# Instant video streaming

## Video without the waiting

Streamed video is becoming more and more important for Internet services – now especially for mobile access and for IPTV. But video access over the Internet involves lengthy start-up delays of up to 30 seconds. Congestion often causes the picture to freeze, followed by another start-up delay (especially frequent with mobile access).

BT's patented 'Fastnets' technology avoids both the delays and the affects of congestion and, coupled with H.264 video technology, provides perhaps the fastest, highest quality streaming capability available.

Fastnets is a high-performance, network-agnostic video streaming architecture that eliminates some of the worst problems of video streaming: slow start, picture freezing on network congestion, and poor video quality. Use of Fastnets can also potentially save 30% on peak bandwidth requirement.

Fastnets has been implemented as a complete system, but is also available as component technologies that can be incorporated into existing streaming architectures.

### Player features

- Fast-start streaming: video display starts much more quickly - e.g. from 2-3 seconds for GPRS, or 0.2 seconds on a LAN.
- Faced with congestion that restricts throughput, the picture quality reduces but the video continues – drastically reducing pausing and rebuffering. This provides application-layer QoS that can work in addition to network QoS.
- Allows 30% or more saving on peak bandwidth.

- Provides fast-forward and fast-reverse in video streams without any pause, and random access into a stream.
- Includes leading-edge H.264 video coding.
- Players available for PC (Windows or Linux), Pocket PC, Symbian and other platforms.
- Suitable for bandwidths of 10Kbps to 5Mbps and beyond.
- Picture format: QCIF (176x144) to Standard Definition and beyond.
- Compact, downloadable player: the player can be downloaded as a compressed file of around 75kbytes (e.g. in a single MMS message). This can be done automatically the first time the user tries to play Fastnets content. Alternatively the player may be built-in to the phone or other terminal.
- Low server requirement: a utility (2GHz) Windows PC can stream upwards of 250 mobile video streams.
- Fastnets can be provided as a complete system, or the technology can be integrated into other streaming systems.

## How it works

The key feature of Fastnets is the patented use of SP (switching) frames to switch between multiple video streams encoded at different data rates. At any time, only one stream is transmitted. For example, consider the case of a GPRS mobile data connection, where the expected data throughput might be 30-40Kbps. One might choose an upper limit of 30Kbps for streaming, but when congestion occurs, the throughput may drop markedly, well below 30Kbps.

For Fastnets use, video is encoded into multiple streams at different data rates. For example, as well as encoding at 30Kbps (including audio), the same video is encoded at perhaps 18Kbps and 8Kbps (at lower quality and probably lower frame rate). Normally the 30Kbps stream is sent. However, if the server determines that the player is not receiving data at this rate, the server switches to the 18Kbps stream, or if necessary the 8Kbps stream. This can be done without pause or glitch in the displayed picture. If the throughput restriction is temporary, and the server detects that throughput is increasing, then it will switch back to a higher speed stream – again, without any pause in video playback.

The same feature is used to achieve a near-instant start. The server streams initially at 8Kbps (in this example), which can be displayed immediately with little or no buffering (it's not needed at this low rate). This gives surplus capacity that can be used to build up a buffer in the background, and after a few seconds, the server can switch up to the 30Kbps stream. In practice, the users rarely notice the initial reduced quality unless they are looking for it; it takes a few seconds to assess quality, by which time the quality has built up.

The figures quoted here (30, 18 and 8Kbps) are examples: the choice used depends on the application and the network bandwidth. It can vary from one video sequence to another – or even from one part of a video stream to another. The lower limit may be dictated by the content provider's choice of lowest acceptable quality. These examples are indicative for GPRS bandwidths, but similar scaling applies for larger bandwidths.

The technology applies equally to IPTV bandwidths: fast start and resilience to congestion.

