# ULC-1000AN MSAN System

(Multi-Services Access Node)

High Density and High Capacity System

## System Summary Description

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# System Description

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# 1. Introduction

Keeping with the current trend of full integration IP and broadband, OPNET Technologies develops the high density, high capacity MSAN system shelves of ULC-1000AN MSAN to meet the market trend and customer requirement. MSA, MSB and MSG are members of ULC-1000AN MSAN product series. Those can be configured to deploy a wide range of voice, data and video applications, to subscribers over copper or fiber wire-line network infrastructure. Combined with the legacy existing MSC shelves in one integrated MSAN system, ULC-1000AN MSAN fully supports all TDM-based, ATM-based and IP-based services in a single platform.

Those high density MSA/B/G shelves are equipped with non-blocking data connection backplane, providing 2 Giga-bits data rate for each service slot, failover-enabled for Central Process Unit (CPUM2, CPUC or CPUCG) and VoIP Media Gateway Unit (MGUM), dual power inputs and various high port density multi-purpose line cards. With comprehensive IP-centric firmware features, MSA/B/G system are a high-density, high-capacity system that facilitates Telecom Operators to deliver high-quality residential or business user services, satisfying its current and future infrastructural requirements of reliability, flexibility and scalability.

The MSA/B/G are high density chassis-based MSAN systems. MSA shelf contains 15 service slots, and MSB shelf contains 8 service slots. Both shelves also have four half sized common unit slots to support 1+1 redundancy, user panel and FAN unit. MSG shelf contains 4 service slots, two half sized common unit slots, user panel and FAN unit. The Central Process Unit, which equipped with number of Gigabit Ethernet (GE) ports for grouping uplinks, is designed to plug into CPU-slots (C1 and/or C2). The Media Gateway Unit, MGUM, is VoIP protocol processing card, and be designed to plug into MGU-slots (M1 and/or M2). Service slots are available for equipping various service line cards. The variety of service line cards are including:

48/24-port ADSL2+ line cards (with or without built-in splitter) that provide subscribers with asymmetric transmission bandwidth up to 24 Mbps/2.4 Mbps;
24-port VDSL2 line cards (with or without built-in splitter) that offer high-speed connectivity

(100/50 or 100/100 Mbps) over copper wires.

72/48/24-ports POTS FXS line card provides telephone service.

4-ports GPON OLT line card provides FTTx high speed broadband service.

The designed of those system shelves are also taking account of the technology evolution such as IEEE Ethernet PON and EFM-G.SHDSL.

ULC-1000AN MSAN system supports various management methods: local console port, Web-based, Telnet and SNMP v1/v2-based EMS. The management functions include, Configuration management (CM), Performance management (PM), Alarm and Status Surveillance Fault management (FM) and Security management (SM). The EMS allows multiple administrative accounts with 3-level access privileges. Accounts with the first-level privilege have full access to all management objects. Second-level accounts have similar access rights except creating new administrative accounts, while the third-level accounts are granted read-only access rights to the management objects. The EMS also provides view-based management that partial objects can be defined and accessed for customization and security reasons. In addition, Cluster Management enables multiple MSAN administration with single/master IP address, northbound interface is optional equipped in EMS to interoperate with external OSS systems.

The ULC-1000AN MSAN system has a very versatile and integrated design well-fit for most application scenarios in access network and comply to latest relevant ITU-T and IEEE standards, which include following services:

***Various of Service Types:**

- POTS (packetized VoIP)
- Payphone (packetized VoIP)
- ISDN (PRI and BRI) (ISDN over IP)
- ADSL, ADSLS2, ADSL2+
- SHDSL (2-wire / 4-wire)
- E1 Leased Line (TDMoIP)
- VDSL, VDSL2
- IEEE GEPON / ITU-T GPON
- Fast Ethernet (electrical and optical)
- VoIP (H.248, MGCP, SIP)
- IP/Ethernet, FE/GE, optical or electrical

- Voice over DSL (VoDSL)
- Virtual Private Network (VPN)
- Video on Demand (VOD)
- VLAN (Virtual LAN)
- Multi-Media service,
- Internet Protocol (IP)
- IP TV Broadcasting
- Multicasting and LAN-to-LAN service

***High Capacity and high density**

- Up to 1080 POTS lines or 720 ADSL2+ lines in an 11U height, 15-service slots MSA chassis.
- Up to 576 POTS lines or 384 ADSL2+ lines in a 7.47U height, 8-service slots MSB chassis.
- One 7’ height standard rack can contain up to three MSA shelves, for total 3240 POTS lines

***Compatible with all standard soft switches (H.248/ MGCP)**

- Huawei, ZTE, Cisco, Nortel, Ericsson, TKD, Siemens, Veraz, ….

***Applications**

- H.248/MGCP/SIP Access Gateway (AG)/Media Gateway (MG)
- IP based Digital Subscriber Line Access Multiplexer (IP-DSLAM)
- Multi-Service Access Network System (MSAN)
- Passive Optical Network (PON)

# 2. System Main Features and Benefits

**Overall of High Density Shelf System**

- Scalable System Capacity
- 1+1 redundancy for CPU and MGU in MSA/B shelf
- High density line card, up to 72 POTS lines per card
- 48G non-blocking switch fabric, dual buses on backplane for each subscriber slots, and  Gbps bandwidth per bus
- Advanced Layer 2 switching functionality
- Multiple Gigabit Ethernet optical or electrical uplinks
- Fast Recovery from network fault by Rapid Spanning Tree Protocol
- Variety of Network Topologies:  Point-to-point, Linear, Star, or Ring

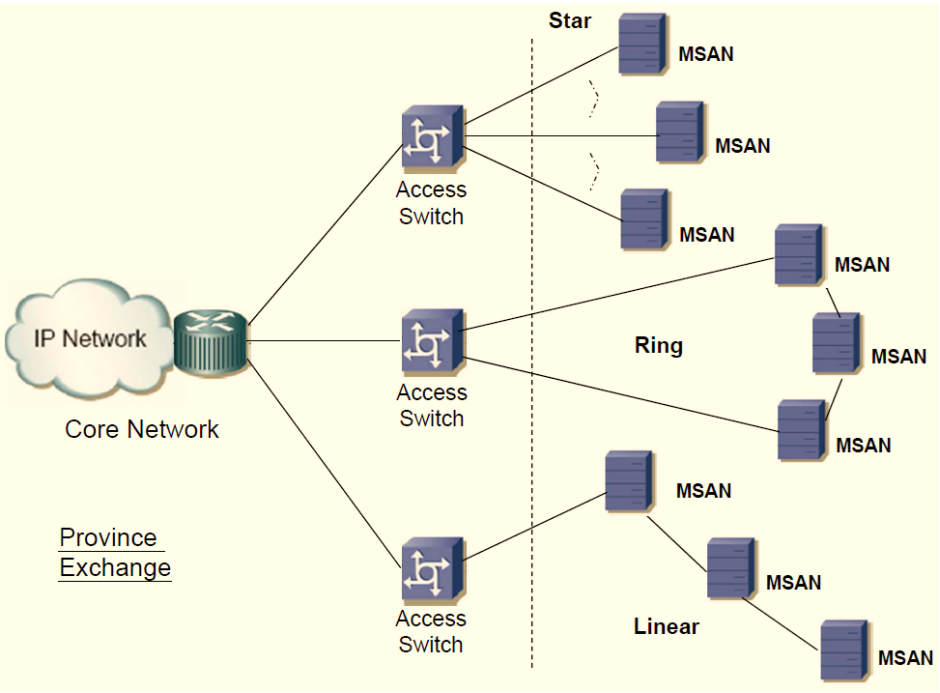


Figure 1: Network Topologies

**Broadband Access Features:**

- Variety of xDSL Access Interfaces: ADSL / ADSL2 / ADSL2+ / G.SHDSL / VDSL2
- Optional with built-in POTS Splitter on ADSL and VDSL board to simplify MDF cross-connection

- SELT/DELT test functions
- Per port LED status indication

**VoIP Access Features:**

- Comply with standardized IP-based control protocols, H.248 / MGCP / SIP
- Supports Voice, FAX, Modem, and ISDN-BRI over IP
- Bi-directionally convert voice formats between PCM payload and IP-based G.711, G.723, G.726 or G.729 payload
- Echo-cancellation mechanism
- Voice Activation Detection (VAD)
- Comfort Noise Generation (CNG)
- Local switching while uplink is failure
- Hair-pinning connection function
- Dual homing
- Up to 20K BHCA
- Metallic line testing
- Per port LED status indication

**Network Management and Maintenance**

- Local management through a craft terminal
- Web-based Management Interface
- View-based User Friendly Interface Network Management
- Cluster Management (Up to 8 cluster members)
- Comprehensive Network Management Features: CM, PM, FM, SM and Inventory Management
- Scalable Management Capacity for Different size of Access Network
- Integrate Line Testing Features for easy maintenance
- North Bound Interface (Option)
- In-band and out-of-band management
- SNMP Management, Standard/Vendor specific MIBs
- Advantages and benefits for the ULC-1000AN MSAN System
- None volatile storage of configuration parameters

# 3. Applications and Services

**VoIP Access Gateway**

System supports VoIP voice access service with the Softswitch platform. Its expansible capacity enables service operators to provide extensive local and long-haul calls on IP-Based Next Generation Network, and flexibly enables fast and convenient service deployment

**ADSL/ADSL2/ADSL2+/SHDSL/VDSL2 Broadband Access**

System supports variety types of DSL interfaces for broadband service access; flexibly provisioning different data-rates and services according to customer requirements

**FTTx Broadband Access**

System supports GPON OLT interfaces, and connecting to ONU for high bit rate broadband service access.

## 3.1 Broadband xDSL Services

The following xDSL services are supported using service-independent IP and/or ATM technology:

Multi-ADSL consists of the Splitter Unit (POTS Filter) which can be configured the software to support the ADSL, ADSL2, and ADSL2+, and can support the xDSL standard shown below:

- ITU-T G.922.1 – Asymmetrical Digital Subscriber Line (ADSL) transceiver (G.DMT) annex A (Upstream 800 Kbps, Downstream 8 Mbps)
- ITU-T G.992.2 – Asymmetrical Digital Subscriber Line (ADSL) transceiver (G.LITE) annex A (Upstream 512 Kbps, Downstream 1.5 Mbps)
- ITU-T G.992.3 – Asymmetrical Digital Subscriber Line (ADSL2) transceiver 2 annex A (Upstream 1 Mbps, Downstream 24 Mbps)
- ITU-T G.992.3 Annex M
- ITU-T G.992.5 – Asymmetrical Digital Subscriber Line (ADSL2+) transceiver 2+ annex A (Upstream 1 Mbps, Downstream 24 Mbps)

- ITU-T G.992.5 Annex M
- ITU-T G.994.1 Handshake procedure for Digital Subscriber Line (DSL) transceiver
- ITU-T G.997.1 Physical layer management for Digital Subscriber Line (DSL) transceiver

Single-pair high bit-rate digital subscriber line (G.SHDSL) service with equal transmission rates for both the upstream and the downstream direction based on use of the TC-PAM line coding scheme, complied with ITU-T G.991.2.

