COMP312-09A
Communications and Systems Software

ADSL

Richard Nelson
richardn@cs.waikato.ac.nz

Lecture Topics

- ADSL – customer access
- DSLAM
- MDF
- LLU

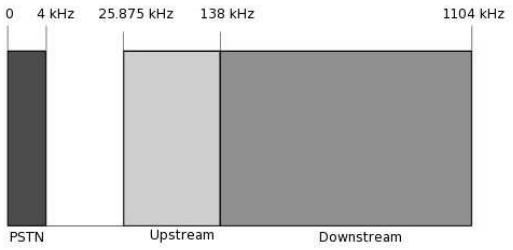
ADSL

- Asymmetric Digital Subscriber Line
- Core idea: utilises existing copper used for the phone network
- Voice signals in 4kHz; most copper is capable of transmitting more than this across a short distance
  - Divide the copper into frequencies used for voice and frequencies used for data via splitter
- Use different frequencies for different directions
  - Full duplex service

ADSL

- ADSL splitter portions off frequencies lying between 25.875 khz and 1104 kHz
  - Upstream 25.875 kHz to 138 kHz
  - Downstream 138 kHz to 1104 kHz
  - Asymmetric

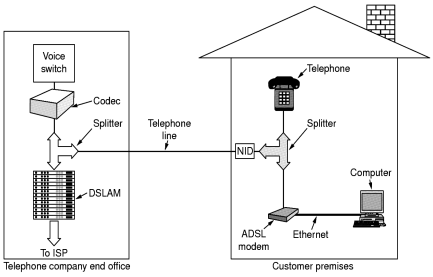
ADSL Spectrum Plan



Asymmetric

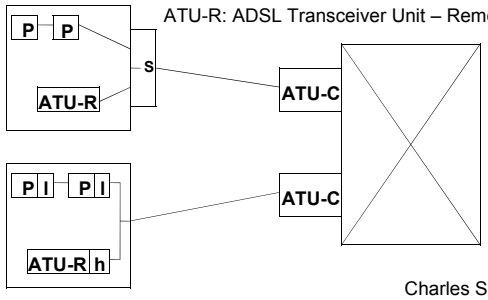
- Technical
  - Cross talk occurs most at the exchange end of a line where it is part of a large bundle
  - Downstream signal is strongest at this end so has greatest SNR
- Service
  - HTTP involves small upstream requests and large downstream responses
- Economic
  - Business require symmetric connection but can afford a more expensive service

ADSL Wiring



ADSL filters

ATU-C: ADSL Transceiver Unit – Central Office
ATU-R: ADSL Transceiver Unit – Remote

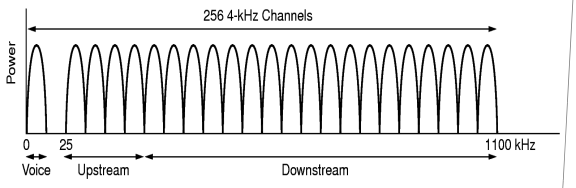


Charles Summers, ADSL Standards, Implementation, and Architecture Figure 2.10

ADSL Channels

- Divided into channels of 4.3125 kHz
- Noise and receiver signal power varies channel by channel in an unpredictable manner
- ADSL modems test each channel to measure SNR
- Can select appropriate modulation for each channel
- Sum of all channels is *sync rate*
- Actual throughput is less due to protocol overhead
  - 84-87% for PPPoA

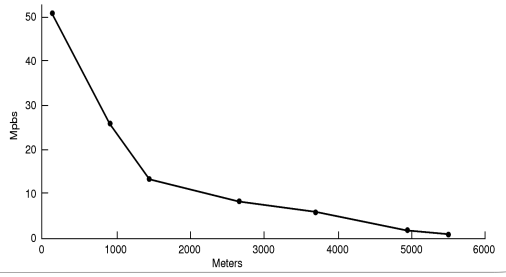
ADSL Channels



ADSL Performance

- ADSL sync rate will depend on
  - Distance from exchange
  - Environmental noice
  - Crosstalk
  - Quality of copper wire in ground
  - Quality of premises wiring
  - Loading coils and surge protectors
  - Chosen BER rate for given SNR
  - Version of ADSL standard

Copper Bandwidth vs Distance (Typical)



