Harris Products in Mobile TV

- Broadcast Approaches to Mobile Television
- Participation in Major Trials
- Reference Architecture for Mobile TV
- Product Portfolio for Mobile TV
- Choosing an Optimal Band for Mobile TV
- Commitment to Mobile TV

Harris Participation in Major Trials

- Arqiva (UK)
  - 9 transmitters, 500 users
  - Start: July 2006
  - Devices: Nokia, Sony, Q2
  - UHF frequency, DVB-H modulation

- Bridge Networks (Australia)
  - Higher power 3-kW test transmitters
  - Trial started 2005
  - UHF frequency, DVB-H modulation

- KPN (Netherlands)
  - Multiple transmitters, limited users
  - Technical trials started Summer 2005
  - Partnering with Digiteena, Noreema, and THX
  - Handset: Nokia 7710

- Swisscom (Switzerland)
  - Several low-power high-definition
  - Trial started Fall 2005
  - 5000 devices: basic services
  - Handset: Nokia 7710

- Modeo (U.S.)
  - 9-site trial in Pittsburgh; installing sites in NYC
  - Technical trials started Summer 2005
  - Partnering with Digitenna, Noreema, and THX
  - Handset: Nokia 7710

- MediaFLO USA
  - OFDM, similar to DVB-H
  - Trials in San Diego, Harris in labs
  - UHF channel 55
  - Handsets: Kyocera, LG, Pantech, Samsung, and Sharp

Swisscom Trial in Bern

- TXs: 2 Main transmitters (16W & 19W ERP)
  - 3-3 Gapfillers (50 – 100W ERP)
- Start: August 2005
- Service: 5-6 TV-Programs (300-350kbps)
- Modulation: 16QAM/QPSK (10Mbit/s & 6.5Mbit/s)
- Trial:
  - September: Friendly User Trial (100 Users)
  - Beginning 2006: Marketing Trial (1000 Users)
- Status: Installation of Transmitters

Swisscom Trial in Oxford

- TXs: 9 Transmitters (200W to 350W ERP)
- Start: July 2005
- Service: 16 TV-Programs (170kbps)
- Modulation: QPSK (~5Mbit/s)
- Trial:
  - August: Friendly User Trial (25 Users)
  - September 2005: Consumer Trial (500 Users)
- Status: 4 Transmitters running, Head-end commissioning on going. Operations and Customer Service training under way.
Harris Mobile TV Solutions 25 July 2006

**Trial in Oxford**
- Indoor (Deep)
- Indoor (Outside Wall)
- In Car
- Outdoor

**The Bridge/Broadcast Australia/ Telstra Trial in Sydney, Australia**
- **TX:** 1 transmitter (Ch 29) (80 kW ERP)
- **Start:** July 2005
- **Service:** 16-17 TV-Programs
- **Modulation:** QPSK; 1/8 Gi; ½ FEC; 7MHz; 8k carriers (4.8 Mbit/s)
- **Trial:**
  - **August:** Coverage survey work
  - **September/October:** Consumer Market Research E-Commerce
- **Status:** On-air

**Broadcast Mobile TV**

<table>
<thead>
<tr>
<th>FLO</th>
<th>DVB-H</th>
<th>T-DMB or IP DAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT/DAB</td>
<td>Potential</td>
<td>Potential</td>
</tr>
<tr>
<td>1.46 GHz</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>1.67 GHz</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2.6 GHz</td>
<td>Potential</td>
<td>Potential</td>
</tr>
</tbody>
</table>

**Mobile TV Reference Architecture**

**DVB-H System Architectures I**
- Pure DVB-H service

**DVB-H System Architectures II**
- DVB-H and DVB-T shared services
Harris Mobile TV Solutions

DVB-H System Architectures III

- DVB-H and DVB-T in hierarchical modulation
  - HP stream: DVB-H services
  - LP stream: DVB-T services

Harris Mobile TV Framework

Harris Mobile TV Products

- Transmitter Products
  - DVB-T / DVB-H UHF Transmitters up to 9 kW
  - DVB-T / DVB-H VHF Transmitters up to 500 W
  - Synchrony SFN adapter for single frequency DVB-H networks
  - DVB-H 1670 MHz Transmitters up to 400 W
  - FLO capable UHF & VHF transmitters, 100 W to 60 kW

- Solution Products
  - Leitch Solutions for Studios and TV Head ends (servers, routers, switchers, distribution amplifiers, Videotek test & measurement equipment)
  - H-CLASS Enterprise Content Management Systems
  - NetVX MPEG Compression and Multiplexing Systems
  - TruPoint Microwave Link Products
  - NetBoss Enterprise Network Management Systems