VTU-CS consists of the Splitter Unit (POTS Filter) which can be configured the software to support the VDSL, and VDSL2 as ITU-T G.993.1 and G.993.2.

Fast Ethernet (electrical & optical) can be used for high speed data access services. The ULC-1000AN MSAN System is transparent for the end user protocol. The interface to the subscriber and the end user protocol depend only on the used CPE.

## Features

- Compatible with ADSL/ADSL2/ADSL2+ modem/router with auto-detection of modulation
- High-density design
- ATM-based QoS: CBR, rt-VBR, nrt-VBR, UBR
- 4-leval priority Queues
- Strict priority (SP) scheduling
- Weighted fair queuing (WFQ) scheduling
- Traffic shaping/Rate limit per port basis
- Traffic shaping/Rate limit per PVC basis
- IEEE 802.1Q VLAN
- IEEE 802.1P VLAN Priority bits

- Support multi-PVC, up to 8-PVC per ADSL port
- ITU-T I.610 F4/F5 OAM loopback test
- Service Profile
- Multicast, IGMP v1/v2 snooping and IGMP fast leave
- ATM adaptation Layer 5 (AAL-5) support
- Logical link control (LLC) sub network access protocol (SNAP) bridged (RFC 2684)
- VC-Mux encapsulation

The ULC-1000AN MSAN System supports several CPEs with different interfaces.

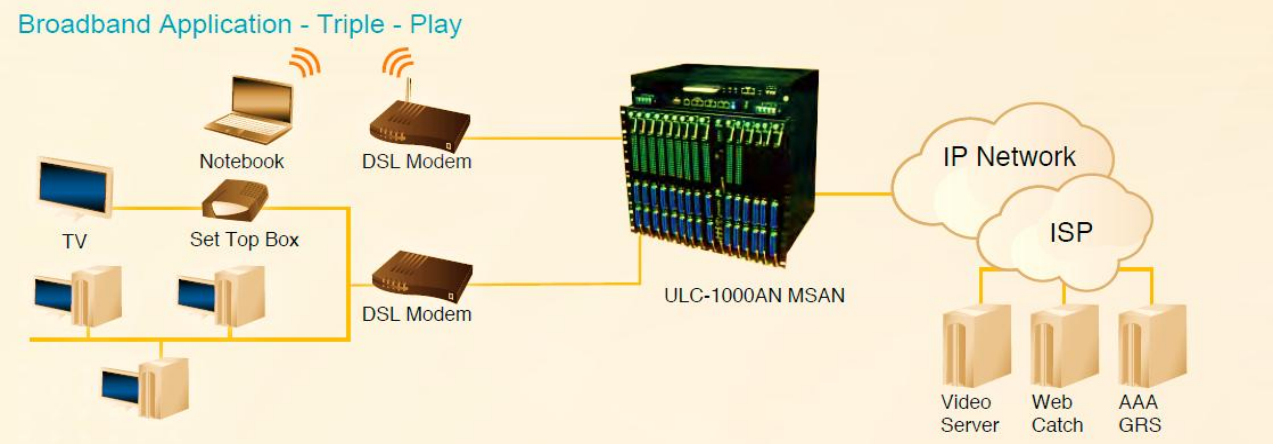


Figure 2: Multi-Service Access Network Application

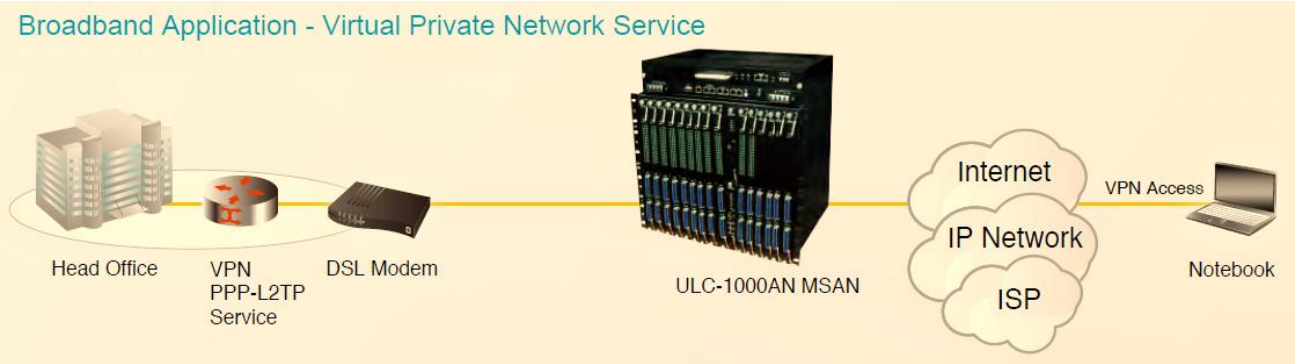


Figure 3: IP-DSLAM Broadband Applications

## 3.2 Services in Next Generation Network

### 3.2.1 NGN Access Gateway (AG) Services

The ULC-1000AN MSAN System supports NGN Access Gateway (AG) application. In NGN, legacy voice traffic is packetized and transport via IP network (VoIP). AG is controlled by Softswtich (Media Gateway Controller, MGC) according to ITU-T H.248 Megaco, MGCP and ETSI TISPAN standard protocol. ULC-1000AN MSAN can be configured as a NGN AG network element and provides the media conversion from legacy service, such as analog POTS, payphone, FAX services, to the format required in IP network, and vice versa. ULC-1000AN also support legacy ISDN BRI and PRI services in AG application according to ITU-T Q.931 over IUA over SCTP protocol

The main features of ULC-1000AN MSAN AG application are list below:

- DSP pools for voice compression and transfer
- Transport voice packets by RTP, RTCP, RTP/UDP/IP Encapsulation
- G.711, G.723.1,G.726, G.729ab voice code
- Call control protocol H.248/Mecago, MGCP and SIP
- Transparent CLIP/CLIR, voice-band FSK,
- Fax detection, Real-time fax relay (T.38),
- Fax and modem pass through,
- DTMF/DP digit sending, receiving and detection (RFC 2833),
- Tone generation and reception, including dial tone, second dial tone and ring-back tone, busy tone and other necessary tones
- Conference bridging,
- Voice recorded announcements
- Echo cancellation (ITU-T G.168),
- Transparent Voice activity detection VAD (silence suppression and comfort noise generation CNG)
- Configurable jitter buffer to deal with delay variation of voice package
- Metallic line testing of subscriber lines
- Voice stream statistics report to Softswitch
- Under control of Softswitch to support value added services, such as:
  - Conference call
  - Call waiting
  - Call waiting with announcement

- Abbreviated dialing
- Hot line
- Call forwarding (immediate, on busy, on no answer or with password)
- Do not disturb
- Wake-up call
- Line/call lockout
- Calling number delivery
- Incoming or outgoing call restriction
- Special call access, such as 119, 110, 162, 1225, etc.
- IVR
- Dual Homing

ULC-1000AN supports voice quality of Service (QoS) features, including IP Precedence (TOS), IP DiffServe or RSVP. It also minimizes the voice processing delay time by high speed DSP to provide high performance voice services to subscribers.

