

The iManager U2000 is a registered mark of the entire network management solutions for the Datacom and Transport network

The iManager U2000 (referred as U2000 hereinafter) is a network management system (NMS).



1.4.2 Basic iManager U2000 Features:

- Topology Management
- Security Management
- Fault Management
- Element Management
- Communication Management
- Performance Management
- System Management

1.5 Voice Solution Design

An IMS (IP Multi-Media Subsystem) network will be installed to support voice services.

1.5.1 Dimensioning principle

Max users per subscriber type

Subscriber Type	Amount
IP Business Trunk	3000
IP Business Trunk Subs(sub)	24,000
Concurrent calls	3000

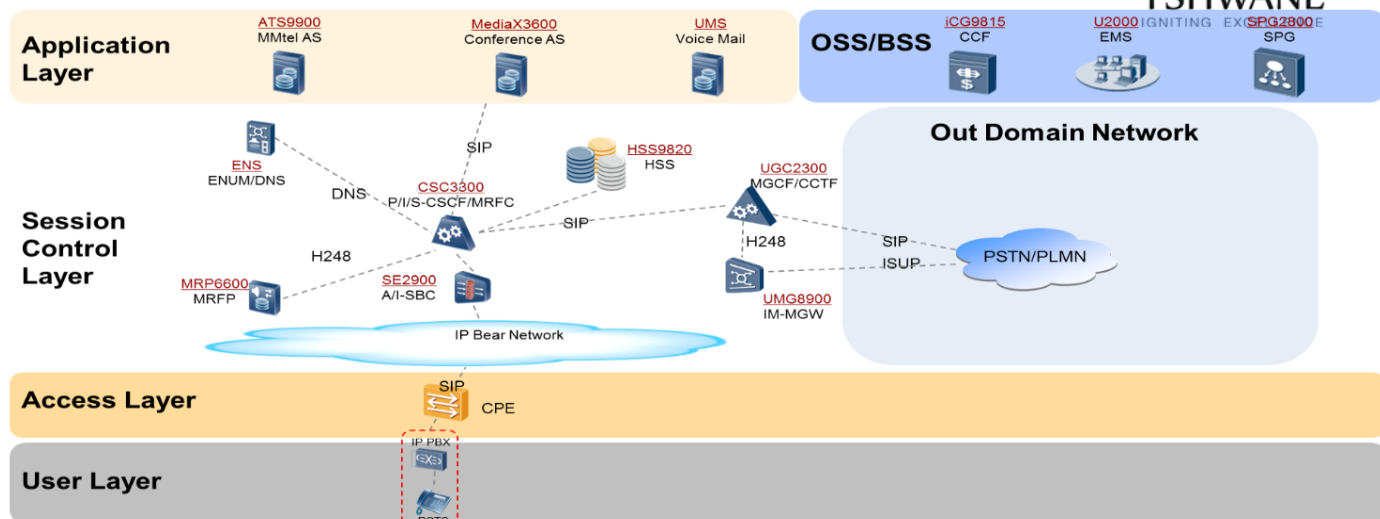
1.5.2 Subscriber

The max number of subscriber is 24,000

1.5.3 Traffic model

Item	Maximum Value
Traffic per registered subscriber(BHSA)	1
The traffic of per Business Trunk Subscriber(ERL)	0.04
Average session holding time (s)	90
Interconnection percentage (with PSTN/PLMN) (%)	30%

1.5.4 The IMS Network Design



The IMS system will connect with all PBX equipment via SIP to the broadband infrastructure. COT will be responsible for the PBX equipment, associated SIP licences and connectivity to PSTN/PLMN service providers, this includes the associated monthly cost.

1.5.5 Other Services

It is envisaged that the TBN will connect to secondary networks such as existing Alcatel Lucent mpls network, Wifi network, Traffic lights and signaling network, Security/camera network, TETRA network. Altech Alcom Matomo has designed the TBN network to incorporate such networks.

1.5.6 OSS & BSS

OSS and BSS will include inventory, configuration, activation, billing, CRM, Trouble Ticket and Workforce management System. The system will be configured to integrate to the TBN network elements of Huawei and interface with the Huawei NMS (U2000), for automatic inventory and system changes