EMERGING TECHNOLOGIES II:
“THE LAST MILE”
(xDSL / CABLE MODEMS)
THE DIGITAL “LAST MILE”

- CHALLENGES
  - EXPENSIVE
  - DISRUPTIVE

- APPROACHES
  - “JUST DO IT” (FIBER TO THE HOME)
  - “USE EXISTING” (TELEPHONE, CABLE)
  - “BYPASS” (RADIO, SATELLITE)
56K MODEMS

- ONLY ONE ANALOG-TO-DIGITAL CONVERSION (ADC)
- ASYMMETRIC (56K “downstream”, 33.3K or less “upstream”)
- NOT GUARANTEED 56K SPEED (OFTEN 40-60% LESS)
## EMERGING REMOTE ACCESS TECHNOLOGIES

<table>
<thead>
<tr>
<th>Voice/Data</th>
<th>Media</th>
<th>Speed</th>
<th>Traffic Flow</th>
<th>Connection</th>
<th>Availability</th>
<th>Distance Limitation</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADSL</td>
<td>Data</td>
<td>Copper pair</td>
<td>T1 to 9 Mbit/s downstream, 16- to 640 Kbit/s upstream</td>
<td>Asymmetric</td>
<td>Point-to-point</td>
<td>Limited</td>
<td>18,000 feet</td>
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<tr>
<td>Cable modem</td>
<td>Data</td>
<td>Coaxial cable</td>
<td>500 Kbit/s to 30 Mbits downstream, 640 Kbit/s to 15 Mbit/s upstream</td>
<td>Both</td>
<td>Point-to-point</td>
<td>Limited</td>
<td>None²</td>
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<tr>
<td>HDSL</td>
<td>Data</td>
<td>Copper pair</td>
<td>384 Kbit/s to T1</td>
<td>Symmetric</td>
<td>Point-to-point</td>
<td>Limited</td>
<td>12,000 feet</td>
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<tr>
<td>ISDN</td>
<td>Both</td>
<td>Copper pair</td>
<td>128 kbit/s</td>
<td>Symmetric</td>
<td>Switched</td>
<td>Nationwide (though not everywhere)</td>
<td>18,000 feet</td>
</tr>
</tbody>
</table>

1 From central office or head-end
2 Customer must have cable service
ADSL = Asymmetric digital subscriber line, HDSL = High-speed digital subscriber line, T1 = 1.544 M
CABLE MODEMS

- HOW SIMILAR TO AND DIFFER FROM ETHERNET
  - IMPACT ON PERFORMANCE / PRIVACY
- WHY ASYMMETRIC (NORMALLY)
- DIRECTION OPTIONS:
  - NO UPSTREAM (UNI-DIRECTION)
  - LIMITED UPSTREAM (ASYMMETRIC)
  - SYMMETRIC
- ROLE OF SATELLITE TV AND TELCO’s
**xDPL MODEMS**

- **DSL = DIGITAL SUBSCRIBER LINE**

**POTS SPLITTER**

**POTS MERGER**

**DATA NETWORK**

**VOICE NETWORK**

**LOCAL OFFICE**

**DATA SOURCE**

**PHONE**

**VOICE SOURCE**

**PHONE**

**xDPL MODEM**

- USES UNUSED PHONE LINE CAPACITY -- VARIOUS ENCODING TECHNIQUES
- DISTANCE KEPT SHORT -- TRADE-OFF: DISTANCE VS. SPEED
- CAN BE SYMMETRIC OR ASYMMETRIC (e.g., ADSL)
- WHAT ARE REASONS FOR DELAY IN DEPLOYMENT?
TYPES OF DSL TECHNOLOGIES

• **ADSL**: ASYMMETRIC DSL

• **R-ADSL**: RATE ADAPTIVE DSL
  – ADJUSTS DYNAMICALLY TO LINE LENGTH AND QUALITY

• **ADSL LITE** (Bell Atlantic, Microsoft)
  – SLOWER SPEED AND WITHOUT POTS SPLITTER
  – LARGER DISTANCES AND SIMPLIFY INSTALLATION

• **HDSL**: HIGH BIT RATE DSL
  – SYMMETRIC AND HIGH SPEED (T1)
  – SHORTER DISTANCES AND MULTIPLE WIRE PAIRS

• **SDSL**: SINGLE LINE DSL
  – USES SINGLE WIRE PAIR AND SHORTER DISTANCES

• **VDSL**: VERY HIGH BIT-RATE DSL
  – ASYMMETRIC AND FASTEST (13-52M DOWN, 1.5-2.3M UP)
  – SHORTEST DISTANCE (1000-4500 FEET)
APPLICATIONS (with differing needs)

- Internet / Intranet Access
- Web browsing vs hosting
- E-mail
- Remote LAN
- Video conferencing
- Transaction processing
- IP telephony
- Call center services
- Video telephony (video conference)
- High-definition TV
- Video-on-demand
- Leased line backup