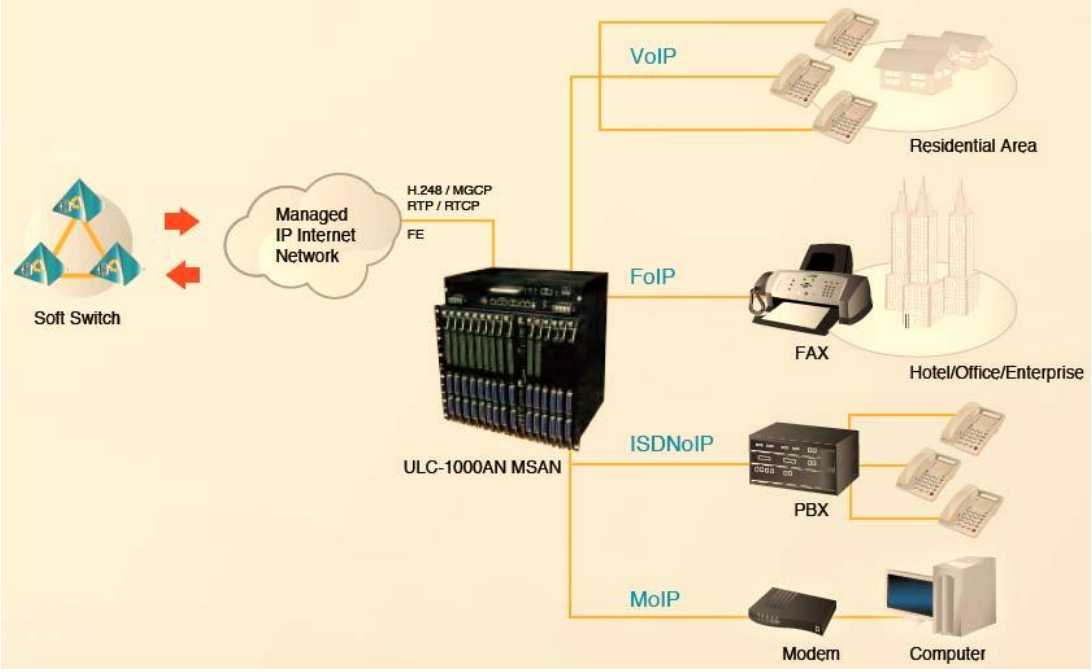


Figure 4: Next Generation Network (NGN) Access Gateway Application

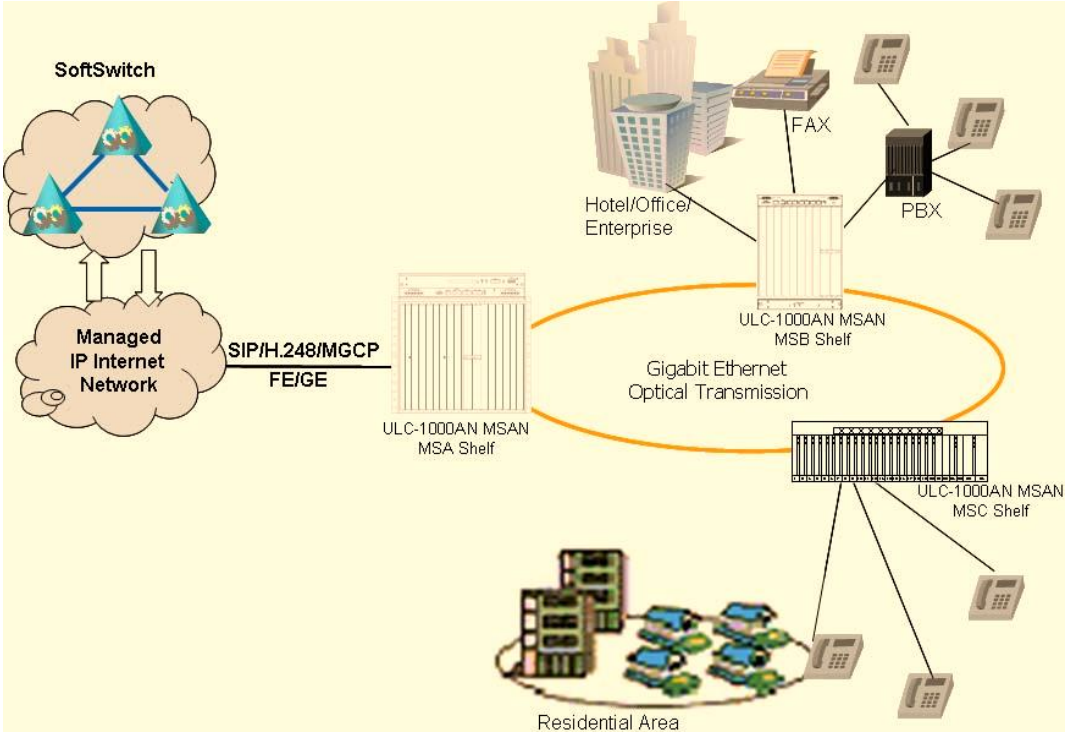


Figure 5: NGN Multi-Service Access Application with remote cascading

### 3.2.2 Data Switch Function

- FE/GE electrical interfaces, GE optical interface
- 16k MAC
- 4k VLAN (IEEE 802.1q)
- VLAN assignment per port, PVC, MAC, 802.1p, TOS/DSCP, IP SA/DA
- VLAN Double Tagging (Q-in-Q), VLAN cross connect for VPN, Service VLAN
- Flow Control (IEEE 802.3x)
- Spanning Tree working as IEEE802.1d and IEEE802.1w standard.
- Link Aggregate as standard of IEEE 802.3ad
- IP Multicast with IGMP (Internet Group Protocol) Proxy and Snooping (v1/v2) (RFC1112/RFC2236)
- Static IP address, IP Forwarding
- 1k Multicast Groups
- Per port Traffic Policing and shaping
- DHCP Relay Agent with option 82
- PPPoE (RFC2516) user operation

- MAC Address Translation
- Broadcast Storm Control
- QoS, CoS and Traffic Management
- Multiple queues per port
  Support of Strict Priority (SP) and Weight Fair Queues (WFQ)
  QoS (Based on port, PVC, 802.1p, VLAN, TOS/DSCP, IP SA/DA, L4)
- Security
  IEEE 802.1x Authenticaiton
  MAC address limitation per port
  Access control list (ACL based on port, MAC, Ethertype, IP SA/DA, L4) MAC Anti-spoofing
  IP Anti-spoofing
- Support transparent and terminated SIP protocol
- Support transparent H.323 protocol working

With those advanced VoIP and Layer 2 data switch function, ULC-1000AN MSAN have ability to support services as Voice over DSL (VoDSL) Service, Virtual Private Network (VPN) Service, Video on Demand (VOD), VLAN (Virtual LAN), Voice over IP and Multi-Media service, Internet Protocol (IP) service, IP TV Broadcasting, Multicasting and LAN-to-LAN service.

## 3.3 Services in TDM-Based Network

### 3.3.1 PSTN/ISDN Application

ULC-1000AN MSAN System can support TDM-Based Switching Network such as PSTN and ISDN. In case of local exchange with PSTN switch and V5.2 interface we can use SDH equipment in the both exchange side and remote side for transmission TDM services and Data services to the remote nodes.

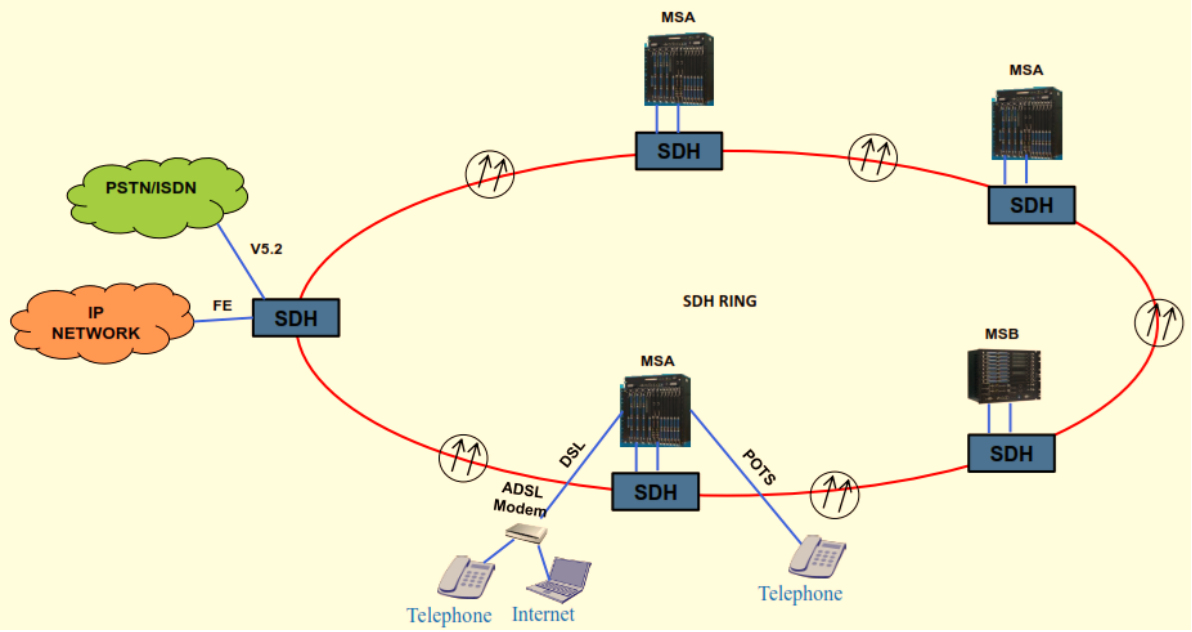


Figure 6: PSTN/ISDN Application

### 3.3.2 Soft switch Application

Since TDM-Based switching network has immigrated to NGN/IMS, with a few changing in the existing hardware and software equipment all systems will become compatible with new uplink for offering soft switch services.

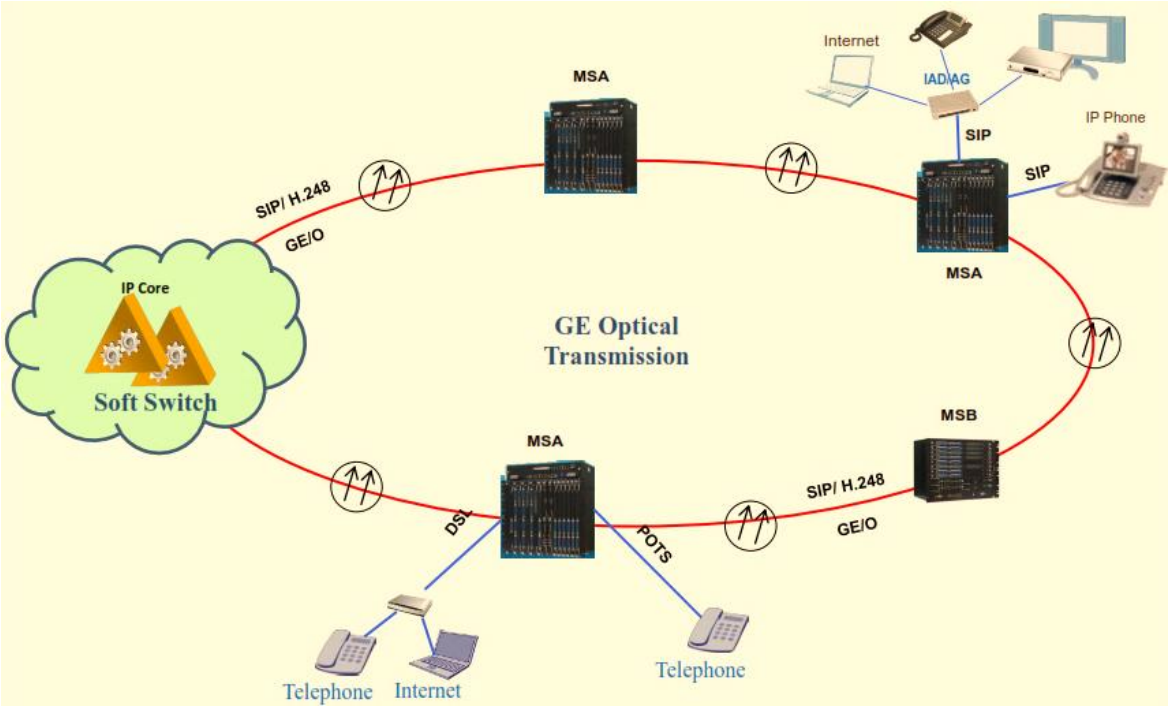


Figure 7: Soft switch Application

### 3.3.3 TDMoIP Application

For transmission TDM leased-line services such as E1 leased line over IP network ULC-1000AN MSAN system can support this application.

