STEM example model

Increasing cable bandwidth to retain high-value customers

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Increasing cable bandwidth to retain high-value customers

Implied Logic has just released a new example model illustrating how the *STEM business modelling software for industry* can be used to measure the extent to which capital investments in local transmission technology and configuration may help a cable-network operator to secure or retain future Internet revenues.

Internet provision via cable is carried in the channels not required for digital (or analogue) TV, and is inevitably a shared resource between all the households connected on a given segment. Unfortunately there is little or no brand loyalty for what is typically regarded as a commodity service. A heavy user will always prefer the fastest downlink and uplink speeds possible, and any moderately-active customer will quickly consider any available alternatives if contended bandwidth is too limited when they need it.

We have modelled the current infrastructure of a typical cable network operator, including Internet CPE, set-top box, optical node, amplifier and head-end, together with future options to address bandwidth limitations such as channel-bonding (if not already implemented), enhanced video compression, RF extension, and segment splitting. According to readily adaptable estimates of the costs involved and the elasticity of relevant market segments (including level of competition), the model compares the cost implications of implementing these upgrades with the potential revenue loss associated with not acting in a timely manner to retain customers.

Figure 1 overleaf shows a live snapshot from the model as it appears on our website.

Figure 1: Live snapshot from the model on www.impliedlogic.com

Implied Logic can work with you to customise this methodology to your individual market and current network position in order to fast track a credible financial assessment of your strategic options.

1. Overview

Broadband services can be supported using different technologies:

- XDSL solutions: FTTC (fibre to the curb) supporting XDSL
- HFC (hybrid fibre coax) cable solutions – DOCSIS standard
- FTTH PON (passive optical network), e.g., EPON/GPON
- FTTH PtP deployments
- radio and satellite.

Cable TV operators have upgraded their cable systems to enable Internet services, adding reverse channels for upstream data. Standardisation has led to DOCSIS (Data Over Cable Service Interface Specification). Operators can extend the capacity of their systems by applying different measures, depending on the current network status.

The model focuses on the effects of limited bandwidth and the various ways of extending the bandwidth available for Internet services.

The general structure of a HFC network is shown below:

