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LLU – A JANET access technology?

By
Barry Forde
B.Forde@Lancaster.ac.uk

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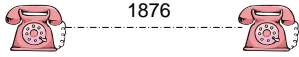
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Telephony



Graham Alexander Bell (1847 -1922)

1876



Uses copper cable to carry analogue signal (300Hz-3.4KHz)

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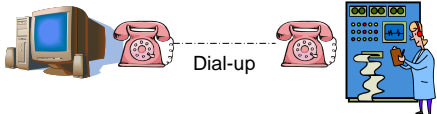
Local Loop

- Telephones connected to exchange by copper pair
- This is the local loop
- BT call it a Metallic Path Facility – MPF
- ~28 million phone lines are connected via
- ~80,000 street cabinets to
- ~5800 Telephone exchanges

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First Generation data



Dial-up

Use MODEM (**MO**dulator **DEM**odulator to put data on phone lines


1979	300 Baud	V21	0.3Kbs
1994	28800 Baud	V34	28.8Kbs
1999	56000 Baud	V90	56.0Kbs

56Kbs about physical limit of telephone network

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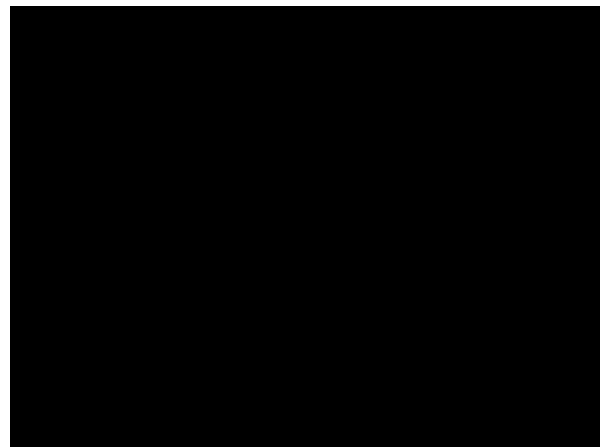
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Low Bit Rate Video



~350Kbs YouTube clip

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MPF Capacity



Shannon's theory defines the upper limit for data capacity

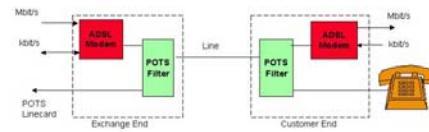
$$C = B \log_2(1+SNR)$$

Where B is the bandwidth and SNR is the signal to noise ratio

Typical telephone line has potential bandwidth up to around 30MHz
BUT
Voice needs only limited data capacity so bandwidth capped at 4KHz
Using low pass filter, rest of spectrum thrown away!

But the rest of the spectrum could be used
if we are able to access the copper pair at the exchange

POTS Splitters/Filters

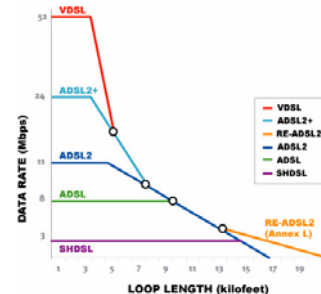


xDSL over MPF



- G992.1 ADSL2
 - up to 12Mbps/768Kbps (up to 1.1MHz)
 - Old technology and not of much interest anymore
- G992.5 ADSL2+
 - up to 24Mbps/1.5Mbps (up to 2.2MHz)
 - BT moving to this under 21CN programme
- G993.2 VDSL2
 - up to 200Mbps (up to 30MHz)
- G991.2 (G.SHDSL.bis) EFM
 - Up to 5.6Mbps
- ANFP
 - Access Network Frequency Plan
 - PSD Mask (Power Spectrum Density)

xDSL Ranges



Connecting a user



- SMPF
 - Order this if your user has a BT phone line and you just want the data portion of the circuit.
 - You can run ADSL2+ and VDSL2 but not SDSL or EFM
 - The phone portion is returned to BT after being separated from the data part by the splitter
- MPF
 - This is a new private line dedicated to your use only.
 - Can be used for ADSL but more commonly used where SDSL/EFM is required.