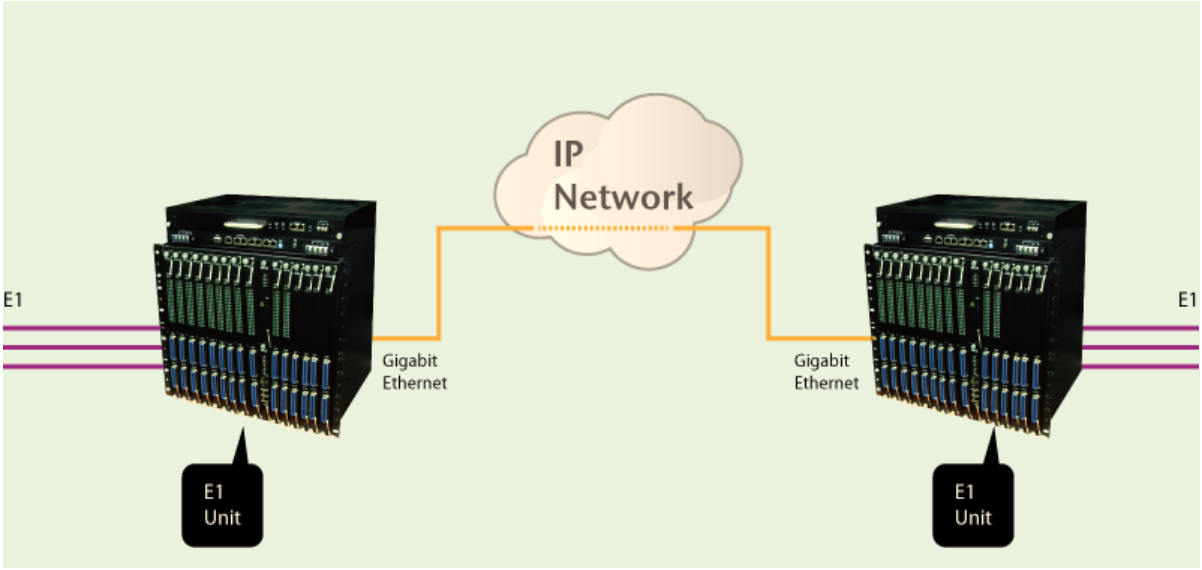


Figure 8: TDMoIP Applications

## 3.4 FTTx Fiber Access Services

### Features

FTTx services are supported by GPON OLT Unit (GPT) in ULC-1000AN MSAN system. It guaranties competitive access performance beyond 100Mbps bandwidth per subscriber necessary for multi-channel high resolution video delivery as well as high speed data and toll quality voice.

The GPT aggregates traffic from 4 PON interfaces and 64 ONTs/ONUs per PON interface into the uplink gigabit Ethernet ports at the CPU unit. Through the GPT, data rate can run up to 2.5Gbps on upstream direction and 1.25Gbps on downstream direction, which proves to be an emerging revenue generation gear for mission-critical service providers.

The GPT supports robust performance as utilizing OAM for link monitoring, loopback and fault indication with SNMP.

 Non-blocking high performance switching platform
 QoS-guaranteed transport for meeting emerging services like HD IPTV, IP telephony.
 Cost-effective proposition for competitive service providers.
 L2/L3 switching and IP multicasting for any service over Internet.
 Secure network capabilities for protect various attacks through network.

### Compliance GPON Standards

- G.984.1 Gigabit-capable Passive Optical Networks (GPON): General characteristics (03/08)
- G.984.2 Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification (03/03)
- G.984.2 Amendment 1 New Appendix III - Industry best practice 2.488
- Gbit/s downstream, 1.244 Gbit/s upstream GPON (02/06)
- G.984.2 Amendment 2 (03/08)
- G.984.3 Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification (03/08)

- G.984.4 Gigabit-capable Passive Optical Networks (G-PON): ONT management and control interface specification (02/08)

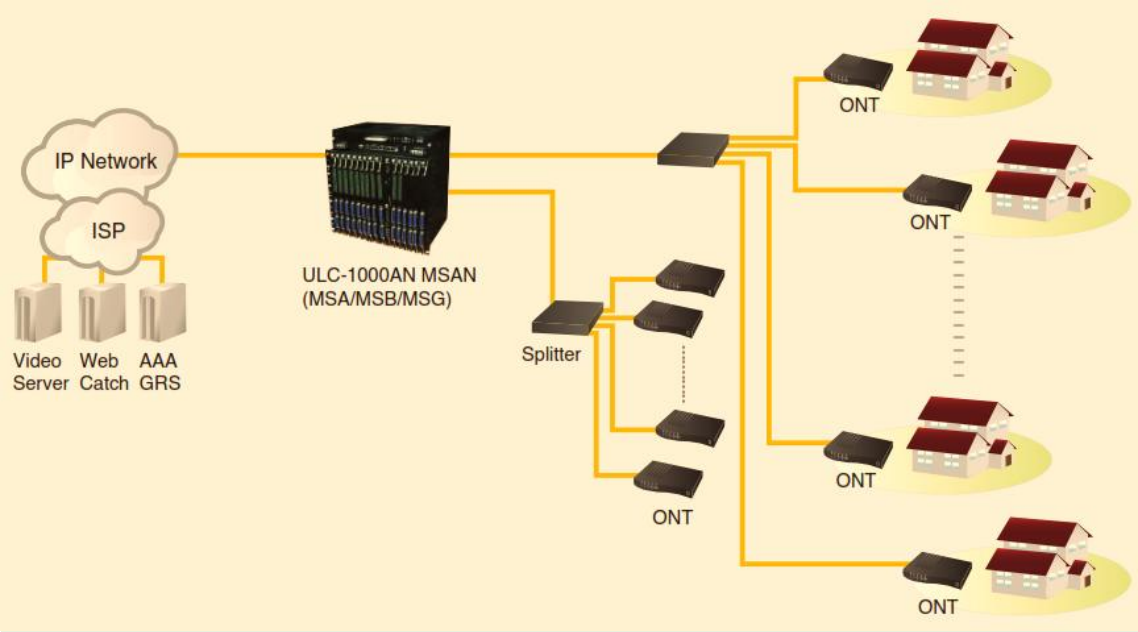


Figure 9: FTTH Applications

# 4. Housing Configuration

The main equipment of ULC-1000AN MSAN has a modular design with common units and functional units as plug-in cards inserted equipment shelf. The equipment shelf is mounted in a 19" rack or an outdoor cabinet. Depending on the application, different types of housing configurations to install MSA, MSB or MSG Systems are available:

## DC-powered 19" Standard Rack

ULC-1000AN MSAN equipment shelf could be mounted in 19" standard rack for indoor application. One 42U height rack could contain up to three MSA equipment shelves for up to 3240 subscribers. Equip with DC power distribution panel, Fuse and Alarm panel.

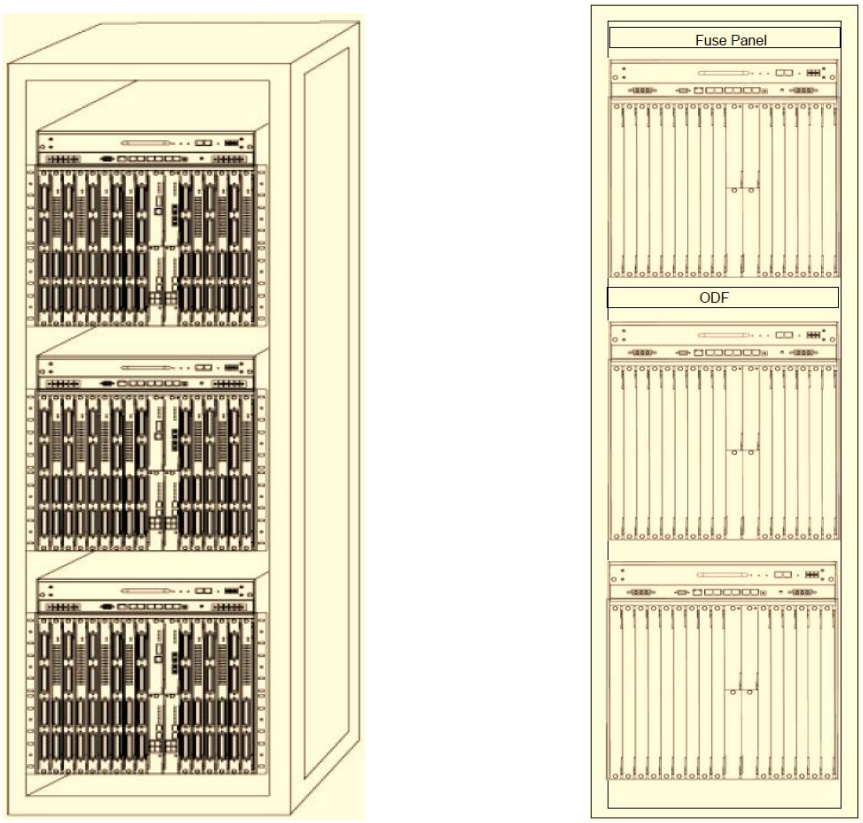


Figure 10: Indoor Rack with 3*MSA

## Outdoor Cabinet

This outdoor cabinet configuration could be installed in an outdoor environment for remote application. Different types and sizes of outdoor cabinet are available. Outdoor cabinet integrate the ULC-1000AN MSAN equipment with customer-specific accessories, such as AC/DC rectifier, backup batteries, MDF and cooling system (heat exchanger or FAN Unit) inside one enclosed housing.

Figure 11: Outdoor Cabinet with 1*MSB inside Config.

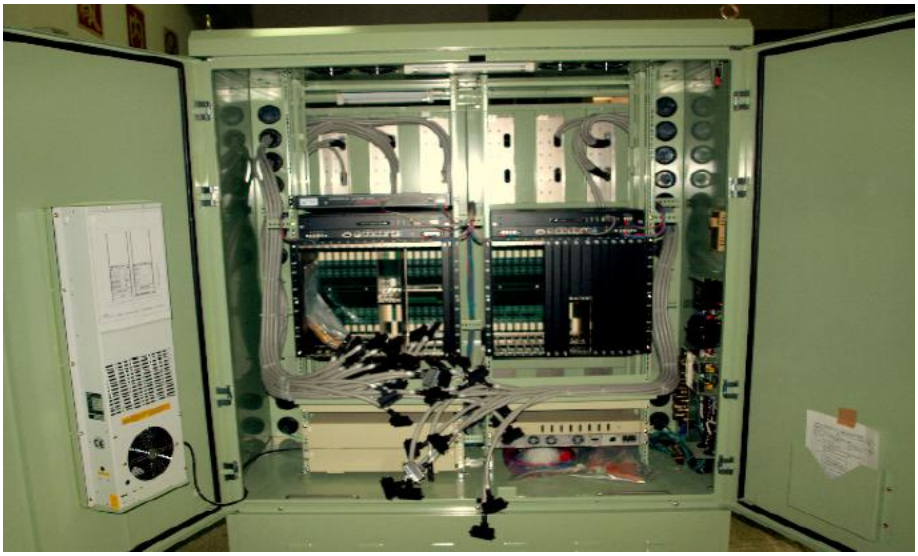

Figure 12: Outdoor Cabinet with 2*MSA inside Config.