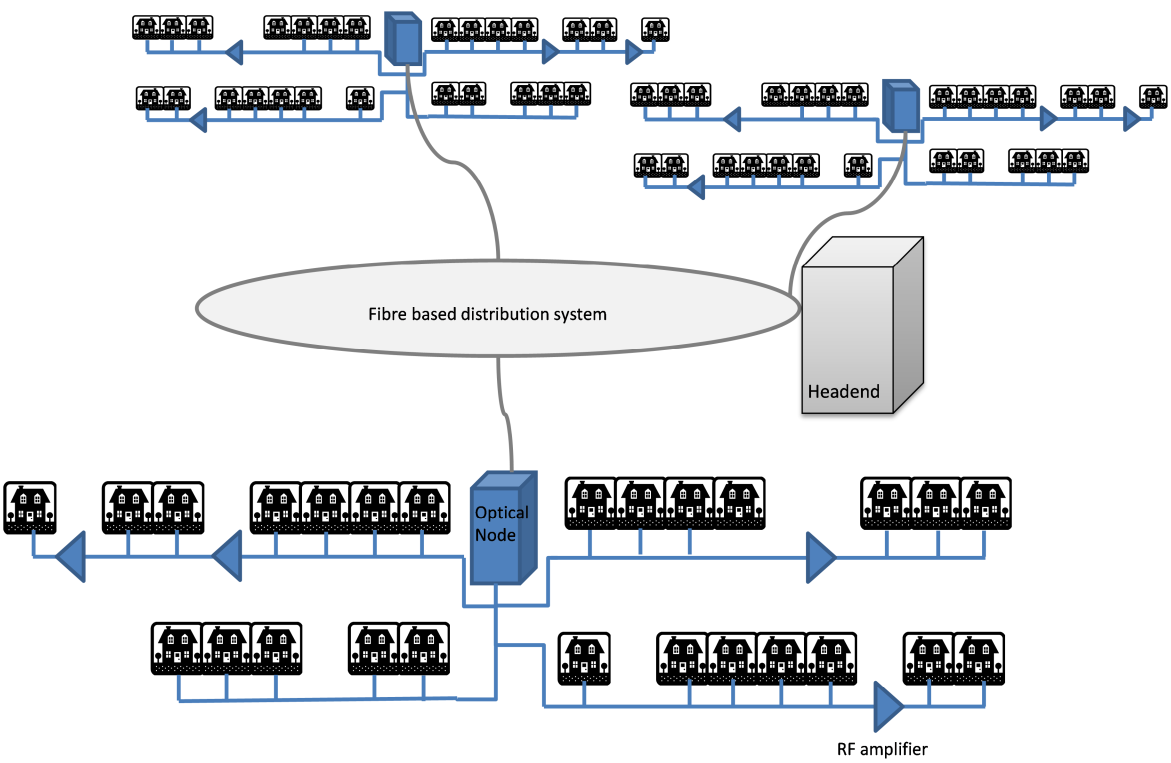

Figure 2: HFC general structure

2. Market segments and services

The model starts with *Households* in a region, representing the 'final customer' to which TV and broadband Internet services are provided.

As the model focuses on additional provisioning of Internet services to households already connected to cable TV systems, this subset of *Households* is represented by the market segment *Households passed*.

Both market segments are assumed to be constant, as extension of the physical reach of the network is beyond the scope of this model.

Two classes of service are derived from the *Households passed* market segment using an assumed penetration.

TV services are modelled in as far as the number of TV channels defines the bandwidth remaining for broadband Internet usage. Some of the extension possibilities would request replacements of the CPEs used for TV (*Set-top Box TV*). The following TV service packages are included:

- *Basic*
- *Premium*
- *Extra.*

The TV packages offered contain different numbers of analogue and digital (SD and HD TV) channels. A general trend is assumed with a decreasing number of analogue channels and increasing number of HD channels for all scenarios.

TV services drive the demand for TV channels required, thus defining the share of available bandwidth to be allocated for TV purposes. The remaining bandwidth can be allocated to broadband Internet services, divided into:

Heavy Internet user represents the most demanding and volatile user; they subscribe to the highest bandwidth available, are not likely to accept bandwidth limitations and change quite fast to another service provider, if available. Such users will also return quite fast if capacity constraints have been removed.

Typical Internet user represents the average user; they subscribe to the standard bandwidth. These users have a higher threshold of tolerance for bandwidth limitation before changing their subscription to another service provider.

Occasional Internet user uses the smallest bandwidth; they are oblivious to bandwidth limitations and are very unlikely to change service provider.

Other services and revenue streams (e.g., IP telephony) are not included in the model but could easily be added.

3. Infrastructure

The focus is on the infrastructure affected by different extension possibilities. The main components are:

- *CPE Internet*
- *Set-top Box TV*
- *Optical node*
- *Amplifier*
- *Headend (e.g., CMTS – Cable Modem Termination System).*

For all of the elements an upgrade component is foreseen which reflects a necessary replacement or upgrade of the element depending on the scenario.

4. Internet capacity and quality feedback

The key element is the capacity available for Internet usage. This capacity is limited and is shared between the subscribers connected to a segment.

Demand which exceeds the available capacity leads to overload situations, decreasing bandwidth per customer and decreasing service quality. Decreasing service quality will drive subscribers to cancel the service and migrate to other service providers and technologies. The reflection of the service quality feedback to subscriber numbers is the key element of the model.

Limiting the demand driven capacity increase

Limiting the demand-driven capacity increase to a predefined number of resources (e.g., one cable segment with a given capacity) is quite easy to achieve. The driving demand must be analysed in a transformation and its output can then be limited to the maximum capacity supported. Thus the capacity for Internet must be defined externally.

Affecting subscriber numbers

The utilisation of resources is normally influenced by a number of factors including subscriber numbers, traffic per subscriber, contention, and so on. Therefore the 'theoretical' utilisation can't be pre-calculated and must be derived at runtime. This would typically lead to a loop, but this can be readily decoupled or resolved with the help of a *Time Lag* transformation.

Once a certain utilisation threshold is reached the model influences the *Penetration* input for the subscribers driving the resource, thereby decreasing the demand side.

