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Overview of Alarm Issue Observed on Original 21CN Voice Trial

Technical Note

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Overview of Alarm Issue Observed on Original 21CN Voice Trial

1. Introduction

Both BT's existing network, and its 21CN network comply with the UK national transmission plan. The aim of the guidelines contained in the UK national transmission plan is to ensure that total end to end round trip delay does not exceed 300ms. Customer premises apparatus should be able to function with end to end round trip delays of up to 300ms, as specified in the Plan, so as to ensure they function properly under network conditions likely to be encountered in the UK.

A previous voice trial carried out at the end of 2005 by BT, preliminary to migration to its 21st Century Network, revealed certain alarm communicators which are sensitive to delays that are less than the 300ms round trip delay specified in the UK national transmission plan. A single older alarm communicator was found to fail to communicate properly with a particular alarm receiver when subjected to marginally increased delay over the voice trial network. This technical note is a brief overview of the results gained from the testing of network delays on certain alarm communicators, in respect of the issues found on the original 21CN voice trial.

This technical note deals purely with the technical results of these tests. The voice trial and the tests described in this note are part of a wider programme of tests and trials which BT is conducting as part of its preparation for 21CN migration. Further information about this programme, and how BT is working with customers to minimise any impacts from migration is available from BT.

It is important to note that so far only a single unit has been found to fail due to the increased delay caused by 21CN. The issue of alarm communicators failing due to increased end to end delay is not a UK only issue and can also be caused by other call routing scenarios such as the use Carrier Pre-Select.

2. Increased round trip delay

Increased round trip delay may result in the Kissoff from the central station returning to the transmitter too late to prevent it from trying a second transmission. The second transmission arriving at the central station then gets garbled by the outgoing Kissoff resulting in an error at the central station rather than correct recognition of the alarm. This is the issue which has been observed and investigated so far. This occurs despite the first transmission being correctly received by the central station, so it could be considered a software issue of not having appropriate timing in the alarm transmitter and central station receivers. That is not to say it can be easily fixed however. We should assume that only half duplex operation is generally possible which means that equipment timings need to ensure no clashes between transmit and receive occur at either end given worst case round trip delays. This cannot easily be guaranteed, except by slowing everything down to accommodate

worst case delays. Alarm transmitters and receivers do not normally provide the means to do this, though it might be possible by firmware changes in some cases.

Figure 1 shows examples of successful and failed calls captured in the previous investigation. A successful call is shown in the top diagram of Figure 1. Data was captured at the customer premises (alarm communicator), so the high amplitude (green) signals are from the CPE, and the low amplitude (blue) signals from the central station receiver. The receiver answers the call with a dual-tone handshake signal, after which the communicator sends a string of 13 DTMF tones identifying itself to the receiver. This digit string is repeated as an error check and if the receiver identifies both digit strings as being the same it issues a 1400 Hz kiss-off tone to acknowledge receipt and clear down the call.

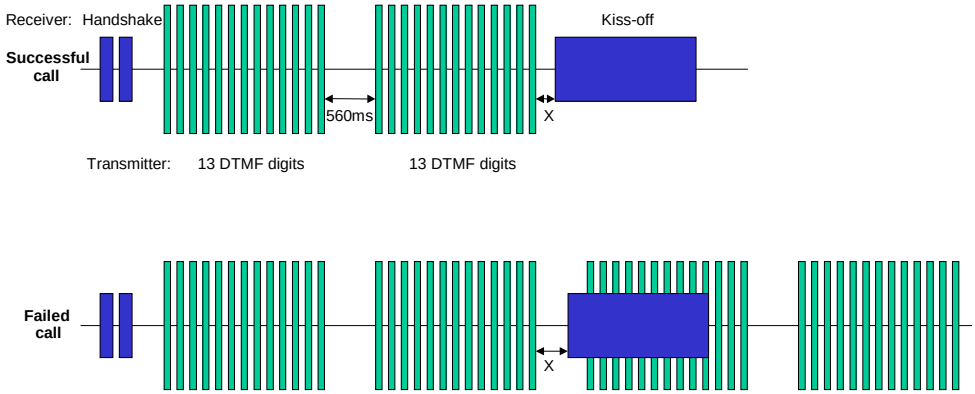


Fig 1. Successful and Unsuccessful Call Traces (Transmitter End)

A failed call is shown in the lower diagram. In this case the receiver receives the first two sets of digit strings and issues its kiss-off tone, but for some reason the customer's alarm transmitter fails to detect the kiss-off tone and so repeats the digit strings a further two times before clearing down. The result of receiving the additional digit strings causes the receiver to report a "Fast Format Error". This is probably because the third digit string is partially masked by the kiss-off tone, which is at a much higher level at the receiver than the digit string.