## 5.1 Equipment Shelf

The three types of equipment shelf are:


Figure 13: ULC-1000AN MSAN High Density Equipment Shelves

The MSA shelf contains a backplane with 15 line card slots, the MSB shelf contains a backplane with 8 line card slots, and the MSG shelf contains a backplane with 4 line card slots. All MSA/B/G backplanes have a TDM bus for VoIP applications and a dual IP stars connection (for 1+1 redundancy) from the switch fabric card (CPUM2/CPUC/CPUCG) to each line card slot. The bandwidth from the CPU switch fabric slot to each line card slot is two gigabit per second bandwidth, which is sufficient for all foreseeable applications.

All MSA/B/G systems are best suited for high density broadband applications and suited for VoIP applications and multi-service broadband applications as well.

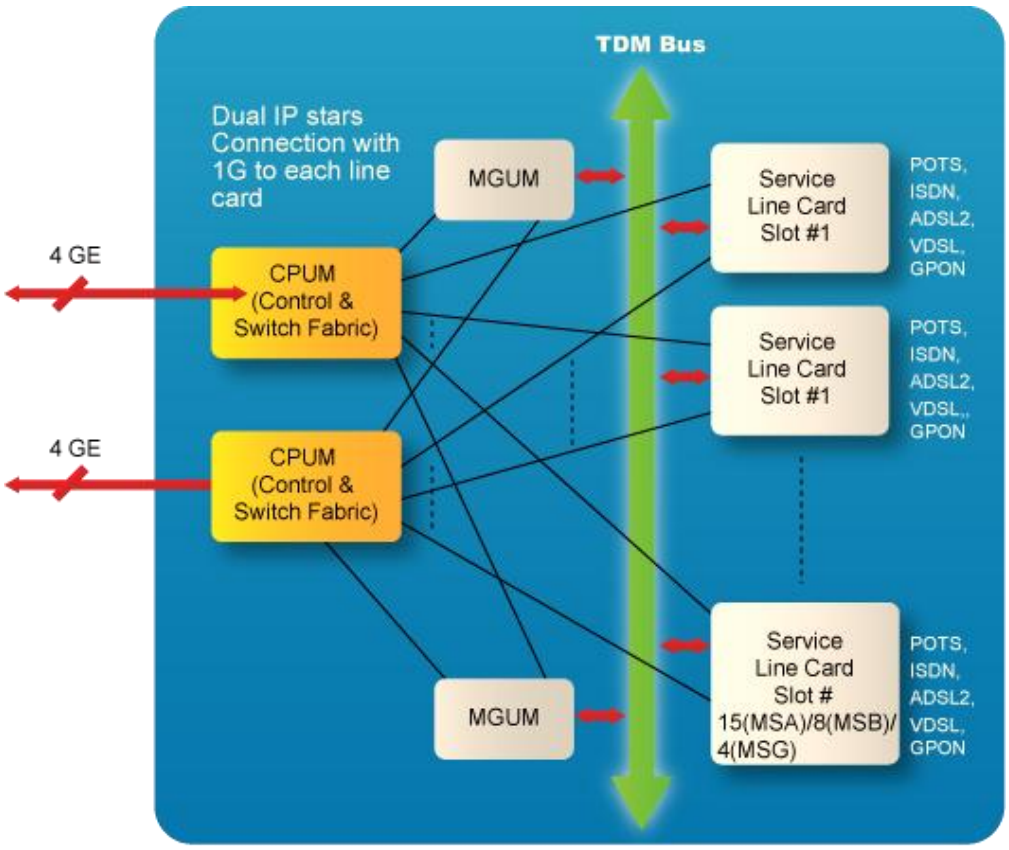


Figure 14: MSA/B/G Backplane Connections

The MSA/B/G and the legacy MSC (CBA-C) shelves can be linked together to optimize performance and cost for different applications. A single network management system, OpnetView, is used to manage all shelves in the same MSAN system from the same connection point of any shelf type.

The MSA/B/G high density equipment shelves are front access designed and are able to being installed back-to-back, side-to-side or against the wall.

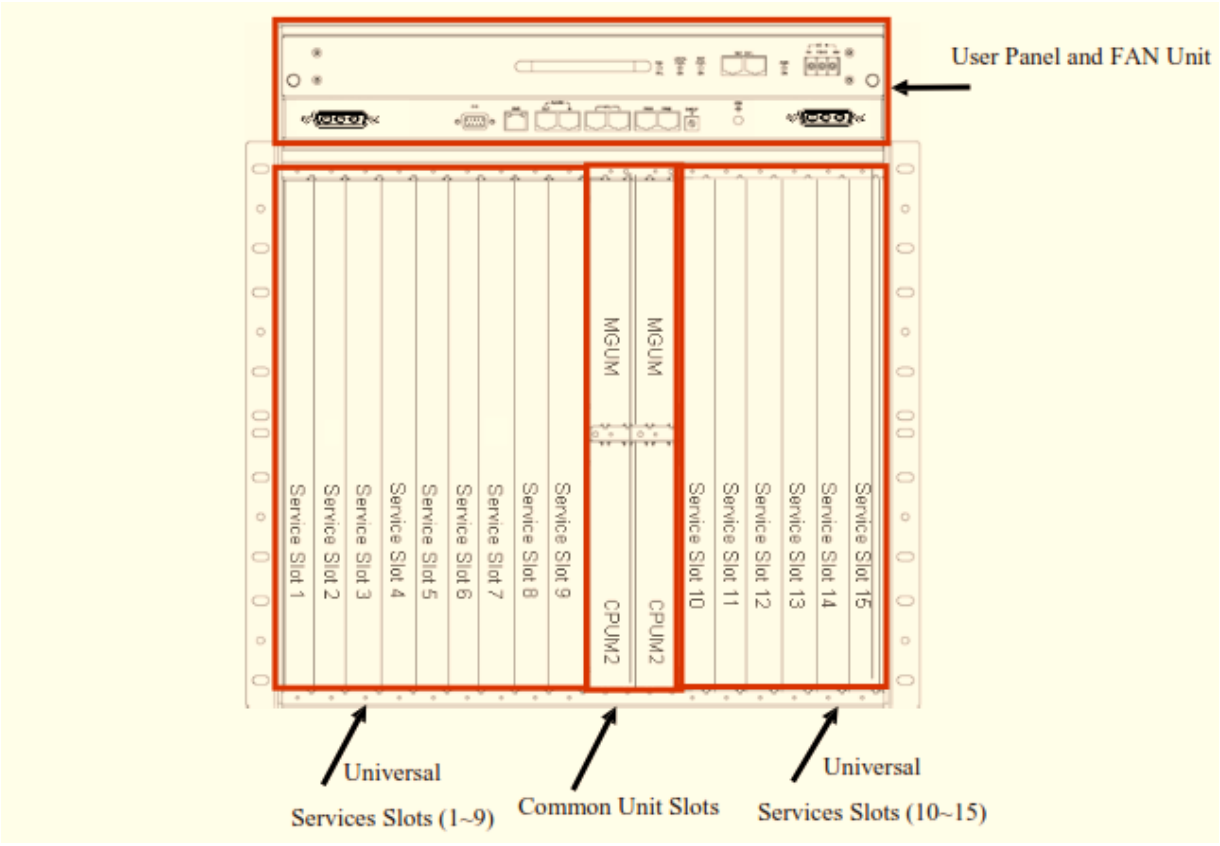


Figure 15: MSA Equipment Shelf Layout

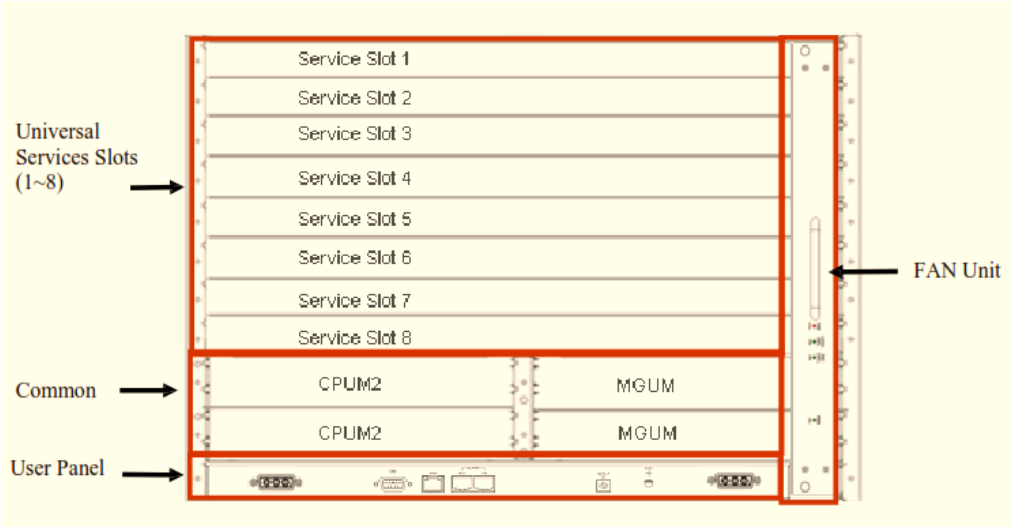


Figure 16: MSB Equipment Shelf Layout

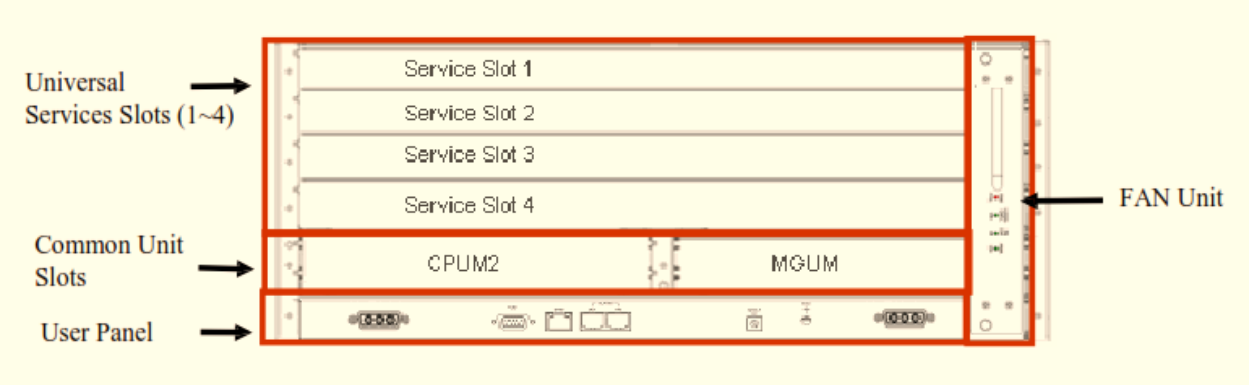


Figure 17: MSG Equipment Shelf Layout

Those system shelves include User Panel to provide status indication, power cable, alarm cable, and NMS cable access function. Below the User Panel, there are equipment slots for common units and service units. Common units can be redundant provided for 1+1 protection in MSA/B shelves.