## Save 30% peak bandwidth

The ability to "flex" the bandwidth has another very important benefit: it can significantly reduce the peak bandwidth needed. As IPTV services typically pay for peak bandwidth used (not average bandwidth) this can critically affect cost. For example, if the video stream is a nominal 1Mbit/s rate, the network layer QoS must be able to give an absolute guaranteed 1Mbit/s throughput. This normally means that a degree of overprovision must be used to guarantee 1 Mbit/s.

In addition, to ensure that a Constant Bit Rate (CBR) video encoded at 1Mbit/s never exceeds this figure, it may be necessary to use unacceptably long buffering in the decoder – perhaps 1 minute – or rely on short-term requirements in excess of 1Mbit/s to keep buffers full.

Fastnets can minimise the effects of these problems: the video can flex temporarily to a lower quality (and bandwidth) to avoid ever exceeding 1Mbit/s (in this example), and to avoid the decoder buffer emptying. This allows a more consistent quality, which in turn means the peak bandwidth can be reduced with confidence.

This avoids the need to over-provision bandwidth, and can save 30% on peak bandwidth requirement.

## Specifications

| Feature | BT implementation |
|---|---|
| Streaming protocol | 3GPP-compliant stream using RTP over UDP (with extensions for buffer management), or using TCP/IP (using RTSP). Will support emerging DCCP standard if suitable for streaming. |
| Video coding | H.263, H.264, MPEG-4 (or similar motion compensated transform coding) |
| Resolution | Any. Mobile handsets typically support QCIF (176x144) |
| Audio coding | AMR (others such as AAC can be provided) |

| Feature | BT implementation |
|---|---|
| User video access | By URL, SMS link, WAP link or other, as required |
| Rights Management | Various methods implemented |
| Billing | Feeds into existing customer management system |
| System requirements | Server: 500MHz P-III Windows machine or better (supports 250 streams or more from one server, multiple servers can be used)<br>Player: 52MHz ARM 9 or better<br>Encoder: 500MHz P-III Windows machine or better |
| Player size | Symbian on Nokia 3650: 175kbytes program memory and 250kbytes data memory for 5 reference frame decoding |
| Platforms supported | PC (Windows & Linux), Pocket PC on ARM-9, Symbian, TI-OMAP. Others (including other DSPs) in development. |
| Scalability | Indefinite; no architectural limits |
| Integration into customer systems | Simple APIs are provided to allow flexible integration onto existing customer systems (such at portals and billing systems) |

## H.264 video coding

Although Fastnets works with a variety of video coding schemes, it supports in particular the new standard: H.264 (also known as MPEG-4 Part 10 AVC).

Approved as a standard in May 2003, H.264 has attracted great interest in the industry by compressing video into lower bandwidth for the same quality, compared to existing video compression systems (e.g. MPEG-2 and MPEG-4, H.263 and Windows Media Player 9®).

For example, for the same picture quality, BT's H.264 can compress video to one third of the size of MPEG-2 streams. Savings of this magnitude are achieved over the whole range of bit rates from the very low bit rate mobile channels of GPRS, through ADSL and beyond.

Fastnets uses the BT implementation, which is a virtually complete implementation of this very comprehensive standard. It offers leading edge performance in terms of compression efficiency, picture quality and processor utilisation.

## Other technologies

BT is at the forefront of video research and product development, and there are many other related technologies relevant to video streaming, including automated perceptual video quality assessment, head centring, and video transcoding (conversion between different data stream speeds, resolutions or coding standards). We have products and technologies in these and many other areas.

## Further information

Further information on our video coding and quality assessment technology is available from licensing@bt.com.



BT Group

**Email: licensing@bt.com**

© British Telecommunications plc
Registered office:
81 Newgate Street, London
EC1A 7AJ
Registered in England no.
1800000
**www.bt.com**

The products and services described in this publication are subject to availability and may be modified at any time. Products and services are provided subject to British Telecommunications plc's conditions of contracts. Nothing in this publication forms any part of a contract. All third-party trademarks are hereby acknowledged.