Harris DVB-H UHF Transmitters

DTV-660 Television Exciter (DVB-T and DVB-H)

Synchrony DVB-T SFN Adapter

- DVB-T/DVB-H head-end SFN adapter for Single Frequency Broadcasting
  - Two ASI inputs for redundancy operation or hierarchical modulation
  - Meets DVB ETS 300 744 and DVB TS 101 191
  - Bit rate adaptation and PCR restamping
  - Internal PRBS generators
  - TCP/IP/SNMP interface for use in global network management systems

- Features
  - 6/7/8 MHz user selectable
  - Internal HTTP server
  - Hierarchical modes
  - Internal GPS receiver option
  - Fully DVB-H compliant
**Cool Play™ 1670**

**Cool Play™ 1670 Mobile TV Transmitter— with Convection Cooled Technology™**

- Initially designed for U.S. Mobile Operator, Modeo (1670 MHz)
- Outdoor installations without air-conditioning
  - Convection Cooled Technology™—developed with Harris Government Communications Systems Division
- Power levels: 50-400 Watts
- Light weight, lower operating cost
- Ideal for extreme operating conditions (-40° to 45° C)
- Extensible to 1450-1500 MHz and 470-806 MHz

**Platforms for T-DMB and Video over DAB**

- DAB-660 exciter platform

**Harris Mobile TV Platforms**

**Extending fixed terrestrial platforms into mobile TV**

<table>
<thead>
<tr>
<th>Platforms</th>
<th>Bands</th>
<th>Amplification</th>
<th>Cooling</th>
<th>Power Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLO Platform</td>
<td>VHF, I &amp; III</td>
<td>6, 7, or 8</td>
<td>solid state</td>
<td>Air</td>
</tr>
<tr>
<td>Atom Repeater</td>
<td>UHF, IV &amp; V</td>
<td>6, 7, or 8</td>
<td>solid state</td>
<td>Air</td>
</tr>
<tr>
<td>DiamondCD®</td>
<td>UHF, IV &amp; V</td>
<td>6, 7, or 8</td>
<td>solid state</td>
<td>Air</td>
</tr>
<tr>
<td>PowerCD®</td>
<td>UHF, IV &amp; V</td>
<td>6, 7, or 8</td>
<td>solid state</td>
<td>Liquid</td>
</tr>
</tbody>
</table>

**Choosing an Optimal Frequency Band for Mobile TV**

- Options for deploying a mobile TV service
  - VHF
  - UHF
  - L-band
  - S-band
- Typical regulations regarding maximum radiated power
- Typical RF channel bandwidth
- Propagation characteristics
- Typical transmitter architectures
- Transmission site characteristics
**U.S. Deployment Differences**

<table>
<thead>
<tr>
<th></th>
<th>MediaFLO</th>
<th>Modeo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Frequency</td>
<td>719 MHz</td>
<td>1672.5 MHz</td>
</tr>
<tr>
<td>Channel Bandwidth</td>
<td>6 MHz</td>
<td>5 MHz</td>
</tr>
<tr>
<td>Maximum ERP</td>
<td>50 kW</td>
<td>2 kW</td>
</tr>
<tr>
<td>Transmitter Site</td>
<td>Broadcast</td>
<td>Cellular or Rooftop</td>
</tr>
<tr>
<td>HAAT (antenna height)</td>
<td>150-600 meters</td>
<td>50-100 meters</td>
</tr>
<tr>
<td>Transmitters/Market</td>
<td>2-3</td>
<td>40</td>
</tr>
<tr>
<td>Transmit Radius</td>
<td>16 km</td>
<td>4 km</td>
</tr>
<tr>
<td>Transmit Area</td>
<td>800 sq km</td>
<td>50 sq km</td>
</tr>
<tr>
<td>Transmitter Environment</td>
<td>Air-conditioned</td>
<td>Open rooftop or cell tower site</td>
</tr>
</tbody>
</table>

**MediaFLO**
- Center Frequency: 719 MHz
- Channel Bandwidth: 6 MHz
- Maximum ERP: 50 kW
- Transmitter Site: Broadcast
- HAAT (antenna height): 150-600 meters
- Transmitters/Market: 2-3
- Transmit Radius: 16 km
- Transmit Area: 800 sq km
- Transmitter Environment: Air-conditioned transmission facility

**Modeo**
- Center Frequency: 1672.5 MHz
- Channel Bandwidth: 5 MHz
- Maximum ERP: 2 kW
- Transmitter Site: Cellular or Rooftop
- HAAT (antenna height): 50-100 meters
- Transmitters/Market: 40
- Transmit Radius: 4 km
- Transmit Area: 50 sq km
- Transmitter Environment: Open rooftop or cell tower site

(U. S. Deployment Differences)

**UHF vs. L-Band**

**UHF**
- Transmitters typically in purpose-built transmission facility with adequate HVAC & often staffed by an operating staff.
- Higher power transmitters often require a climate-controlled transmission facility.
- Transmission sites are often mountain tops near an urban area or high-rise buildings within the urban area.