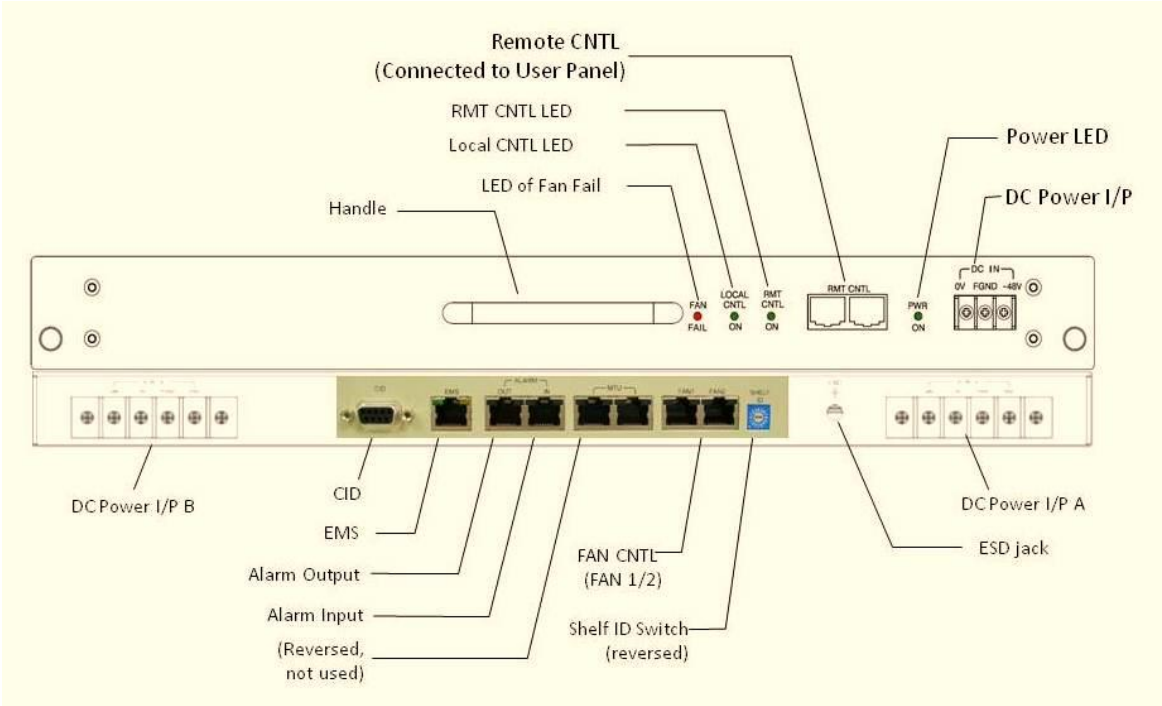


Figure 18: User Panel and FAN Unit

The following components are used or can be used in the ULC-1000AN MSAN high density equipment shelves:

## 5.2 System Unit

There are two kinds of unit in this system:

### 5.2.1 Common Unit

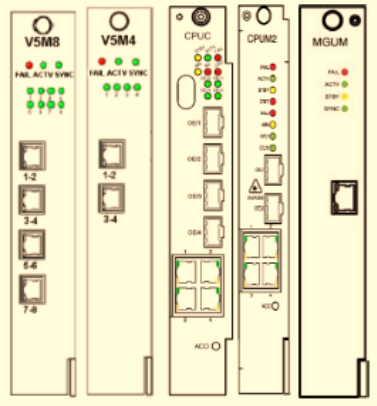


Figure 19: Common Units

- **Central Process Unit (CPUM2)**

  One or two Central Processor Unit cards per system. CPUM2 is located at CPU-slots in shelf. CPUM2 is used to control the MSAN system, communication with all application packs internally, and also processes management functions from LCT or EMS.

  An integrated Layer 2 Data Switch Unit is also built-in CPUM2 to support advanced data operation features, such as VLAN, VPN, IGMP, etc. CPUM2 contains four FE/GE electrical interfaces, and two GE-SFP slots, which could be configured as 1000BaseX optical interface by plug-in SFP module. The switching capacity is up to 48 Gbps. One system shelf can be equipped with two CPUM2 units for 1+1 redundancy in and hot swappable.

- **Central Process Unit Type C (CPUC)**

  CPUC has the same functionality of CPUM2, except it contains four GE electrical/optical combo interfaces for the uplinks. Four GE-SFP slots are located on the faceplate for the optical modules, which could be configured as

  1000BaseX optical interface by plug-in SFP module. The switching capacity is up to 48 Gbps. One system shelf can be equipped with two CPUC units for 1+1 redundancy and hot swappable.

- **Central Process Unit Type CG (CPUCG)**

  CPUCG has the same functionality of CPUM2, except it contains two GE electrical/optical combo interfaces and one GPON (ITU-T Gigabit Passive optical network) interface for uplink to an GPON OLT system. Two GE-SFP slots and one GPON SFP slot are located on the faceplate for the optical modules, GE-SFP slots could be configured as 1000BaseX optical interface by plug-in SFP module. The switching capacity is up to 48 Gbps. One system shelf can be equipped with two CPUCG units for 1+1 redundancy and hot swappable.

- **Media Gateway Unit Type M (MGUM)**

  This unit processes Access Gateway signaling protocols, ITU-T H.248 Megaco, MGCP or SIP for PSTN, and IUA for ISDN over IP network. The MGUM card also packages voice signal to VoIP format. MGUM contains scalable DSP pool, 128, 256, 512, and 640, for different size of system capacity. It is located in the MGU-slot (M1/M2) and 1+1 hot swappable redundancy is supported. The MGUM card is used with RI-POTS2 series line card.

## 5.2.2 Subscriber Channel Unit

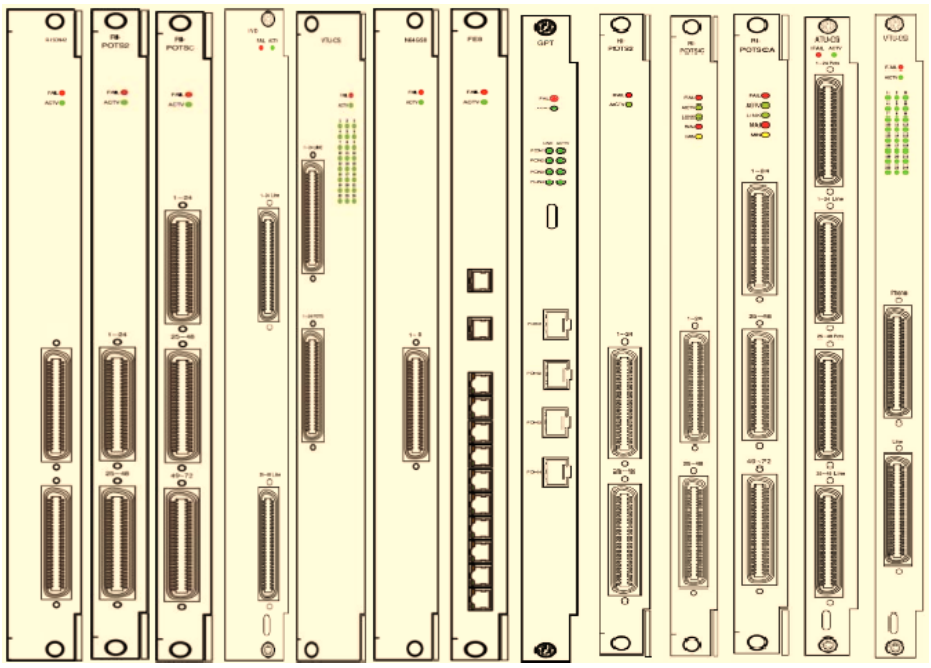

Figure 20: Subscriber Channel Units

ULC-1000AN MSAN supports variety types of analog or digital subscriber channel unit as below:

| Unit Name | Functions of Unit |
|---|---|
| RI-POTS2 | 48-ports FXS, supports reverse battery and 12/16 kHz metering function. This card should work with MGUM |
| RI-POTS2A | 72-ports FXS, supports reverse battery and 12/16 kHz metering function. This card compactable with RI-POTS2 series line card and should work with MGUM. |
| R-ISDN6<br>R-ISDN12<br>R-ISDN36<br>R-ISDN42 | 6/12/36/42-ports of ISDN BRI over IP (IUA) Unit.<br>R-ISDN6 is one slot width unit, and R-ISDN12, 36, 42 are two slots width units. |
| PRI4<br>PRI12<br>PRI21 | 2/12/21-ports of ISDN PRI over IP (IUA) Unit.<br>PRI4 is one slot width unit, and PRI12, 21are two slots width units. |
| ATU-C2S | 48-ports multi-ADSL line unit, with on-board POTS splitters. |
| ATU-CS | 48-ports multi-ADSL line unit, with splitter, 1-slot width (2.4cm) |
| VTU-CS | 24-portVDSL2 line unit, with on-board POTS splitters. |
| TDMoP | 8-ports of E1overIP line unit. |
| IVD | 48-ports combo (POTS + ADSL2+) line unit |
| GPT | 4-ports GPON OLT unit. |
| N64-GSD | 2-ports G.SHDSL line unit |

# 6. System Capacity

ULC-1000AN MSAN system shelf capacity could be scalable from small to large for each node. The system capacity may only contain one line card, or full equipped up to 1080 POTS or 720 ADSL2+ lines.

| Item | MSA | MSB | MSG |
|---|---|---|---|
| Dimension (WxDxH mm) Bracket Included | 486*340*477 | 482*340*332 | 487*314*135 |
| Shelf Height | 11U | 7.47U | 3U |
| Service Slots | 15 | 8 | 4 |
| Common Unit Redundancy | Support | Support | Not Support |
| ADSL2/2+ Port Qty (48-port/card) | 720 | 384 | 192 |
| ADSL2/2+ w/splitter built-in (48-port/card) | 336 | 192 | 96 |
| POTS Port Qty (72-port/card) | 1080 | 576 | 288 |
| VDSL Port Qty (24-port/card) | 360 | 192 | 96 |
| Switching Capacity | 48G | 48G | 24G |
| Weight (Kg) | 18 | 15 | 6.0 |

- Up to 1080 POTS lines or 720 ADSL2+ lines in an 11U height, 15-service slots MSA chassis.
- Up to 576 POTS lines or 384 ADSL2+ lines in a 7.47U height, 8-service slots MSB chassis.
- One 7’ height standard rack can contain up to three MSA shelves, for total 3240 POTS lines

# 7. Network Element Management Tools

OPNET Technologies provides software for the initial system turn-up as well as for the central and regional management scenarios based on the standard Telecommunication Management Network (TMN) models by supporting the tasks of the International Standardization Organization) (ISO) functional areas.

