Wholesale IP Bitstream on a Cable HFC infrastructure

In order to understand the issues related to an ISP reselling Cable Based Internet access it is necessary to look at similarities and dissimilarities between the two architectures or more exactly, topologies.

The main distinguishing feature between a cable infrastructure and an xDSL infrastructure is the fact that a cable (HFC: Hybrid Fiber Copper) topology provides a Shared Medium Access where typically, up to 1000 connections may share a common RF Domain. Figure 1 below shows a typical HFC Infrastructure built around DOCSIS 2.0.

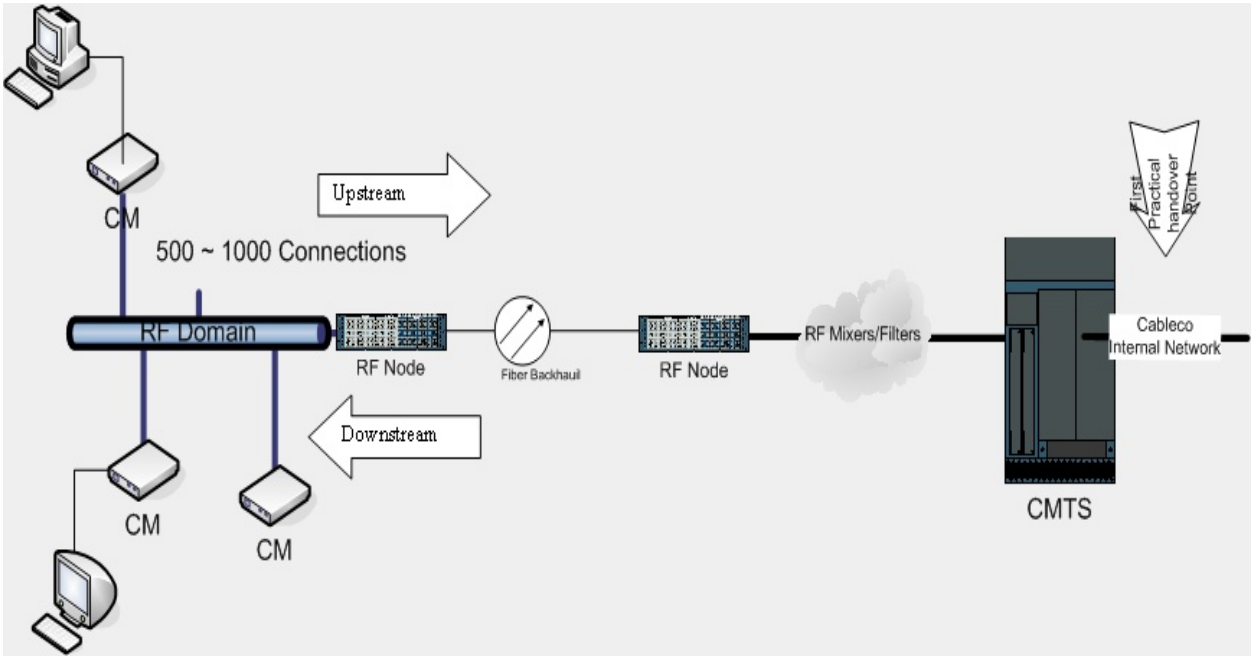

Figure 1: A Typical HFC Network Topology

The shared RF Domain is typically a tapped coax network with around 60MHz of shared RF bandwidth used for upstream data transfer in chunks of 6.4MHz channels. Downstream data would usually occupy around 100MHz in 8MHz channels but this depends on the spectral plan of the Cable provider because most of the bandwidth would be allocated to analogue and digital TV services. Each cable modem would send data on a single 6.4Mhz channel and receive on a single 8MHz downstream channel. Each channel would typically support an aggregate data throughput of around 30Mbps in upstream and

between 27 and 56Mbps in downstream. Multiple devices on the same RF segment would share the same channels so in theory any device using a channel exclusively would be able to achieve these speeds.

