In general, a signal transmitted (uplinked) on a particular polarization is received (downlinked) on the opposite polarization. The uplink and the downlink antennas have operationally adjustable polarization, but the receive and transmit antennas on the satellite are fixed.

2.7 The transmission system

As we look at the functions within a complete satellite transmission system, there are certain elements that are part of the uplink and the downlink which will be seen in principle to be common, as the signal is modulated or demodulated, amplified, and converted up or down in frequency. There are also similarities in some of the processes on board the satellite. Although the actual components vary in construction, as they are built for the environment in which they will be operating, they essentially fulfil the same functions.

Within an uplink system there are a number of processes, some of which are typically mirrored at the downlink. The uplink is primarily composed of a 'modulator', an 'upconverter' and a 'high power amplifier' (HPA), which is connected to an antenna ('dish'). This is shown in overview in Figure 2.20. Some form of monitoring of the uplinked signal would also be implemented. Additionally, for a digital system, there would be an 'encoder' – the compression device.

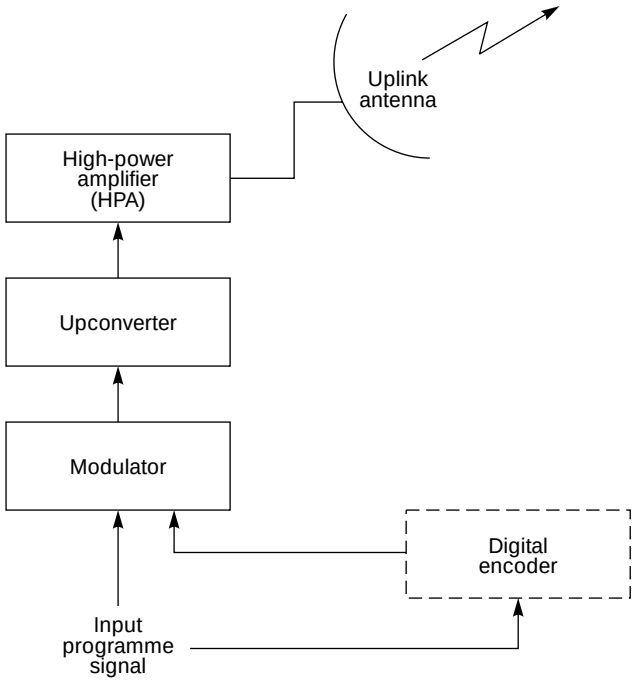
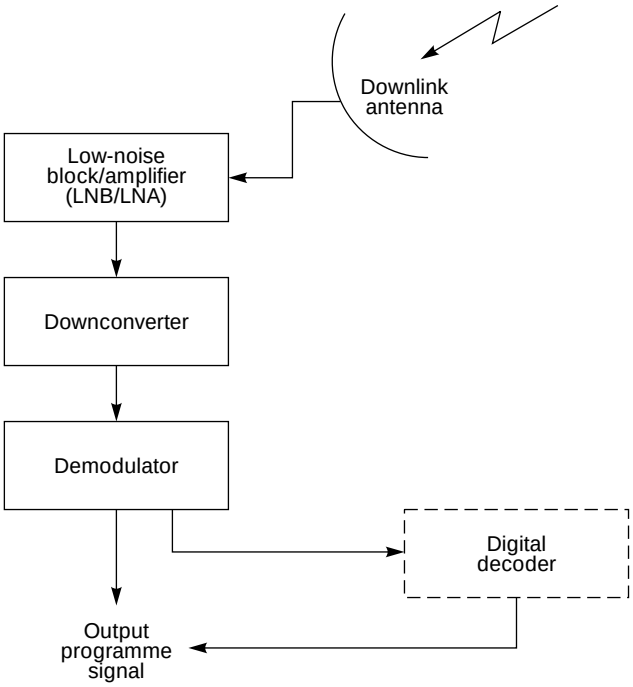


Figure 2.20 Uplink overview



(a)

(b)

Figure 2.21 (a) Simplified downlink overview. (b) BT London teleport. *(Photo courtesy of BT Broadcast Services)*

The downlink has an antenna, a 'downconverter' and a 'demodulator', and as with the uplink, additionally a 'decoder' for the digitally compressed signal. This is shown in overview in Figure 2.21a. There would also be a sophisticated monitoring system able to measure all the parameters of the received signal. Typically the downlink antenna will be significantly larger than the SNG uplink antenna (from 4–30 m in diameter) and a cluster of antennas at one location is termed a 'teleport'. National PTTs, PTOs, satellite operators, individual broadcasters and private enterprises operate teleports.

2.7.1 Delay

As we have seen earlier in the chapter, the signal path from the uplink to the satellite is approximately 35 785 km above the Earth. The signal therefore travels a 'round-trip' distance of 71 570 km, and as radio signals travel at the speed of light, this is calculated to take 238 ms if both the uplink and the downlink are on the Equator (the sub-satellite point). If either (or both) are moved away from the Equator, this delay will increase as the path length increases. The maximum delay would be 277 ms, and so the delay is generally approximated to 250 ms.

Each earth-satellite-earth path is termed a 'hop', and care has to be taken to allow for the multi-hop delay if a signal has to traverse several satellite links from the point of origination to the final destination. This delay causes unnatural pauses or hesitations if a 'live' two-way conversation is attempted, and this delay can be further exacerbated by digital coding and decoding caused by the compression process on a digital link (see Chapter 4).

2.8 The analogue uplink

As uplinks are clearly the focus of attention in this book, this section will be the most descriptive. In terms of the equipment, there is a degree of commonality between analogue and digital systems, so we will describe the typical analogue system first (and it is still widely used). Where possible, we will give some idea of the size of each of the pieces of equipment in the uplink, expressed in terms of how much space is occupied in equipment racks.

The uplink has a baseband video and audio signal as its input, and from the antenna it produces a high-power radio signal directed towards the satellite. For the purposes of describing the process, we will use a Ku-band signal as it is the more common band used for SNG. Figure 2.22 shows the analogue uplink 'chain' in more detail – note the uplink transmission chain is often referred to as a 'thread'.

2.8.1 Modulator

In an analogue signal chain, the input video and audio baseband signal is processed and then applied to a modulator. The RF carrier frequency of the modulator output is usually either at nominally 70 or 140 MHz (these are standard carrier frequencies