The following software tools are used for Operations, Administration, Maintenance, and Provisioning (OAM&P) actions and tasks of the ULC-1000AN MSAN System for both Narrow Band and Broadband services:

- Craft Interface Terminal (CIT), it could manage one MSAN access network element.

- OpnetView EMS is the graphical user interface (GUI) software which can be installed either on PC-based or Unix-based server, it could be is used to monitor the whole access network over multiple NEs, including standalone or mixed MSA/MSB/MSC application. The EMS can manage over 500 network elements (NE) at a time, however number of managed network element also depend on NMS server hardware specification.

- Firewall friendly: All clients communicate with server smoothly over firewalls.

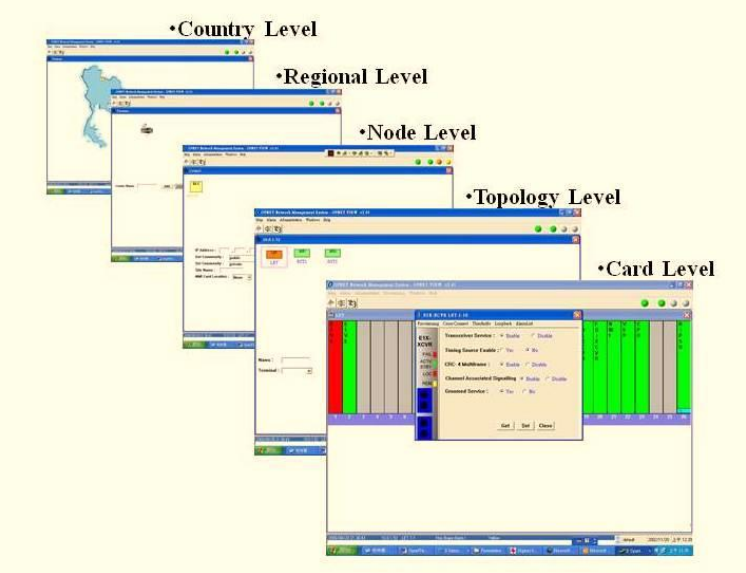


Figure 21: OpnetView EMS

# 8. Operations, Administration, Maintenance, Provisioning

The OAM&P management actions are as follows:

- Configuration Management
- Fault Management
- Performance Management
- Security Management.
- Inventory Management

The OpnetView EMS provides the following main characteristics/functions:

- Support of all ULC-1000AN MSAN Systems features (telephony and data)
- Equipment overview
- Telephony and data service provisioning
- Common alarm handling for all network elements (NEs)
- Test management
- IP traffic monitoring
- Report, log, backup and restore functions
- Southbound interfaces:
  - SNMP NE access via UDP/IP for data agents based on DCN
- User security handling (user profiles, NE domains)
- Online help
- Multi user access
- Northbound interfaces (Option)

## Configuration Management

The configuration management supports the complete range of graphical functions to provision and maintain ULC-1000AN MSAN. Network topologies, shelf views and self-explaining menus are navigating the operator to configure the following services:

- Telephony
  - POTS
  - ISDN BRA
  - ISDN PRA
  - Structured leased line services (64 kbps or Nx64 kbps leased lines)
  - Unstructured leased line services.

- Data
  - IP/ATM virtual paths
  - IP/ATM virtual channel connections carried over ADSL/SDSL/SHDSL/ VDSL lines.
- Inventory management
- Equipment provisioning and maintenance (sub-shelves, packs, ports)
- Telephony and data service provisioning
- Clock synchronization
- System/equipment/service status
- NE database backup and restore
- System date/time synchronization

## Fault Management

The fault management supports the operator in detecting, displaying, localizing and logging any faults occurring in the managed network.

- Handling of alarm severity (critical, major, minor)
- Receiving of autonomous alarm messages
- Retrieving of alarms per NE
- Retrieving of alarm and event logs from NE
- Filters to display pre-selected alarm types only.

## Performance Management

The performance management provides facilities for retrieving, storing logs and printing the logs of the NE performance data to ensure the quality of service.

## Security Management

The security management functions control the access to the EMS and to the managed NEs. The following main functionalities are offered:

- EMS user administration
- EMS user security profile
- No additional NE login for current EMS user
- EMS access via login name and password
- Inactivity user session time-out.

# 9. System Specification

## General Hardware Specification

**Shelf Dimensions (W x D x H)**

MSA Shelf: 486 mm x 340 mm x 477 mm MSB Shelf: 482 mm x 340 mm x 332 mm MSG Shelf: 487 mm x 314 mm x 133 mm

**Weight**

MSA Shelf: Less than 40 kg in fully equipped shelf MSB Shelf: Less than 25 kg in fully equipped shelf MSG Shelf: Less than 13 kg in fully equipped shelf

**Power Supply**

VDC: -42V to -72V

**Operating Requirements Temperature**

Operating: -5 ~ 65 $^{o}$C

Short-term Operating: -10 ~ 70 $^{o}$C Storage: -20 ~ 75 $^{o}$C

**Relative Humidity**

5% to 100% (non-condensing)

**Standards and compliances**

CE mark
EN55022 ClassA / CISPR 22
EN61000-4-5

## Supported Interfaces and Protocols

**Management**

SNMP Manageable
CIT through RS-232 console
In-band management
Out of Band Management

**ATM Support**

Up to 8 PVCs per port
F4/F5 OAM loopback
RFC 2684 bridged and routed modes
RFC 2516 PPPoE

**Subscriber Interface** POTS,

Payphone IEEE 802.3 Ethernet
ADSL/ADSL2/ADSL2+, G.SHDSL, VDSL/VDSL2
FE (electrical or optical) GEPON,
GPON

**Network Interface**
100/1000-BaseT Ethernet
1000-BaseX Ethernet IEEE 802.3z (-SX, -LX, -LH/EX, -ZX) GPON
Uplink
H.248/MGCP/SIP

**Switching and Service L2 switching** Up to 16k
MAC address learning Ethernet CoS per IEEE
803.1p STP/RSTP
Link Aggregation per IEEE 802.3ad

**VLAN**
Up to 4K VLAN
VLAN Tagging pass-through
Q-in-Q VLAN Tagging

**Multicast**
Support 512/1000 Multicast Groups forwarding
Support IGMP Snooping v2/v3

**QoS Classification**
Support IEEE 802.1p 4 priority queues, traffic classification, and rate limiting, in step of 1 Mbps.

**Service Access Control**
MAC address filtering
PPPoE, DHCP, and Bridge Over ATM DHCP relay
agent with option 82

## 9.1 Transmission Specification

### 9.1.1 Gigabit Ethernet Optical Interface

| | |
|---|---|
| Complied standard | IEEE 802.3, IEC 825-2 Class 1 safety |
| Line rate | 1,250 Mbps |
| Line code | NRZ, Scrambled |

| | **1000Base-SX** | **1000Base-LX** | **1000Base-LH** | **1000Base-ZX** |
|---|---|---|---|---|
| Wavelength (nm) | 850 | 1310 | 1550 | 1550 |
| Maximum Tx Power (dBm) | -4 | -3 | 1 | 4 |
| Minimum Tx. Power (dBm) | -9.5 | -9.5 | -4 | -1 |
| Rx | -18 | -20 | -23 | -24 |
| Rx saturation | -1 | -3 | -3 | -3 |
| Minimum | 8.5 | 10.5 | 19 | 23 |

### 9.1.2 POTS Interface Signaling Specification

| | |
|---|---|
| DC Supervisory | |
| Exchange | Off Hook 500 ohms, On Hook 10k ohms |
| Remote | Up to 1800 ohms (including telephone)<br>With 0.4 sq.mm cable can support distance at least 4.5 Km<br>Idle circuit voltage, <= 55 Volts Battery feed<br>voltage, >= 44 Volts Loop Current, 23mA |
| Battery Reversal | < 50 ms( Line Reverse Function ) Forward |
| Disconnect | <50 ms |
| Single Pulse Distortion | <12 ms |
| Loop Start | Off Hook < 50 ms |
| Meter Pulse | 12/16 kHz tone, +/- 1%. 2 Volts, +/- 20% (adjustable), Pulse Width 150 ms, +/-20% |
| Apparatus Resistance | 300 ohms nominal |
| Switch-hook Flash | 200 – 1500 ms |
| Howler Tone | saw tooth output from 1.5 kHz to 3.2 kHz / 500ms, Output level rising from 0dBm to +20 dBm |
| Line Lockout | Busy tone 30 seconds, line feed at -48 V to - 32 V (Change according to the subscriber line condition.) |
| Insulation Resistance | 20k ohms |
| DTMF Dialing | Complies with ITU-T Q.23 |
| Battery Feed Resistance | 400 ohms balanced (+/- 80 ohms) Ringing |
| Detection | Input voltage: 20-100 Vrms, Frequency:<br>14 - 55 Hz Duration: > 150 ms<br>Impedance > 800 ohms at 25 Hz, >20K ohms at 1 kHz |
| Generation | Frequency: 16.0 - 65 Hz settable<br>Output voltage: 75-100V.peak to peak at 25Hz Sine Wave |
| Delay | < 200 ms Envelope |
| Distortion | < 25 ms |
| Amplitude Distortion | < 10% |
| Cadence | Ring following |