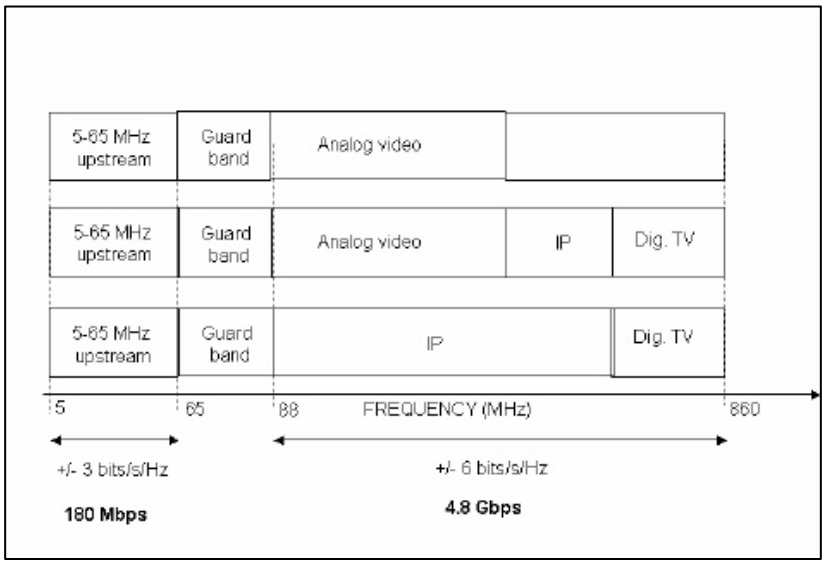

Figure 2: Typical Cable HFC Spectral Bandplan

The relevance of all this in a scenario of wholesale resale is that as a consequence of their topology, Cable HFC networks (and similar networks) are not amenable to Local Loop Unbundling. This fact is accepted by many National Regulatory Authorities in Europe, and in particular in the local context, by the Malta Communications Authority [MCA][1].

On the other hand, whilst it is not possible to unbundled an RF coaxial segment for wholesale to different players, it is relatively straightforward for ISP to purchase wholesale Bitstream access by picking up traffic at predefined CMTS Access points as referred to by the MCA on page 22 of the Wholesale Broadband Market Consultation Document dated 25th July 2006.

There are a number of possibilities where ISP service selection can be achieved. Typical methods of achieving handover of ISP Wholesale Bitstream Traffic are:

Option 1

> **PPPoE Termination on CMTS** with traffic separation and separate handovers to different ISPs over IP VPNs. By this method, the CMTS could provide PPP termination for an ISP's client. This method would be fairly similar to the mechanism achieved within xDSL networks where the CMTS could take on the secondary role of a Broadband Access Server. All ISP's traffic is then forwarded to the ISP over a dedicated IP VPN or VLAN across a dedicated Fiber connection (Ethernet).

[1] Wholesale Broadband Market Consultation Document dated 25th July 2006

Option 2

A Separate Aggregation Device / BRAS on the Network Side Interface enables Customer Premises Equipment to terminate PPP sessions onto this device. This which could also provide service/ISP selection as in method 1 outlined above

Option 3

Extending the mechanisms currently in used by Cable providers, namely **use of DHCP**. By this method, subscribers taking a Bitstream wholesale offer from a party other than the Cable provider will be assigned an IP address either by DHCP servers by proxy on behalf of the ISP or directly by the ISP via its own DHCP server. The CMTS will then aggregate all ISP IP traffic into an ISP assigned vpn. This traffic is then backhauled to the ISP in a manner similar to that referred to in the previous options.

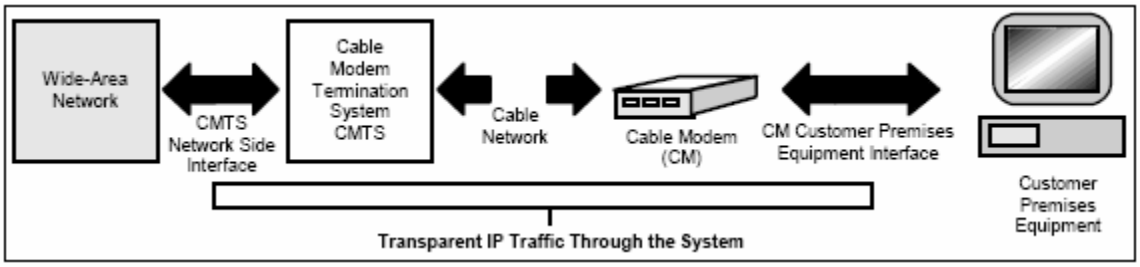

Figure 3: Transparent IP Traffic through Data-over-Cable (Docsis) system

Therefore, the provisioning or enabling of the facilities that enable such wholesale access do not impose any more onerous financial or architectural obligations on the Cable Company than those imposed on DSL infrastructures.

From the wholesale competitive ISP point of view, the infrastructure necessary to support Cable wholesale can be very similar to any existing setup used to support DSL wholesale. This will depend on the method chosen by the Cable Operator to provide wholesale bitstream.

With options 1 and 2 as described above an ISP that is currently retailing DSL based broadband will only need to carry out the following minor changes

I. Establish of a dedicated IP connection with the Cable Provider. This can be done either through a separate dedicated router or else via the same router currently handling DSL aggregate traffic.

II. Reconfigure (software) its AAA (Authentication, Authorisation and Accounting) and RADIUS servers to accept authentication requests from the cable operator in addition to similar requests arriving from the DSL provider. Alternatively, an ISP may opt to dedicate a separate server for authentication via the Cable provider but in any case, the level of new investment necessary would be trivial.

