CASE STUDY **MPC480 IN INDIA**

India Operator BNG and IP Router

1 BACKGROUND

The India Operator (Operator) provides Internet services to approx. 40,000 end users (residential and business users) in a city in eastern India.
The Operator has a contractual relationship with hundreds of Local Cable Operators (LCO). LCOs are privately owned entities that own and develop cable TV and Internet infrastructure in a building or neighbourhood – LCOs provide the local physical network (including active equipment) that connects the end-users.

The LCO contracts the Operator to provide Internet services to their customers; the end-users. Each end-user has an individual subscription which is enforced in a network access server (NAS).

1.1 Network challenges

- Frequent fiber cuts and various other issues, degrade the stability of the aggregation network. Spanning-tree/ERPS operation is not possible due to topology architecture.
- MAC-address scalability in central nodes in aggregation network is a problem.
- LCO networks are not controlled by Operator; end-users are connected using a mix of managed and unmanaged switches and end-users are not separated into VLANs.
- Static IP assignment for end-users is required to avoid unintentional local DHCP servers (end-users sometimes configure or operate their home routers incorrectly) which affects network stability.
- Policy routing of web traffic and peer-2-peer (torrent) traffic is required to reduce bandwidth on external links to upstream providers
- The current NAS solution has performance and scalability issues.
- Horizontal scaling means increased complexity and there is a need for policy routing combined with increased bandwidth demand – the network is simply outgrowing the existing deployment solution.

SUMMARY

Company: India Operator
Bransch: ISP
Location: India

Challenges:

» Frequent fiber cuts- MAC-address scalability

» LCO networks are not controlled by Operator

» Avoid unintentional local DHCP servers

» Reduce bandwidth on external links

waystream

1.2 TOPOLOGY DETAILS

The Operator network has grown over time, creating multiple – even overlapping – physical and logical structures in both the fiber and Layer 2 Ethernet network. Introducing redundancy protocols for the Layer 2, switched network requires significant upgrades in equipment and also requires considerable time to redesign the live network.

1.2.1 Local Cable Operators

In addition to growth problems, there is the uncontrolled LCO environment. As private entities, LCOs make their own purchasing decisions about the network equipment that is used to connect to their end-users. Often, this includes unmanaged switches which do not support VLANs so all end-users are put in the same VLAN. Also, if an end-user configures a typical wireless router incorrectly, the router can act as a DHCP server for the entire neighbourhood. It is therefore necessary to give all end-users a static IP address while DHCP is explicitly prevented in the network.

To further complicate the LCO environment, some LCOs have multiple upstream providers, in addition to the Operator which means that there is external traffic injected into the VLAN of the LCO from time-to-time. Because of the current topology, this external traffic may travel deep into the Operator network before being dropped.

From a functionality perspective, VLANs are carried much further than necessary due to the network topology which causes MAC-address tables to fill up in central switches.

1.2.2 Network access servers

The network access server (NAS) solution used today is an appliance-based solution with a built-in customer database. This platform scales poorly and there are already a large number of deployed NAS devices. Troubleshooting capabilities are limited which further complicates the situation for first- and second line support. The Operator has already decided to move to a RADIUS/BNG approach and the vendor for the RADIUS-server has been approved.

1.2.3 Special needs for traffic

To scale the network, policy routing is required to direct each LCO into a specific NAS unit. Each NAS unit is configured to handle a specific LCO.

Because the addition of LCOs has transpired over time, there can be multiple LCOs in the same geographical (and even topological) area of the network that are assigned to different NAS units.
Central policy-routing is already implemented but this solution has reached a limitation in the maximum number of ports. Link-aggregation is heavily used in order to scale bandwidth and this, in turn, increases the port consumption.

Furthermore, the NAS-solution does not support a redundancy setup – if the NAS goes down, all end-users assigned to the NAS are left without network access until full functionality is restored.

The policy routing solution deployed today also sends traffic through local web-cache and peer-2-peer (torrent) servers that are installed to save upstream bandwidth. The servers have a significant impact on bandwidth but require that traffic is classified when it is sent via them, as well as traffic being separated over different NAS units.

2 MPC480 SOLUTION

The proposed solution from Waystream for the Operator is based on the MPC480 edge router that serves in multiple network roles. The MPC480 introduces several key functions into the topology:

Creates a Layer 3, routed and redundant, distribution network to segment the aggregation network, thereby reducing size of MAC-address tables on central nodes

Distributes the BNG functionality into the MPC480 distribution nodes to reduce the required number of BNGs while increasing the scalability of the service solution

Upscales central nodes for policy routing of web and torrent traffic and enables use of multiple carrier-grade network address translators (for auditing purposes to remain compliant with local regulations).

Using the MPC480 gives the Operator a scalable network solution that offers simplified maintenance and troubleshooting while boosting the service capabilities of the network which keeps the overall costs to a minimum.

The proposed solution from Waystream for the Operator is based on the MPC480 edge router that serves in multiple network roles.

2.1 MPC480 solution for a scalable and redundant network

To create a scalable and redundant topology, the MPC480 is deployed in the Operator network *(**refer next page Figure**)*

2.1.1 Segmenting the access network

The access network is segmented into geographical areas where customers (direct business customers and LCOs) are aggregated into a major point of presence (POP). One MPC480 unit is deployed into each major POP.
By segmenting the network, the size of the Layer 2 domain is reduced, the number of MAC addresses is reduced, and VLAN reuse between segments is enabled. Any issue in the Layer 2 network is contained within that segment and does not affect other parts of the network. A cleaner Layer 2 topology allows redundancy protocols to be deployed into the network.
These measures improve the scalability of the network, as well as limit the impact of issues in the Layer 2 access network.

