Cellular and Cordless Radio Technologies

• First generation technologies
• Second generation technologies
• Third generation technologies (future concepts)
Wireless Personal Communications

- Cellular
- Cordless
- Paging
- Wide area wireless data
- Wireless LAN’s
- Satellite
Wireless applications

<table>
<thead>
<tr>
<th>Office</th>
<th>Residential</th>
<th>Public CTM</th>
<th>Public RLL</th>
<th>Terrestrial Mobile</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAN</td>
<td>PBX</td>
<td></td>
<td></td>
<td>voice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Analog</td>
<td>analog</td>
<td>data</td>
</tr>
<tr>
<td>Wireless LAN</td>
<td>Analog cordless</td>
<td>cellular</td>
<td>wide area wireless data</td>
<td></td>
</tr>
</tbody>
</table>

Digital cordless

Paging

Digital cellular
First generation analog *cellular* technologies

**Systems**
- AMPS
- NMT
- TACS
- NTT
- ...

**Characteristics**
- analog FM speech
- FSK signalling
- FDMA/FDD
- cell sizes 0.5-10 km
- mobile power 1W-8W
- frequency reuse
- handover
First generation analog cordless technologies

**Systems**
- US cordless
- MPT1322 ("CT0")
- CEPT/CT1
- NTT
- ...

**Characteristics**
- analog FM speech
- FSK signalling
- FDMA / FDD
- mainly residential
- low power (<<1W)
First generation cordless/cellular technology positioning

Data rate (kbit/s)

100 m 1000 m 10 km

Cell size

Analog Cordless
Analog Cellular
Second generation
digital cellular technologies

• GSM-type
• GSM (Europe, TDMA)
• DCS 1800 (Europe, similar to GSM)
• PCS 1800 (US)
• Digital AMPS: IS-54 in US (TDMA)
• Cellular CDMA: IS-95 in US
• PDC (Japan, TDMA)
<table>
<thead>
<tr>
<th>Where</th>
<th>GSM</th>
<th>DCS1800</th>
<th>IS54</th>
<th>IS95</th>
<th>PDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe, Australia, Asia</td>
<td>Europe, Australia, Asia</td>
<td>UK, Germany</td>
<td>US</td>
<td>US</td>
<td>Japan</td>
</tr>
<tr>
<td>Multiple Access</td>
<td>TDMA</td>
<td>TDMA</td>
<td>TDMA</td>
<td>CDMA</td>
<td>TDMA</td>
</tr>
<tr>
<td>Frequency band (MHz)</td>
<td>890-915</td>
<td>1710-1785</td>
<td>824-849</td>
<td>824-849</td>
<td>810-826</td>
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<tr>
<td></td>
<td>935-960</td>
<td>1805-1880</td>
<td>869-894</td>
<td>869-894</td>
<td>1429-1453</td>
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<tr>
<td></td>
<td>1477-1501</td>
<td>824-849</td>
<td>1477-1501</td>
<td>869-894</td>
<td>25 kHz</td>
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<tr>
<td>Modulation</td>
<td>GMSK</td>
<td>GMSK</td>
<td>$\pi/4$ DQPSK</td>
<td>BPSK/ QPSK</td>
<td>$\pi/4$ DQPSK</td>
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<tr>
<td>RF carrier spacing</td>
<td>200 kHz</td>
<td>200 kHz</td>
<td>30 kHz</td>
<td>1250 kHz</td>
<td>25 kHz</td>
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<tr>
<td>Channel bit rate kbit/s</td>
<td>270.833</td>
<td>270.833</td>
<td>48.6</td>
<td>1288/9.6</td>
<td>42 kbit/s</td>
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<tr>
<td>Speech channels/carrier</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>?</td>
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</tbody>
</table>
Second generation
digital cordless technologies

- CT2 (FDMA/TDD)
- CT2+ (CT2 + mobility)
- DECT (TDMA/TDD; Europe)
- PHS (TDMA/TDD; Japan)
- PACS (TDMA/FDD; US)
- ISM band digital cordless
Second generation digital cordless technologies

<table>
<thead>
<tr>
<th></th>
<th>CT2</th>
<th>CT2+</th>
<th>DECT</th>
<th>PHS</th>
<th>PACS</th>
</tr>
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<tbody>
<tr>
<td>Region</td>
<td>Europe</td>
<td>Canada</td>
<td>Europe</td>
<td>Japan</td>
<td>US</td>
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<tr>
<td>Duplexing</td>
<td>TDD</td>
<td>TDD</td>
<td>TDD</td>
<td>TDD</td>
<td>FDD</td>
</tr>
<tr>
<td>Frequency band</td>
<td>864-868</td>
<td>944-948</td>
<td>1880-1900</td>
<td>1895-1918</td>
<td>1850-1910</td>
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<td></td>
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<td>1930-1990</td>
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<tr>
<td>Carrier spacing</td>
<td>100</td>
<td>100</td>
<td>1728</td>
<td>300</td>
<td>300/300</td>
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<tr>
<td>Channel bit rate</td>
<td>72</td>
<td>72</td>
<td>1152</td>
<td>384</td>
<td>384</td>
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<tr>
<td>Modulation</td>
<td>GFSK</td>
<td>GFSK</td>
<td>GFSK</td>
<td>π/4 DQPSK</td>
<td>π/4 DQPSK</td>
</tr>
<tr>
<td>Average TX power</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>25</td>
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<tr>
<td>Number of carriers</td>
<td>40</td>
<td>40</td>
<td>10</td>
<td>77</td>
<td>16 pairs</td>
</tr>
</tbody>
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# Wireless Applications

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- **CT 1**
- **CT2, CT2+**
- **first gen. cellular**
- **GSM - IS54 - IS95 - PDC**
- **DECT, PHS**
- **PACS**
## Cordless versus cellular

<table>
<thead>
<tr>
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<th>Cellular</th>
<th>Cordless</th>
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<tr>
<td><strong>Cell size</strong></td>
<td>Large (0.5-30 km)</td>
<td>Small (50-500 m)</td>
</tr>
<tr>
<td><strong>Mobility speed</strong></td>
<td>High (up to 150 km/h)</td>
<td>Low (less than 6 km/h)</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Wide area</td>
<td>Zonal</td>
</tr>
<tr>
<td><strong>Handset complexity</strong></td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Base complexity</strong></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Handset TX power</strong></td>
<td>High (100mW-600mW)</td>
<td>Low (5-10 mW)</td>
</tr>
</tbody>
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Second generation
cordless/cellular technology positioning

Data rate (kbit/s)

Cell size

100 m 1000 m 10 km

Analog Cordless

Digital cordless

Digital cellular

Analog Cellular
Future Technologies (Third generation)

Some objectives:
- Provide a seamless radio infrastructure
- Customer should see services, not technology!
- Maximize commonality of radio interfaces
- Enable cost-effective dual mode operation
- Universal personal mobility
- Evolution from 2nd generation technologies