



**DYNAMIC LINE MANAGEMENT
WORKSHOP PROPOSAL**

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**Talk Talk Technology
Northbank House
Siemens Road
Northbank Industrial Park
Irlam
Manchester
M44 5AH**

**Tel : +44 (0) 845 330 5005
Fax : +44 (0) 845 330 5008**

1 COMPANY BACKGROUND

Talk Talk Technology is the technology division for Talk Talk Group, providing voice and broadband services to 4.1m customer in the UK through a number of brands, including Talk Talk, AOL and Opal. Last year Talk Talk acquired Tiscali, making Talk Talk the second largest UK ISP.

Talk Talk has the largest next generation network in the UK and is the also largest LLU (local loop unbundler) in the UK, with broadband and voice equipment in 1750 exchanges around the UK.

2 TECHNOLOGY BACKGROUND

The majority of broadband services are provided over ADSL which utilises existing copper telephone lines to customers' homes to provide broadband services. Routers in customers' homes connect to Talk Talk equipment located in exchanges using ADSL signalling.

The copper lines were only designed for voice signals, operating in the 0-4kHz frequency range. Using low frequency filters in the home and exchange, ADSL signals extend the use of the copper, carrying signals in the frequency range 25kHz to 2.208MHz. The broadband frequency space is dividing into up to 512 separate equally sized frequency 'tones' (of about 4kHz size). A smaller number of lower frequency tones are reserved for upstream (from the home) traffic, with the majority of tones allocated to downstream.

Symbols are passed as fixed duration signals with the amplitude and phase representing a bit pattern of up to 15 bits. Noise interferes with the signal and affects the number of bits that can be carried per tone. Longer lines see significant attenuation with higher frequencies suffering worse attenuation, so that for longer lines many of the higher frequency tones cannot carry any information at all.

Because the copper lines weren't designed for broadband usage, ADSL has to cope with a variety of different sources of interference, including:

- RF noise from amateur radio and MW radio;
- Crosstalk between phone lines;
- Impulse noise (such as immersion heaters);
- Poor cabling in the home;
- Poor cabling outside the home (including bad joints, waterlogged cables and tapped cables).
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ADSL is designed to mitigate the effects of this interference with a number of error correction techniques built in.

3 DYNAMIC LINE MANAGEMENT (DLM)

Whilst ADSL supports error correction, these have an impact on the performance of the line. There are therefore a number of parameters that can be specified to tune how ADSL operates. A set of profiles are constructed that define particular combinations of these parameters. By selecting the appropriate profile for a particular line a balance can be made between getting the fastest line and providing a stable customer experience.

Using Dynamic Line Management data is collected from a customer's line, analysed and changes made to move the customer to a more appropriate profile. The approach is typically iterative, so that a number of profile changes are made before the customer's line is fully optimised.

Measurement data is limited and can sometimes be of poor quality. The following data is typically available from the exchange equipment:

- Signal attenuation
- Data Error measures
- Actual line speed

- Theoretical maximum attainable speed
- Numbers of synchronisation events (the number of times that the customer's router has had to re-synchronise the connection)
- Resistance (*)
- Capacitance (*)
- An estimate of line length (*)

Prior to taking a new customer onboard, we provide an estimate on their likely line speed. This is an important part of the sale that we need to be as accurate with as possible. Broadband speeds have been the subject of much consumer and Ofcom interest. One of the challenges with providing accurate speed estimates is that at the pre-sales stage only the asterisked data is available. Currently the line length is used to determine the likely speed, but we know that there are quality issues with the line length data we receive.

4 AREAS OF INTEREST

Talk Talk Technology has an ongoing programme of work on DLM, looking to improve customer experience and the efficiency of the DLM process. For the purposes of this workshop, the following questions are proposed:

- Can a better estimate of speed against line length, resistance and capacitance be made?
- Is it possible to systematically identify the errors in supplied parameters (e.g. line length)?
- Can we distinguish between lines on the wrong profile and faulty lines?