To further improve redundancy, the main switches in each Layer 2 segment can be dual- homed towards multiple MPC480 units in different POPs. In this dual-homed host scenario, the VRRP protocol provides a single gateway address for LCOs and business customers while still enabling.

The MPC480 in each POP works as an IP router that routes traffic over uplinks and between POPs. In addition, the MPC480 works as a Broadband Network Gateway (BNG) that authorizes users in the LCO VLANs to access the network and to control the service rate.

This solution includes a captive portal for user logins and RADIUS-based authorization and service control. The redundancy solution provides a failover function to a secondary BNG and each MPC480 handles all customers in its immediate area which creates a distributed and scalable BNG solution.

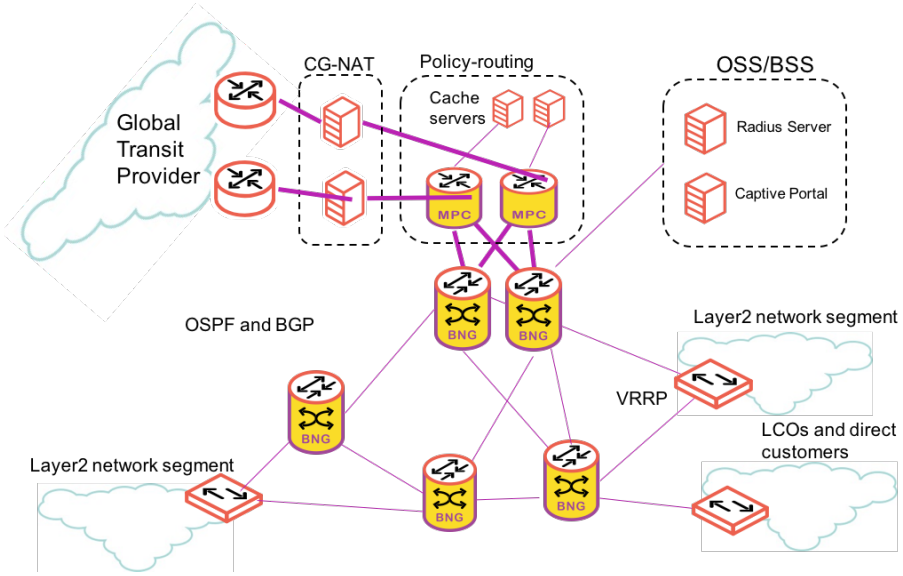

Figure 1

Furthermore, the BNG solution implements different speeds for the traffic to end-users based on whether the traffic comes from the Internet, or if it is received from the cache servers (for cache servers, the end-user is granted a higher download speed for the traffic). The flexibility of the solution allows the Operator to create a wider service portfolio to address smaller customer segments, and to set the stage for business-VPN services within their own infrastructure in the future.

The MPC480 supports a highly flexible policy routing framework with advanced rules that take into consideration protocols, port ranges, traffic direction and multiple prefixes.

2.1.2 Routed aggregation network

The MPC480 units are connected over high-speed 10Gbit/s links and run OSPF and BGP. The aggregation network is therefore redundant with automatic failover in the event of fiber cuts. The network also supports advanced services including peering and transit access for key business customers in the network. Some business customers purchase transit capacity to Google for content distribution, and this can be offered by using BGP peering.

The network is also prepared for a future migration to MPLS because the MPC480 platform supports MPLS operations. This could enable a wider offering of VPN services, and would enrich the fiber infrastructure that the Operator is building.

2.1.3 Policy routing to reduce bandwidth

To reduce bandwidth on uplinks to global transit providers, traffic from end-users must pass through the web cache- and torrent cache servers that are deployed centrally in the network.

The MPC480 supports a highly flexible policy routing framework with advanced rules that take into consideration protocols, port ranges, traffic direction and multiple prefixes. In lab tests, 40,000 clients in different LCO-subnets were policy-routed across four different cache servers and through 16 different network address translators. The average system throughput was approximately 78Gbit/s.

2.1.4 Carrier-grade NAT and uplinks

Due to the depletion of IPv4 addresses, the Operator uses a mix of private- and public IP addresses for its services. The majority of residential services are based on private address ranges assigned to the LCOs and this is where central carrier grade network address translation takes place.

For load-sharing purposes, the network address translation is initially split over several devices so policy routing is required to distribute different LCOs over different network address translators. Over time, the translators will be consolidated to fewer units.

The Operator peers with multiple external providers, both for equal cost terms and for global transit access. There is also a degree of load sharing happening here in order to spread the public IP scopes over multiple links.

3 CONCLUSION

The MPC480 from Waystream makes it possible for the Indian Operator to simultaneously upgrade their network capacity and enhance scalability and flexibility. When the fiber infrastructure grows, the network is fully prepared to meet the increased demands for extra bandwidth and new services while continuing to provide a reliable and robust topology that is easy to maintain.

For more details on the MPC480 Edge Router, contact our sales representative at sales@waystream.com, or find a Waystream reseller near your location at www.waystream.com