**L-Band**
- Roof-top or cell-site, often open-air requiring less to modest climate control.
- Transmission sites are often mountain tops near an urban area, high-rise buildings within the urban area, or 300-600 meter towers.

**Typical Scenario Costs**

<table>
<thead>
<tr>
<th></th>
<th>716 MHz</th>
<th>1670 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Level</td>
<td>50 kW ERP</td>
<td>5 kW ERP</td>
</tr>
<tr>
<td>DTV Transmitter</td>
<td>$300,000</td>
<td>$85,000</td>
</tr>
<tr>
<td>Mask Filter &amp; RF System</td>
<td>$28,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>Power Conditioning</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Antenna &amp; Line</td>
<td>$70,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>Transmitter Installation</td>
<td>$10,000</td>
<td>$8,000</td>
</tr>
<tr>
<td>Other Install Costs</td>
<td>$90,000</td>
<td>$40,000</td>
</tr>
<tr>
<td>Total Site Costs</td>
<td>$500,000</td>
<td>$105,000</td>
</tr>
</tbody>
</table>

(UHF 716 MHz shown with DVB-H parameters; assumptions made about transmission mode, guard interval, constellation, code rate, and MPE-FEC Code Rate)
Typical Mobile TV Planning Model

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>716 MHz</th>
<th>1670 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum ERP</td>
<td>50 kW</td>
<td>2 kW</td>
</tr>
<tr>
<td>Coverage Area</td>
<td>1600 sq km</td>
<td>1600 sq km</td>
</tr>
<tr>
<td>Planning Radius</td>
<td>16 km</td>
<td>4 km</td>
</tr>
<tr>
<td>Coverage per transmitter</td>
<td>800 sq km</td>
<td>50 sq km</td>
</tr>
<tr>
<td>Transmitters/1600 square km</td>
<td>2</td>
<td>32</td>
</tr>
<tr>
<td>Typical site cost</td>
<td>$500,000</td>
<td>$125,000</td>
</tr>
<tr>
<td>Infrastructure per 1600 sq km</td>
<td>$1.0 m</td>
<td>$4.0 m</td>
</tr>
</tbody>
</table>

Generic Advantages/Disadvantages

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>716 MHz</th>
<th>1670 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handset Antenna Gain</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Multipath Gain</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Doppler Performance</td>
<td>-</td>
<td>✓</td>
</tr>
<tr>
<td>Channel Capacity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Equipment Cost per Transmission Site</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Equipment Footprint per Tx Site</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Transmission Costs per Market</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Urban Transmission Site Availability</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rural Transmission Site Availability</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Planning Worksheet

<table>
<thead>
<tr>
<th>Frequency Band</th>
<th>Existing Services</th>
<th>Spectrum Availability</th>
<th>Spectrum Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>174-240 MHz</td>
<td>VHF, Band III</td>
<td>DAB</td>
<td></td>
</tr>
<tr>
<td>470-806 MHz</td>
<td>UHF, Bands IV &amp; V</td>
<td>TV</td>
<td></td>
</tr>
<tr>
<td>1452-1492 MHz</td>
<td>L-Band</td>
<td>DAB</td>
<td></td>
</tr>
<tr>
<td>1.6-1.7 GHz</td>
<td>L-Band</td>
<td>Misc</td>
<td></td>
</tr>
<tr>
<td>2.5-2.7 GHz</td>
<td>S-Band</td>
<td>MMDS</td>
<td></td>
</tr>
<tr>
<td>174-240 MHz</td>
<td></td>
<td></td>
<td></td>
</tr>
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</tr>
<tr>
<td>2.5-2.7 GHz</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UHF or L-Band

- Careful network strategy development includes a wide range of considerations
- Technology works today for both UHF and L-Band
- Optimized product configurations are available for both bands
- By late 2006 or early 2007, U.S. subscribers likely will be able to choose between a UHF and an L-Band mobile TV service, enabling empirical research to further refine the UHF vs. L-Band considerations

Harris Mobile TV Position

- Technology base in amplification, modulation
  - Modulation: DVB-H, FLO, and DAB (T-DMB)
  - Frequencies: VHF (TV and DAB), UHF, L-Band (DAB and DVB-H)
  - Powers: 100 watts to 100,000 watts
  - Single Frequency Network enablers
- Largest digital video transmitter installed base
- Network operations and service expertise
- Leading transmitter manufacturing capacity
- Global brand strength and broadcast experience