III. Replace client DSL modems with cable modems provided by the cable provider. Depending on existing client configuration, the client PPP dialler may also need to be modified from PPPoE to PPTP (or L2TP) for option 2 or from PPTP to PPPoE from Option 1. This is however a trivial operation compared to replacing the modem.

Should the Cable Operator decide to offer wholesale Bitstream access by extending his current DHCP offer, service provisioning would be slightly more complicated particularly to handling churn. In this case, the ISP setup will necessitate

I. Establishment of a dedicated IP connection with the Cable Provider. This can be done either through a separate dedicated router or else via the same router currently handling DSL aggregate traffic. (identical as before)

II. Installation and configuration of a DHCP server capable of handling DHCP scopes and the various DHCP options. This will allow ISP to be able to reply to DHCP requests of its customers relayed to it by the Cable Operator. Whilst this allows an ISP to authorise a client's connection, since DHCP is fundamentally different from the PPP model currently used within DSL wholesale, this may necessitate changes in the way the ISP carries out Authentication and Accounting.

    However there are no undue technical constraints in doing so. The ISP may opt to build up a system based on what are called Service Selection Gateways whereby individual client traffic, once assigned the appropriate IP address via DHCP, may be further authenticated and managed at the IP level. This may require an additional extra investment in a new setup and associated effort in rewriting OSS and BSS integration scripts. However these are already efforts that all ISPs of reputable standing tend to do in the normal course of their business. Moreover, this will allow the ISP to have even greater control on his client, thereby allowing him to be more innovative in his product offering.

III. Replace client DSL modems with cable modems provided by the cable provider. In addition, all PPP options will be removed and client devices will simply need to be configured for DHCP.

Notes

The document is not intended as a guide to a cable operator to set up and manage the setup necessary to be able to offer IP Bitstream at wholesale. Consequently any details related to the configurations of specific devices have been purposely left out.

The document merely presents the relevant conclusions drawn from research into Cable HFC topology and current equipment and software to the way that such equipment in the marketplace can support wholesale enabling technology. The availability of such features and functionality is backed up

with documentation from one of the most popular suppliers of CMTS devices and who is incidentally the supplier of choice of the local Cable Company. This notwithstanding, it is easily demonstrated that the cost of reengineering some network components or the network setup is at worst not any more onerous than similar obligations imposed on other players having significant broadband market power.

Moreover, ISPs deciding to retail Broadband Access via Cable are not presented by any insurmountable technical or financial obligations. It is naturally expected that there is a cost to bear but it is also shown that costs and complexities can in many cases leverage on existing infrastructure being used to offer DSL broadband services. Furthermore where relatively higher investment is required (as in Option 3), this is something that should be still within the capabilities of any quality ISP.

Glossary

BRAS: Broadband Access Server. Is usually an IP router that terminates PPP connections across ATM or Ethernet and aggregates user traffic whilst providing segregation via IP VPNs of traffic belonging to different domains (or ISPs). Although it is usually a dedicated device, BRAS functionality is often found integrated into IP routers, IP DSLAMs or Cable Modem Terminating Stations. [CMTS]

CMTS A cable modem termination system (CMTS) is a network component that exchanges digital signals with cable modems on a cable network. A cable modem termination system is usually located at the local office of the cable company. When a CMTS receives signals from a cable modem, it converts these signals into IP packets, which are then forwarded to the Internet via the connected Cableco internal network. When a CMTS sends signals to a cable modem, it modulates the downstream signals for transmission across the cable to the cable modem. All IP traffic exchange between modems therefore takes place at the CMTS

DHCP: A method whereby IP devices receive their IP configuration automatically from a remote DHCP server. In its basic form, DHCP does not allow for authentication.

PPP (Point-to-Point Protocol) is a layer 2 (or data link) protocol used on physical or logical point-to-point connections through which upper layer protocols can be negotiated and established. It is typically the protocol of choice in DSL Broadband access since it provides an easy way by which Authentication, Authentication and Accounting of a user's connection can be achieved. A PPP connection provides a logical interface for a subscriber's IP connection. PPPoE is an extension wherein PPP connections can be established across inherently Broadcast Ethernet medium to provide secure connectivity via a terminating Access Device [BRAS].

RADIUS: Remote Authentication Dial-In User Service (RADIUS) is a client/server protocol and software that enables remote access servers (called RADIUS servers) to communicate with a central server to authenticate dial-in users and authorize their access to the requested system or service. RADIUS allows the maintaining of user profiles in a central database against which subscriber services can be authenticated and authorized.

(IP) VPN: Provides a logical separation of traffic from different entities on a single network or network device such that the said network will appear as independent and private to each different entity even though it shares the same physical infrastructure.