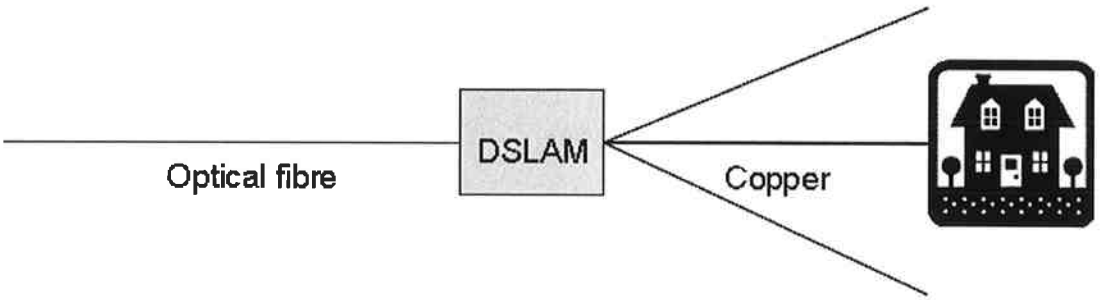
Shared capacity and broadband speeds

There are a number of access technologies being used, or which could potentially be used, to provide broadband services. These include DSL (from an exchange or from a node), FTTH (or similar, such as FTTC), HFC and wireless (such as LTE).

These various technologies differ in their network architecture.

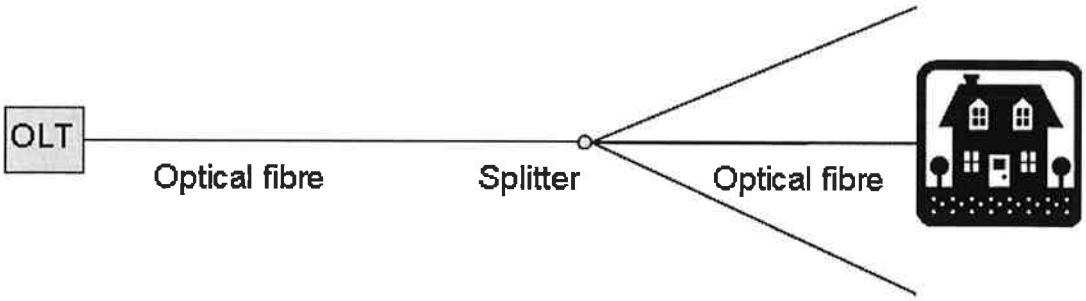
DSL

DSL uses a DSLAM located either at an exchange or closer to the customers at a node (and it would then be FTTN). The DSLAM is connected to the core network using an optical fibre. Customers are connected to the DSLAM using copper pairs. There is a DSL modem in the customer's premises.