Consideration of competition

The key influencing factor for customer migration other than customer satisfaction (service quality and pricing) is the availability of competitive services (both in terms of tariffs and quality). This factor is modelled with three different scenarios in the complete desktop version of the model:

- *no competition* – there is no choice for unhappy customers but to stay with their existing provider, as there is no comparable or better offer in the region
- *moderate competition* – alternative and comparable services are available from other providers
- *significant competition* – there is a quite challenging competitive environment regarding quality, pricing and ease of switching to another provider.

It is assumed that the same mechanics influence customers to return to the HFC provider, once capacity constraints have been removed. Competition and service degradation affect subscriber types differently. The model allows for different thresholds for the *typical* and *heavy* user. It is assumed that the *occasional* user will not change provider as it is likely that capacity bottlenecks are not even noticed.

5. Scenarios in detail

The model covers some extension possibilities for an existing HFC network. Extension of bandwidth available for Internet services can be realised by three main measures or a combination of them:

- reduction of bandwidth used for TV services
- overall increase in available bandwidth
- reduction in the number of customers served by a common segment.

Current situation as starting position

The operator runs a HFC network, which is already Internet enabled, uses MPEG 2 coding for the digital TV channels and operates with 630 MHz bandwidth.

The available bandwidth allows the use of four channels downstream for Internet services per segment. The QAM channel bandwidth of 50 Mbps leads to a situation in which it is not possible to offer a 100 Mbps service for *Heavy Internet users*. The model checks for *Heavy Internet users* if the required bandwidth exceeds the technical possible bandwidth. If this is the case, the number of subscribers is assumed to decrease to zero. However, depending on the competition situation, a proportion of those subscribers will be ready to accept the bandwidth limitation. The model considers this and instead moves those subscribers to the total for *Typical Internet users*.

Channel bonding

The DOCSIS standard allows for the combination or bonding of several channels. The main effect of channel bonding is the higher maximum bandwidth which can be offered for Internet services. The implementation of channel bonding doesn’t require changes in the HFC plant. Currently the number of channels to be combined is assumed to be four.

The major benefit compared to the starting position is the possibility to offer Internet services with more than 100 Mbps, meaning that *heavy* users can be served during the complete timeframe. Nevertheless, as the overall total bandwidth available remains the same, the same service degradations due to overload situations are likely to occur, followed by a corresponding decrease in subscriber numbers.

Video compression

The majority of bandwidth is required to transport TV channels. Although the MPEG2 coding assumed in the base case is already compressed, more effective standards (MPEG4/H.264) can be applied to TV signals. Applying more effective compression standards for TV services allows a significantly higher share of bandwidth to be used for Internet services. It is quite likely that a partial or complete replacement of set-top boxes for TV is required, as older equipment doesn't support the MPEG4 compression.

Compared to the four channels in the starting case, now 24 channels (six bonding groups) can be used for Internet services once the change to MPEG4 coding has happened.

RF extension

Cable systems have been upgraded in the past and are still subject to upgrades; major steps were 470 MHz, 630 MHz and 860 MHz. Finally, frequencies up to 1 GHz are defined. Upgrades in the RF area are quite time consuming, disruptive and expensive as they require changes in the physical infrastructure such as partial or total cable replacement, replacement of amplifiers, and so on.

The current scenario assumes an upgrade of a 630 MHz system to a 1 GHz system allowing the use of approximately 44 additional channels downstream. Therefore, in total, 48 channels (12 bonding groups) can be used for Internet per segment.

Segment splitting

Bandwidth for Internet usage is shared between users of the same segment. Thus, the usable bandwidth per subscriber depends directly on the number of subscribers per segment. A logical approach to increase bandwidth is to reduce the number of customers per segment. As this requires restructuring of the physical network (cable system), a typical approach is to subdivide existing service areas into several by defining each distribution chain as its own segment and serve it from the same (and previous) location. Ideally this approach does not require significant restructuring, as existing feeder infrastructure and sites can be used, and the upgrade is not very disruptive.

In the scenario, a segment is divided into four areas, so the number of usable channels increases by a factor of four.

Combined situation

Cable TV operators will probably combine some of the measures in parallel to make an efficient use of their cable infrastructure and keep service interruptions as limited as possible. The model contains a scenario where all measures can be combined. It shows that the network would have more than enough capacity to cope with future bandwidth growth for Internet services. It is probable that the number of TV channels offered could increase in parallel and more interactive TV content could be offered.