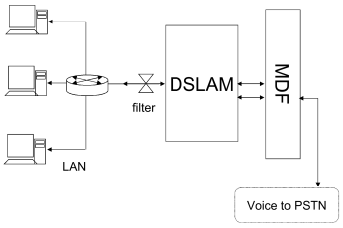
ADSL Standards

Standard name	Common name	Downstream rate	Upstream rate	Approved in
ANSI T1.413-1998 Issue 2	ADSL	8 Mbit/s	1.0 Mbit/s	1998
ITU G.992.1	ADSL (G.DMT)	12 Mbit/s	1.3 Mbit/s	1999-07
ITU G.992.1 Annex A	ADSL over POTS	12 Mbit/s	1.3 MBit/s	
ITU G.992.1 Annex B	ADSL over ISDN	12 Mbit/s	1.8 MBit/s	
ITU G.992.2	ADSL Lite (G.Lite)	1.5 Mbit/s	0.5 Mbit/s	1999-07
ITU G.992.3	ADSL2	12 Mbit/s	1.0 Mbit/s	2002-07
ITU G.992.3 Annex J	ADSL2	12 Mbit/s	3.5 Mbit/s	
ITU G.992.3 Annex L	RE-ADSL2	5 Mbit/s	0.8 Mbit/s	
ITU G.992.4	splitterless ADSL2	1.5 Mbit/s	0.5 Mbit/s	2002-07
ITU G.992.5	ADSL2+	24 Mbit/s	1.0 Mbit/s	2003-05
ITU G.992.5 Annex M	ADSL2+M	24 Mbit/s	3.5 Mbit/s	

ADSL Infrastructure

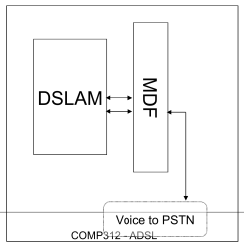
- ADSL has been the largest scale fixed data networking system to date
- It has been cheap to implement because existing copper in the ground has been re-used.
- It has required changes at the exchange end.
- Potentially tens of thousands of customers can be supported at an exchange.

ADSL Infrastructure



Central Office

- Large building that holds telephone switch equipment, DSLAM, etc.
  - e.g. Big White Building on Galloway St.



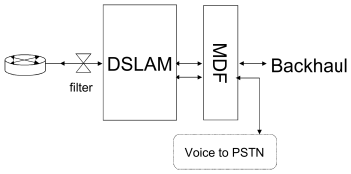
MDF

- Main Distribution Frame
  - Copper Aggregation point
  - Terminates local-loop

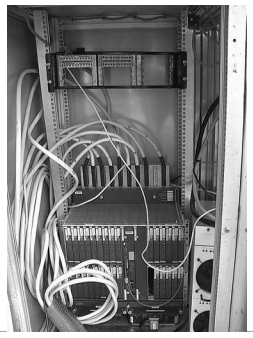
MDF

DSLAM

- Digital Subscriber Line Access Multiplexer
  - Houses a large number of DSL modems



CO DSLAM



Mini-DSLAM

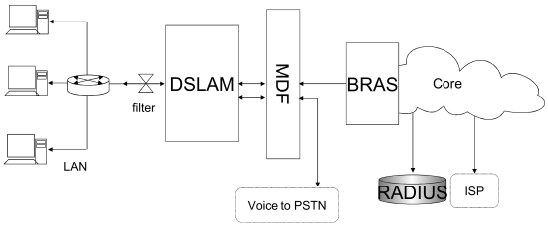
- Installed in a roadside cabinet
  - Low power devices, strict heat requirements
- A unit that is situated closer to customers who are too far away to get DSL service via telco's central office
  - Backhaul to central office.

Mini DSLAM

Network Backend

- DSL customers want to connect to the Internet.
  - Network configuration
  - Security
  - Accounting
  - Internet connectivity
  - QoS

DSL connection



Local Loop Unbundling (LLU)

- LLU allows an ISP to place their own equipment in an exchange and provide their own data services over the local-loop copper.
  - They are responsible for backhauling their services
- NZ went further than most with LLU
  - 'Naked DSL' – allows for the exclusive use of the copper

Cabinetisation

- Move DSL equipment to roadside cabinets
- Improves connection speed by reducing copper line length
- Backhaul to exchanges over fibre optic cables
  - Fibre to the Curb (FTTC)
- Associated upgrades
  - ADSL2+
  - Ethernet backhaul
- See www.chorus.co.nz