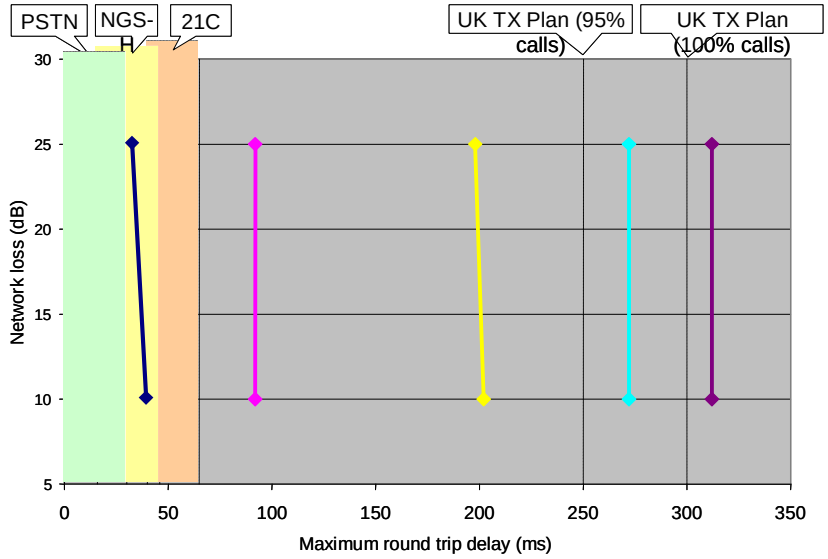
Increased round trip delay resulted in the CPE starting its second transmission attempt before recognising the kissoff relating to the first transmission sent from the central station. At the central station receiver, the second DTMF transmission arrival overlapped with the outgoing Kissoff (for the first reception). It appears the central station receiver was not able to receive the DTMF re-transmission in the presence of its outgoing Kissoff, so indicated an error. Theoretically, it should be possible for it to receive DTMF in the presence of its outgoing Kissoff, but from the above details it is not surprising that it fails. Therefore, as noted above, we should assume such half duplex operation for

DTMF, and the majority of the other alarm communication methods also appear to be half duplex. This means that round trip and equipment timings need to ensure no clashes between transmit and receive occur at either end. This is cannot easily be guaranteed, except by slowing everything down to accommodate worst case delays and this will usually need changes to software timers in the equipment at both ends.

The previous investigation quantified the delay issues for five different models of customer transmitters and two central station receivers. These results are summarized in Figure 2.

THE GRAPH SHOWS THE LIMIT OF RELIABLE WORKING FOR EACH OF THE DIGITAL COMMUNICATORS AS A FUNCTION OF ROUND-TRIP NETWORK DELAY AND OVERALL END TO END NETWORK LOSS. IT ALSO SHOWS THE TYPICAL ROUND-TRIP DELAYS EXPECTED FROM DIFFERENT NETWORKS AND THOSE ALLOWED BY THE UK TRANSMISSION PLAN. .

Fig 2. Performance of different Digital Communicators with network delay and loss



3. Conclusions

- 21CN is compliant to UK Transmission Plan, as is the existing PSTN
- Existing call routing can already increase e2e delay (e.g. carrier pre-select, number portability, mobile).
- For calls entirely on the 21CN Voice Trial, only one out of the five customer alarm transmitters investigated appeared likely to have a problem. The unit appears to be already very close to the limit for reliability on the present PSTN and is likely to have a problem at present if routed over another network, for example by the use of Carrier Pre-Select.
- For call delays at the limit of the UK transmission plan, four out of the five customer alarm transmitters investigated would experience a problem. Such calls would imply routing over other networks in addition to the 21CN and the majority of the extra delay comes from such routing (i.e. the contribution of the 21CN is quite a small part of the total). Some of the newer equipment probably tolerates longer delays because it is also designed for reporting over the cellular network.
- The central station receivers contribute significantly to the overall round trip delay as experienced by the alarm transmitter. This is something the alarm industry might be able to address: it forms a substantial part of the overall delay budget, there are relatively few receivers and they are located at the central stations.
- Relevant security industry players will need to proactively check whether the equipment that their customers use is able to cope with end to end delays as defined in the UK Transmission Plan.

Deleted: <#>There may be additional CPE that can be too delay sensitive to cope with increased end to end delay, whether caused by 21CN, Carrier Pre-Select routing, or other types of call routing. Any CPE / application that makes a PSTN call and transfers information, but fails to allow for sufficient end to end delay, may fail to operate correctly.¶

End of Note