6. Cross section of results

The following graph shows the expected number of subscribers in different competition environments. The Internet capacity gets highly utilised from Y3, leading to customer migration to other providers. Conversely, if the HFC operator is able to extend the capacity usable for Internet, customers come back and the original target penetration may be nearly reached. *Figure 3* shows an example in which the RF extension in Y5 leads to a significant capacity increase and then customers returning to the operator.

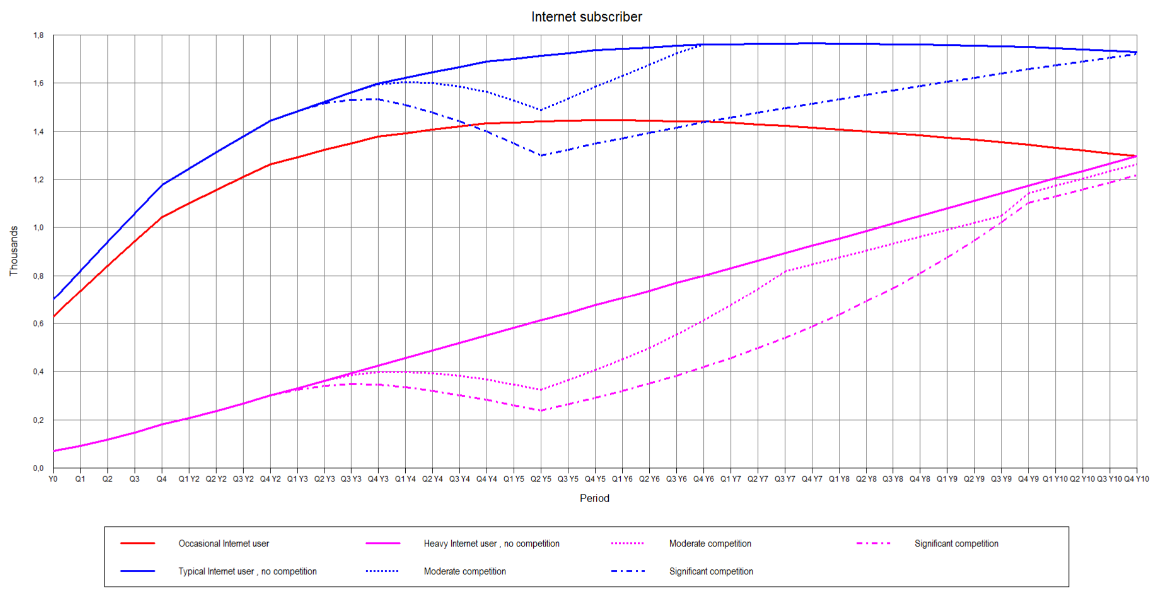

Figure 3: Influence of capacity limitations and extension on subscriber numbers

Figure 4 shows that, in capacity-limited cases, the bandwidth per subscriber doesn't grow significantly. This increase is only possible at all because the total subscriber numbers decrease due to the loss of users to the competition.