Table of Tone Characteristic:

| Tone | Frequency | Level (dBm) | Periodicity | Other Characteristics |
|---|---|---|---|---|
| A. Dial Tone<br>Normal Dial Tone | 400Hz modulated with 50Hz | -20 ~ -10 | Continuous | |
| Special Dial Tone | | | | 0.4s on /0.1s off continuous |
| Second Dial Tone | | | | |
| Internal Dial Tone | 600Hz modulated with 50Hz | | | |
| B. Busy Tone | 400Hz | -15 ~ -5 | 0.5s on /0.5s off | |
| C. Congestion Tone | 400Hz | -15 ~ -5 | 0.3s on /0.3s off | |
| D. Ringing Tone (Ring Back Tone) | | | | |
| Immediate ringing tone | 400Hz | -15 ~ -5 | 1.0s on /4.0s off | |
| Special ringing tone | 400Hz | -15 ~ -5 | 1.0s on /3.0s off | |
| E. Supplementary service tone | | | | |
| Positive indication tone (Confirmation tone) | 400Hz modulated with 50Hz | -20 ~ -10 | Continuous | |
| Negative indication tone (Refusal tone) | 400Hz | -15 ~ -5 | 0.5s on /0.5s off | |
| F. Call waiting tone | 400Hz | -25 ~ -15 | 1.0s on /10.0s off/1.0s on | |
| G. Offering tone (Operator intrusion tone) | 400Hz | -25 ~ -15 | 0.17s on/0.17s off<br>0.15s on/0.17s off | |
| H. Lock-out tone (Howler tone) | Sweep from 1.5kHz to 3.2kHz | -20 ~ -0 | Sweep in 500ms level rising during 20s | Saw tooth wave |
| I. Number Un-obtainable tone | 400Hz | -15 ~ -5 | 0.1s on /0.1s off<br>0.1s on /0.1s off<br>0.1s on /0.1s off<br>0.3s on /0.1s off | |

## 9.2 POTS Analog Channel Specification

| | |
|---|---|
| Impedance | 2-wire, 600 ohms or 900 ohms |
| Insertion Loss | 2 dB +/- 0.5 db |
| Return Loss | Complies with ITU-T G.122 |
| | 2-wire RL > 20 dB, 400-3000 Hz |
| | 4-wire RL > 28 dB, 300-3000 Hz |
| Frequency Response | 300-3400 kHz (+0.5 to -1.0 dB), ITU-T G.713 |
| Input/output Lever | ITU-T G.713 |
| Idle Channel Noise | <= -65 dBm, G.712 |
| | <= 200 pW, G.123 |
| Cross-talk | < -67 dBm, line-to-line |
| Longitudinal Balance | Complies with ITU-T G.117 & O.121 |
| Amplitude Tracking | Complies with ITU-T G.713 & G.714 |
| Single Freq. Distortion | Complies with ITU-T G.713 & G.714 |
| Inter-modulation Distortion | Complies with ITU-T G.713 & G.714 |
| Signal to Distortion Ratio | Complies with ITU-T G.713 & G.716 |
| PCM Coding | A-law, Complies with ITU-T G.711 |

## 9.3 GPON OLT Specification

### 9.3.1 GPON OLT Optical Fiber Specification

- Fiber Type: ITU G.652 from GLC to premise and ITU G.652 or G.657 in premise
- Single-mode fiber with zero-dispersion wavelength around 1310 nm
- Minimum optical return loss: -40 dB
- Maximum PON length: 20 km standard

### 9.3.2 GPON OLT GPT Functional Specification

MAC Table Entry

MAC: 16K, VLAN: 4K
Multicast (L2): 1K, Multicast(L3): 1K

L3 Table (V4): 4K, L3 Table (V6): 8K

Functions:

IEEE 802.1d STP, IEEE 802.1w RSTP, MSTP IEEE 802.1q
VLAN, IEEE 802.3x Flow Control
IEEE 802.1p Priority, IEEE 802.3ad Link Aggregation
MAC Address Limiting (1~16)
Port based ACL Filtering, Port Redirection/Mirroring
Max. 8 COS queue/port supported
WRED, SPQ, WRR, WFQ, SPQ+WRR, SPQ+WFQ, DWRR
Broadcast/Multicast Storm Control
Port based ACL Filtering
DHCP Server, Snoop & Relay (Option 82) IGMPv1 v2
v3 (Snoop & Proxy supported) PIM-SM, Static Routing
IPv4/IPv6 Dual Mode Operations
Static Routing, Dynamic Routing (RIP, OSPFv2, BGP4) DHCP
packet filtering supported

## 9.4 Environment Specification

Operation Environment: Indoor type:

Temperature: 0 to 45 $^{o}$C

Relative Humidity: 85% at 29 $^{o}$C

Outdoor type:

Temperature: -5 to +65 $^{o}$C,

Relative Humidity: 100% at 45 $^{o}$C

System could work normally in temperature range from -10 to +70 $^{o}$C for a short period.

Storage Environment:

Temperature: -20 to +75 $^{o}$C

Relative Humidity: 100% at 30 $^{o}$C

Altitude: 3000 meter under sea level.

Earthling: Always connect to Ground by grounding kit, has the resistance lower than 4 ohms.

Electromagnetic Compatibility: Complies with CISPR 22 CLASS A, IEC 1000-4-5 standards

## 9.5 Powering Specification

Operation Power Input: Nominal -48Vdc, +20% to -10%, AC ripple up to 0.5 Vpp, or 220 ±10% VAC, 50 ± 10% Hz with AC to DC rectifier. Two power input for dual-feeding power.

**Individual Unit Power Consumption:**

| Unit Name | Power Consumption |
|---|---|
| MSA Shelf (with FAN Unit) | 20.0 W |
| MSB Shelf (with FAN Unit) | 15.0 W |
| MSG Shelf (with FAN Unit) | 10.0 W |
| CPUM2 / CPUC / CPUCG | 28.0 W |
| MGUM | 28.0 W |
| IVD (POTS and ADSL2+ combo) | 80.0 W |
| RI-POTS2 | 37.0 W |
| RI-POTS2A | 50.0 W |
| R-ISDN6 | 10.0 W |
| R-ISDN12 | 16.0 W |
| R-ISDN36 | 40.0 W |
| R-ISDN42 | 46.0 W |
| PRI4 | 10.0 W |
| PRI12 | 16.0 W |
| PRI21 | 45.0 W |
| ATU-C2S | 43.0 W |
| ATU-CS | 43.0 W |
| VTU-CS | 32.0 W |
| GPT | 45.0 W |
| N64-GSD | 20.0W |
| N64-GS8 | 60.0W |

## 9.6 Reliability Specification

In this section, the ULC-1000AN MSAN system reliability figures are estimated according to Bellcore TR-NMT-000332.

**Individual Unit Reliability Data:**

| Unit Name | Fits | Fail Rate | MTBF | MTBF |
|---|---|---|---|---|
| | | (%/yr) | (Hrs) | (Yrs) |
| CPUM2 | 6,789 | 5.9% | 147,297 | 16.8 |
| CPUC | 6,351 | 5.6% | 153,073 | 18.0 |
| CPUCG | 6,548 | 5.8% | 157,456 | 17.5 |
| MGUM | 4,927 | 4.3% | 202,963 | 23.2 |
| IVD (POTS and ADSL2+ combo) | 8,384 | 7.3% | 119,275 | 13.6 |
| RI-POTS2 | 5,937 | 5.2% | 168,435 | 19.2 |
| R-ISDN6 | 3,206 | 2.8% | 311,915 | 35.6 |
| PRI4 | 3,884 | 3.1% | 279,017 | 31.8 |
| ATU-C2S | 6,983 | 6.1% | 143,205 | 16.3 |
| VTU-CS | 4,207 | 3.7% | 237,699 | 27.1 |
| GPT | 5,204 | 4.6% | 192,160 | 21.9 |
| N64-GSD | 2,381 | 2.1% | 419,992 | 47.9 |

Where:

Fits (Failures In Time) = failures/10^9hours (No. of failures in ten to the ninth hours) Fail Rate (%Failures/yr)=Fits/(1142x100)

MTBF(hrs)=10^9/Fits

MTBF(yrs)=(10^9/Fits)/8760 hrs per yr

Fits @ 40 $^{o}$C and 50% Electrical Stress with 1.0 ENV Factor

*Actual Field Reliability is two to five times better than predicted.

## 9.7 Other

**Safety Information**

This section lists the safety information needed for the ULC-1000AN MSAN Access System for system turn-up after installation has been completed, operating, provisioning and maintaining the system.

This system has been developed in line with the present state-of-the-art and fulfils the current national and international safety requirements. It is provided with a high degree of operational safety resulting from many years of development experience and continuous stringent quality checks in our company.

The system is safe in normal operation. There are, however, some potential sources of danger that cannot be completely eliminated. In particular, these arise during the

- Opening of housings or equipment covers
- Manipulation of any kind within the equipment, even if it has been disconnected from the power supply
- Disconnection of optical or electrical connections through possible contact with
- Live parts
- Laser light
- Hot surfaces
- Sharp edges, or
- Devices sensitive to electrostatic discharge.

In order to keep the technically unavoidable residual risk to a minimum, it is imperative to observe the following rules:

- Installation, configuration and disassembly must be carried out only by expert personnel and with reference to the respective documentation.
- The unit/system must be operated by expert and authorized users only.
- Any conversions or changes to the system or parts of the system (including the software) must be carried out by qualified personnel
- The unit/system must not be operated unless it is in perfect working order.
- The equipment must be supplied with Safety Extra-Low Voltage (SELV) of -48 V and the positive terminal of this source must be correctly connected to the protective earth.

- The unit/system must be operated only with the connections and under the environmental conditions as described in the documentation.
- The removal or disabling of safety facilities, the clearing of faults and errors, and the maintenance of the equipment must be carried out by specially qualified personnel only. The respective parts of the documentation must be strictly observed.
- Only use tested and virus-free diskettes.
- Do not place the shelves on an unstable cart, stand, or table. The product may fall causing serious damage to the equipment.
- Never push objects of any kind into this product through cabinet slots as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electrical shock. Never spill liquid of any kind on the product.

All safety instructions have a uniform appearance. They include a signal word that classifies the danger and a text block that contains descriptions of the type and cause of the danger, the consequences of ignoring the safety instruction and the measures that can be taken to minimize the danger. In some safety instructions, a ***warning symbol*** is placed underneath the signal word.

There are five classes of safety instructions: “Danger”, “Warning”, “Caution”, “Important” and “Notice”. The classification is shown in the following.

- ***DANGER***

Serious injury is definite or likely.

- ***Warning***

Serious injury is possible.

- ***CAUTION***

Minor injury is definite, likely or possible, or material damage to the product or in the product environment is definite or likely.

- ***IMPORTANT***

Material damage to the product or in the product environment is possible.

- ***NOTICE***

A fault, i.e. considerable impairment to operation, will be caused or may be caused.

**Labeling**

All equipment is labeled by permanent type label in English or Customer’s specified. The label shows the manufacturing factory, type of equipment, part number and serial number of the equipment.