

# 21st Century Network



## Background

If you have seen or heard the hype, you will know that over the next few years BT is planning to replace the main core of its telephone network, including the local exchanges, with a new system known simply as 21CN, short for 21st Century Network. One way or another, this will affect every installer, even if it's only the phones in their home/office. So what exactly is it?

## Some Basics

The current generation of BT telephone exchanges were designed and installed from around 1980. Speech, converted to an alternating voltage by the telephone handset, is transmitted to the local telephone exchanges where successive samples are converted to an 8 bit digital value. These samples are then transmitted over the telephone network, the destination telephone exchange converting them back to an analogue voltage for transmission to the line of the telephone being called.

The basic frequency range needed to reproduce intelligible speech at the receiver is 300Hz - 3.4 kHz. The samples are taken every 125µs (8 kHz) giving a basic 64 kbit/s for each connection. By increasing the bit rate on circuits within and between exchanges, samples from a large number of calls can be transmitted on a single circuit, the samples from a given connection still appearing in a dedicated timeslot every 125µs.

Switching the connection from one circuit or timeslot to another is simply achieved by writing successive samples from one circuit into a memory and reading them out in a different order. This introduces a delay; a typical call within the UK will be switched several times introducing a typical end-end delay of 10-20ms, although the UK National Transmission Plan allows a maximum end-end delay of 35ms. Once the call is established, the end-end delay for a particular call is then constant. This delay is imperceptible during normal voice calls.

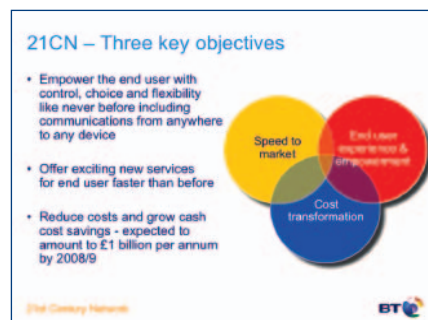
## So how is 21CN different?

The current system uses two dedicated time multiplexed slot through the network for each active connection (i.e. one in each direction). 21CN uses techniques developed for the internet, where data is transmitted in blocks (packets). Each packet contains information in a header so that the network knows where it came from, where to send it, and what type of data it contains.

In 21CN the basic sampling and conversion to 8 bit digital values remains unchanged, however these are not immediately transmitted. Successive samples are held until a number have been generated. These are then transmitted as a packet along with the necessary header information. A typical packet might contain 80 samples, representing some 10ms of speech.

When the packet arrives at the destination exchange the individual samples are then converted back to their analogue values and transmitted to the destination phone at the original sampling rate of 8 kHz. At the same time, the originating exchange will be gathering samples for the next packet. By the time the last sample from the first packet has been transmitted, the next packet should be arriving, so that the analogue signal sent to the destination phone is a delayed version of the original.

Transmission and switching the packets from the originating to the destination exchanges introduces further delays. An unwanted effect of the increased delays is that customers would be aware of an echo on voice calls. To mitigate this echo cancellation will be used for all calls, whereas it was previously only used on international calls. Whilst this does remove virtually all of the echo it also introduces a further delay. (Echo cancellation is switched out for calls from FAX machines and high speed modems as these can be detected by the network.)



The overall effect of the above is a significant increase in the end-end delay. The UK National Transmission Plan specifies that for 95% of connections this should be below 125ms with a maximum of 150ms. Again the average delay will be less than

these figures, but will still be several times that of current calls.

One further effect of 21CN is that successive packets may well have differing delays, the more intermediate nodes/exchanges the call passes through the more it is likely to vary. At each node, packets are treated on a 'store and forward' basis. If the required route to the next node/exchange is busy, packets are essentially queued, waiting their turn to be transmitted. Because each packet contains details of the intended destination it is also possible for the network to re-direct individual packets around particular bottlenecks. So in a call between Birmingham and London it is quite possible that at peak times some of the calls packets would be routed direct, whilst others might be routed via Bristol.

This variable delay can lead to discontinuities (gaps) in the signal re-constituted at the destination exchange. This would usually not be noticed in a voice call but is potentially critical when detecting tones sent across the network (e.g. Digital Communicator receivers).