LLU Prices



Current Costs	Handover	Annual
Shared MPF Transfer	£34.86	£15.60
MPF New Provide	£99.95	£81.69 wef 1/8/08

Cost for 10Mbs symmetrical



- Using G992.1 (EFM)
- 5.6Mbs/pair to about 1.5Km
 - Bond two pairs (MPF not SMPF) to get 10Mbs
 - Install =£199.90, annual rental=£163.38
- 2.8Mbs/pair to about 2.5-3Km
 - Bond four pairs (MPF not SMPF) to get 10Mbs
 - Install = £399.80, annual rental=£326.76
- Using WES10
 - Same serving exchange
 - Install = £1950, annual rental=£4200
- Using WES10-Local Access
 - Presence in exchange same as LLU model
 - Install = £1950, annual rental = £2650

Access to Exchange



- Used to need to be on OFCOM's Annex II list
- Since July 03 this changed to a general authorisation scheme.
- See OFCOM's site for details
 - http://www.ofcom.org.uk/telecoms/oi/g_a_regime/
- Next need to enter into LLU contract with BT.
 - <http://www.openreach.co.uk/org/products/llu/signup/signup.do>
- Once that's done you can start the LLU process

Exchange Space/Equipment



- Several options
 - ASS600 typically 3 RUs of space
 - MCU2 is fixed at 2RUs
 - MCU1 is fixed at 1RU
 - LCU is 27U of space within a BT rack
 - B-BUS3, B-BUS7
 - UBASE
 - Each has different limits on both space and number of MPFs that can be delivered
- Need to make decisions on amount of mains power and is it metered, air-conditioning, number of MPF pairs, etc.
- MPFs are delivered via tie cables from the BT handover frame to your termination blocks in the LLU's rack space.
- Tie cables come in 100pair units.
- You get magnetic swipe cards and PIN numbers to give you 24 hour access to the exchanges.
- For pricing of everything see <http://www.openreach.co.uk/org/pricing/loadProductPrices.do?data=%2B55xT91%2FPruY0Pxy4HVnq51m6Ock2301sgolk8P2FdialKKEPfrCsJCb3s2kzj>

LLU exchange costs



- A typical ASS600 or MCU2 deployment will cost
- ~£15K-£20K to setup
- ~£2.5-£3K per annum plus electricity used.
 - Based on 2RU
 - 2Kw max power feed
 - 1Kw actual power (plus air-con and standby for 1Kw)
 - 2x100Pair tie cables
- To this you need to add the cost of your own equipment (ADSL2+, EFM, SHDSL) and backhaul

Backhaul



- BT BES (Backhaul Extension Services)
 - 100Mbs install = £1950, rental = £3660 pa
 - 1Gbs install = £3995, rental = £9730.50 pa
 - Also in both cases add 40p per metre/pa times the radial distance between the two exchanges.
 - 5Km distance adds £2K/pa for either 100 or 1000Mbs
- BT EBD (Ethernet backhaul direct)
 - Uses CWDM to carry BES service across BT fibre network
 - No distance component to cost
 - But very few exchanges are EBD available
- Cablelink
 - Fibre from LLU space to chamber outside exchange where you bring your own fibre for interconnecting

Access Locate



- LLU Contract – RAN
 - Only permits MPFs termination in LLU space
 - NOT fibre products such as WES
- Access Locate
 - Separate contract
 - Small cost - £220/site
 - Allows WES circuits to be terminated in same rack
- WESxxx-Local Access
 - Single ended circuit so lower cost
 - WES100 capex=£1950, opex=£4600
 - WES100-LA capex=£1950, opex=£2650

Aggregation



- LLU MPF
 - ADSL2+
 - Lowest cost, up to around 10-12Mbps out to 3-4Km (conservative?)
 - OK for small sites just browsing internet
 - G992.1 EFM
 - Bit more expensive but symmetrical
 - Up to ~10Mbps out to 3-4Km
 - Substitute for 10Mbps LES/WES service
- LLU Access Locate
 - WES100-LA
 - More expensive again but now 100Mbps
 - Range out to 25Km
 - Completes portfolio
- Single Backhaul used by all above services

Modelling



- Complex
- Case studies commissioned by JANET
- What is the breakeven point?
- How many sites and at what speed
- What backhaul options?
- LLU Project will take one MAN region and identify potential connection sites and costs
- Maybe, if justified, look at trial LLU

LLU Project



- Started 1st February 2009
- Project group
- JANET.UK
 - Rina Samani, Mark O'Leary and Don Bishop
- KPSN (Kent Public Service Network)
 - Peter Banbury and Gavin Hutchinson
- Lancaster University
 - Barry Forde and Nick Race
- YHGfL (Yorkshire and Humberside Grid for Learning)
 - Clive Moore and Richard Cook
- End date for project 31st January 2010

Professor Barry Forde

InfoLab21
South Drive
Lancaster University
Lancaster UK, LA1 4WA
Tel:01524 510119
B.Forde@Lancaster.ac.uk