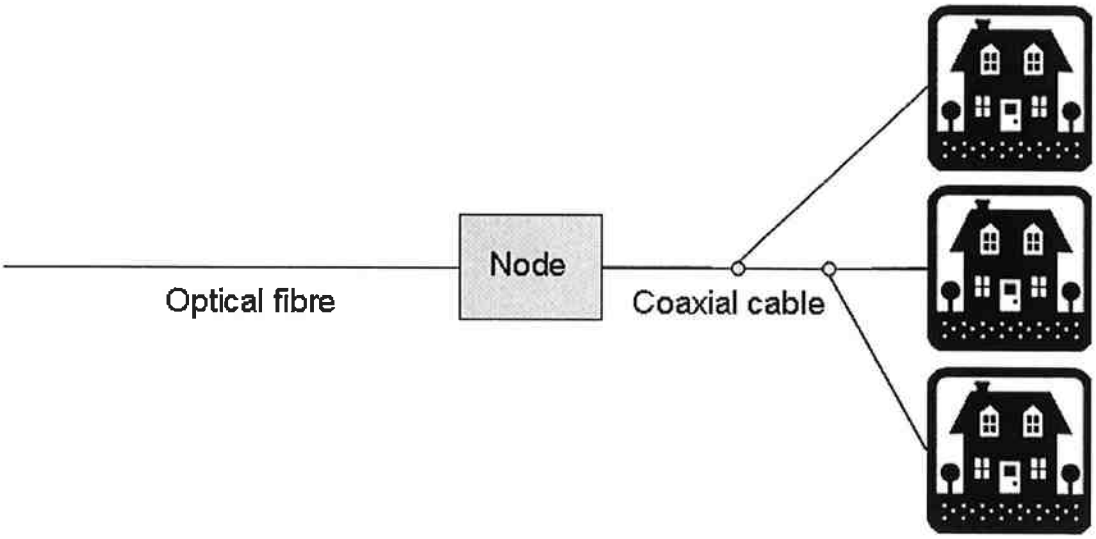
FTTH

FTTH is frequently implemented using a GPON. A GPON has an OLT (optical line terminal) in an exchange and connects to customers using optical fibre. There is an ONT (optical network terminal) in the customer's premises. The optical fibre splits near the customer premises in order to serve a number of customers from the one OLT. The OLT is connected to the core network using an optical fibre.



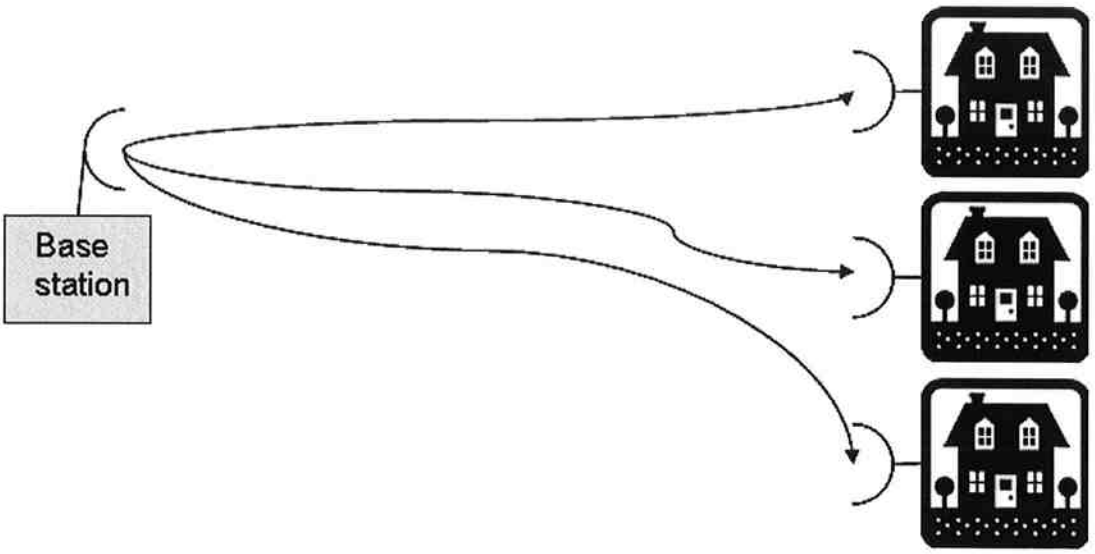
HFC

HFC uses an optical fibre to connect to an optical node close to customers' premises. The optical node is connected to customer premises using a shared coaxial cable.



3G LTE

3G LTE uses radio spectrum to connect from a base station to customers. Customers could be at a fixed location (such as the customer's premises) or wandering around.



Shared network elements

Each of these technologies has some network elements that are shared between customers.

DSL has dedicated copper pairs for each customer. However, the optical backhaul link from the DSLAM is shared between all the customers served by that DSLAM (and potentially by other DSLAMs if the DSLAMs are daisy chained). The optical backhaul link is typically a 1 Gb/s Ethernet link. This is the case for both DSLAMs located in the exchange and in nodes.