## Why is BT Changing to 21CN?

In practice there are a number of reasons quoted by BT in various presentations and Web sites. These include:

- The existing exchanges are based on 25 year old technology and becoming difficult to maintain.
- BT currently has several different 'core' networks and it's difficult to manage and share the load between them. This change will result in one primary core network making it easier to manage.
- The current technology holds open one circuit in each direction for the entire duration of a call. For most calls this means that a given circuit is transmitting silence for over 50% of the time. By detecting silent periods the 21CN network will only need to transmit packets where there is speech or other tones on the line, giving a significant improvement in network utilisation.
- With 21CN local exchanges will be replaced by relatively simple concentrators known as Multi-Service Access Nodes or MSAN's (pronounced M-SAN); calls will be managed from a limited number of call control centres, making it much easier to change facilities and offer new services.



### Some Other Changes

The following changes will also occur as a result of the change to the local line cards in the exchanges.

- Existing exchanges used unbalanced ringing, that is a ringing voltage is applied to one wire of the telephone line. This loops round through the telephone(s) and returns to a fixed voltage (usually -48v) on the other wire. The line cards in the MSAN's use balanced ringing where the ringing voltage is applied between the two wires. This is technically easier to produce and also reduces interference that ringing can cause to other circuits in the same cable, especially broadband. It is possible that some equipment intended to detect ringing may not reliably detect this form of ringing.
- The maximum (dc) current available on the line will be reduced from 40mA to 25mA. This will also affect the voltage detectable at the phone. The main affect is likely to be on very old telephones that rely on the current through a carbon granule transmitter to convert the sound to an alternating voltage.

It is possible that it will also affect equipment that monitors the line voltage to detect if the phone line is in use. The simple voltage monitors used in Digi's and other security equipment should not be affected, though it's possible that the threshold voltage on some detectors may need to be adjusted.

- The MSAN's do not currently support 'Earth Calling'. With this the calling equipment connects an Earth to the phone line to indicate a call request, rather than simply 'looping' the line, and is primarily used by older PABX's to reduce the time between the end of one call and the start of another.

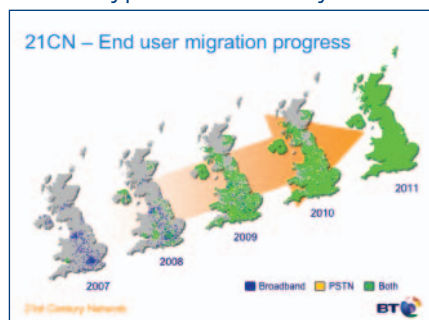
### Likely Affect on the Security Industry?

At present BT, security manufacturers and other interested organisation are working to test the security products currently on the market to assess the likely effect of the changes. It is too early to give any details, but the following are likely to be the more significant issues.

- The main effect of the changes will be felt by digital communicators and other transmission devices that use tone signalling to transmit data (e.g. Social Alarms). It is likely to affect particular digi/receiver combinations and the effect will vary depending on the network loading at the time of the call
  - As a result of the end-end delay some digi's may time out the acknowledgement from the receiver and prematurely start to re-transmit the data and/or clear the call and restart. As a minimum this would result in delayed alarm transmission and increased utilisation of lines and receivers at the Alarm Receiving Centre. In some cases the calls will fail.
  - The discontinuities in the transmission could result in tones not being recognised. Again this will lead to repeat transmission/repeated calls.
  - The change to balanced ringing may affect some digi receivers and other security equipment intended to detect incoming calls.



### Other Types of Security



### Transmission

Whilst the main and most obvious systems affected will be digital communicator systems, its worth noting that other systems may be affected. In particular:

- Systems using higher speed modems may have problems due to the data discontinuities. In most cases it can be expected that the data protocol will handle this, although data transmission may take longer.
- Systems where the primary transmission route is over a private network using dial-backup may suffer to the extent that they effectively lose the backup facility.

### So What Should Installers Be Doing?

The main thing for installers at present is to be aware that the changes will be happening and to keep up to date with the latest information.

Whilst implementation dates have been changing, check and periodically monitor the likely changeover dates for areas in which you install and/or use an ARC.

It is a good idea during your system maintenance visits to check/record the make, model and firmware level of all/any transmission devices. At least that way, if there is a need to upgrade equipment or firmware for some transmitters, you will already know how many of your systems are affected and where they are.

UK manufacturers are working with BT, testing various combinations of equipment to identify any problems and their solutions. Keep an eye out for announcements of 21CN compatible transmitters - though check that any testing uses the same receivers as your ARC.

### Additional Information

- General information about 21CN can be found at:

[www.btplc.com/21cn](http://www.btplc.com/21cn)

- Information about 21CN and migration can be found at:

[www.switchedonuk.org](http://www.switchedonuk.org)

This site includes options to check the likely changeover dates of individual phone lines (as a 3 month period).