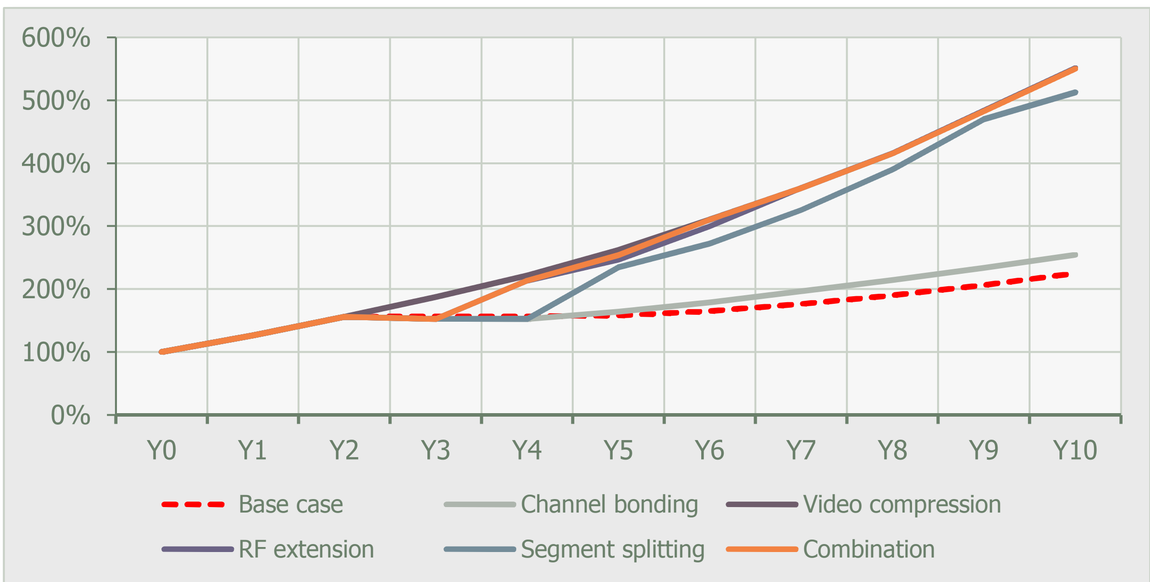

Figure 4: Relative bandwidth provided per subscriber

The network economics are mainly improved by changes in revenue due to subscriber retention. This is of course balanced by additional cost in terms of replacement and upgrade of infrastructure and CPEs, and the necessary effort to make those extensions operational. *Figure 5* shows an indicative comparison of different extension possibilities in terms of net present value.

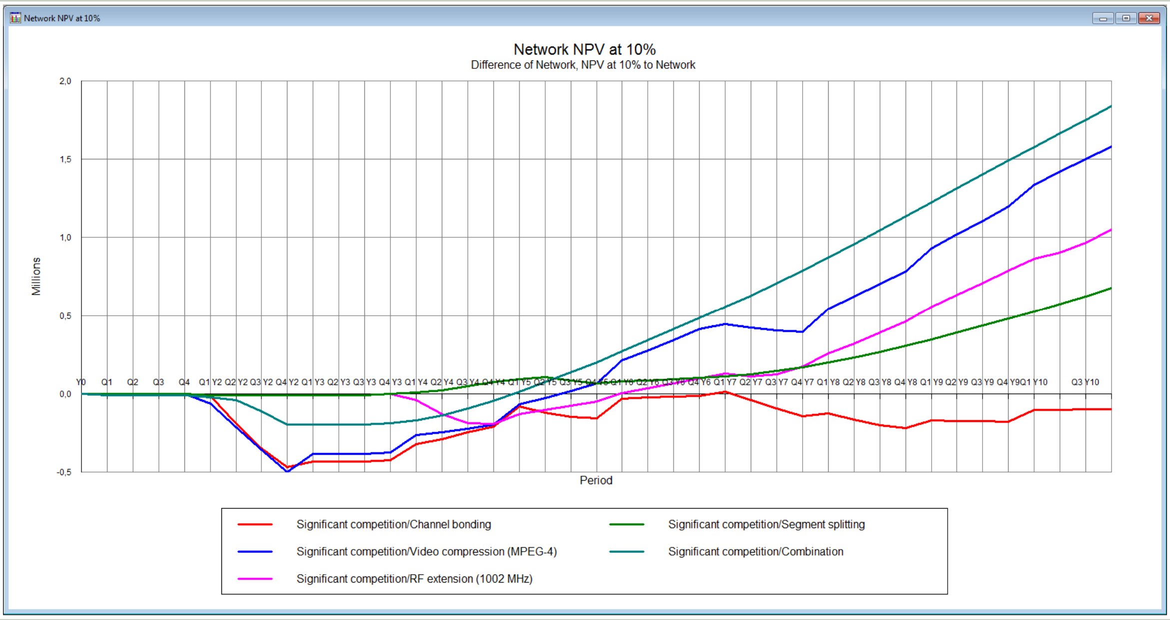

Figure 5: Network NPV of various scenarios compared to the base case

7. External interfaces

STEM supports different ways to input data (e.g., directly or via MS Excel). In this model, one MS Excel workbook is used to input data. This workbook holds statistical data, and market and infrastructure-related assumptions.

Model results can be presented directly with the STEM results program. Alternatively, they may be accessed from MS Excel. The workbook *Key results.xlsm* contains some overall results. A web-enabled version can be accessed live at www.impliedlogic.com.

8. Future improvements

The shortest lag currently supported by STEM is one year, thus resulting in a long feedback time. A planned technical enhancement will make it possible to use the quality indicators from a previous quarter and thus make the simulation more compelling.

For more information please contact:

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