A GPON uses a single shared optical fibre to the point where the fibre splits. Optical signals for one customer pass along the shared fibre to the split and after the split along all the fibres, not just the one for the particular customer. For a GPON this optical fibre uses 2.4 Gb/s shared between all the customers connected to the particular OLT. The optical connection from the OLT back into the core network is also shared.

HFC networks use a shared coaxial cable between the optical node and customers' premises. The backhaul optical fibre from the node is also shared.

3G LTE networks use shared radio spectrum to connect to all the customers in the area covered by the antenna segment. The backhaul from the base station might be an optical fibre or a microwave radio system, and that is shared between all the customers connected through the base station (which is possibly a number of antenna segments).

Access network capacity

Each of the access network technologies is able to provide very high data rates.

DSL data rates over the copper pairs are dictated by a number of factors, and especially by the length of the copper pair. With copper pairs of less than 1 km, 50 Mb/s should generally be possible, and future use of DSM3 could push this to 100 Mb/s.

GPON uses 2.4 Gb/s over the shared optical fibre.

HFC uses one or more TV channels to provide data services, with each channel able to provide about 40 Mb/s. Using DOCSIS 3 a number of these can be bonded together to provide higher data rates. Equipment to bond four channels to give around 160 Mb/s is now available, and it is expected that eight channels and 320 Mb/s will be available soon.

3G LTE using 20 MHz of spectrum and MIMO has been demonstrated at 170 Mb/s and equipment is now available.

Each of these technologies uses similar technology for the shared backhaul, and typically this will be 1 Gb/s Ethernet, several 1 Gb/s Ethernet connections, or 10 Gb/s Ethernet, and in each case it will be shared.

Capacity available for a particular customer

While each of the technologies is able to offer very high speeds, the actual speed available to a particular customer depends upon the applications being used by customers, the number of active customers, and how many customers are using the various shared network elements that each technology includes. That is, it is not a simple question.

In each case the capacity available for a particular customer can be tailored by selecting the sharing of the shared elements.

For DSL the shared element is the backhaul, and the capacity per customer is managed by selecting the number of customers to be served by the DSLAM. Often the DSLAM serves 384 customers and has a 1 Gb/s Ethernet connection. If greater capacity is required per customer then either additional backhaul capacity can be added or the number of customers being served reduced.

For a GPON the capacity available to customers is managed by selecting the split ratio for the optical fibre. This is generally either 32 or 64, but fewer customers can be connected if desired.

For HFC the capacity available per customer is managed by selecting the number of customers to be served off a particular coaxial cable section. If needed, the coaxial cable can be segmented to serve fewer customers with the same capacity.

For 3G LTE, the capacity available per customer is managed by selecting the cell size. If greater capacity per customer is required the cells can be made smaller (and in the end with one cell per customer provided by a femptocell).

That is, each of the technologies is able to provide very high speeds for a customer, and in each case the shared network elements can be managed as required.

Are the various access technologies competitors?

Each of the technologies is able to provide very high speeds. The speeds possible are in each case probably higher than most customers desire (or at least desire to pay for).

The choice of technology to provide a particular customer speed is not a technology question (as they can all do it). It is rather an economic question – how much does it cost to share the shared network elements in the manner needed to provide the desired speeds.

That is: assume the technology is able to provide the speed and work out the cost. Then do the comparison.

What speed will the customer actually see?

While most of the talk is about the access network speed, that is usually not what the customer actually sees. The customer is interested in how fast the application works (and more so, it seems, in how much it costs). The application works from end to end over the connection, and the speed is usually strongly dictated by the speed and loading of the computer at the other end or by the speed the customer has purchased from the carrier. That is, it is the weakest link that matters, not the access link necessarily.

That is, despite all the hype about speed, just about always the speed at which the customer sees his applications work will be much less than is possible for just the access network segment of the connection.