Mobile TV
Inside MediaFLO
Madison 10-2007
Mobile TV from 35,000 Feet
Mobile TV Technologies

- "Streaming" -- Unicast
  - IPTV
  - "Clips"
  - Digital Multimedia Broadcasting (DMB)
  - Sling Box ™
- "Broadcast/Multicast"
  - DVB-H
  - ATSC-A & Harris MPG ™
  - MediaFLO (Multicast)
Two “Broadcast” Systems

“So now it’s down to two: QUALCOMM and Aloha Partners’ Hiwire. QUALCOMM, of course, already commands the lion’s share of the market—its two MediaFLO customers count a combined total of 125.8 million subscribers, more than half of the 240 million-strong U.S. wireless market.”

- RCR Wireless News
- July 28, 2007
Mobile Challenges

- Coverage / Building Penetration
- Power
- Display Brightness
- Moving RF
  - 8VSB and DVB-T
    - Doppler, and Filters
    - Noise
    - Reflections
DVB-H

- Adapts DVB to handheld
- Time Sliced – Coexist with DVB-T
- DVB-H2 – DVB-T2
• Harris and LG Shown at NAB 2007
• TV Technology Star Award
• In Band Solution
• Backward Compatible w/ 8 VSB
• High Vehicle Speed
• Small Receivers
• Power Saving
• Flexible Data Rates and Robustness
• Advanced Video and Audio Coding
Unleashing the Power of Television
World-Class Programming Partnerships

Providing familiar, full-length content from the most popular networks
Unique Viewing Experience

- Consumers can watch **HIGH-QUALITY, FULL-LENGTH PROGRAMMING** and **LIVE EVENTS** from their favorite networks in the palm of their hand.
- TV-quality video and audio
- As power efficient as voice service
Intuitive User Experience

- Consumers can locate and select programming as if at home in their living rooms.

- As EASY TO USE as a remote control
  - User-friendly programming guide
  - Fast switching between channels
  - No splash screens, buffering or progress bars
Unparalleled Technology

- MediaFLO USA was BUILT FROM THE GROUND UP to overcome technical and business challenges like bandwidth, battery life, cost of deployment, storage, subscriber licensing, billing, and quality of playback. It is the product of precise planning and ingenuity, backed by visionary industry leader Qualcomm Incorporated.

- Dedicated multicast network
- State-of-the-art network and broadcast operations center
- Powerful and secure transmitter sites
- 24/7 quality control and technical support
Ready Commercial Markets

MediaFLO USA is currently transmitting in major markets and continues to build and expand the network.
Hardware
<table>
<thead>
<tr>
<th>Chip</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBR1000</td>
<td>QFN 32 Pin Package</td>
</tr>
<tr>
<td>MBD1000</td>
<td>BCSS 116 Pin Package</td>
</tr>
<tr>
<td>EBI2</td>
<td>Codec Support</td>
</tr>
<tr>
<td>6550</td>
<td>Media FLO SW Runs on ARM</td>
</tr>
</tbody>
</table>

- RBR1000
- QFN 32 Pin Package
- 5MM x 5MM
- .5mm pitch
- Designed to operate in 700 MHz spectrum
- Samples 4Q05

- MBD1000
- 9MM x 9MM
- Interfaces with MSM via EBI2
- Samples 4Q05

- Codec Support
- Media FLO SW Runs on ARM
- Reverse Link traffic over WAN
Encoder One
Breadboard
Monitoring Tools
Ops Center
Edit
The MediaFLO Modulation
Modulation Scheme

• What Qualcomm does very well is:
  – Air interface...they invented CDMA and more.
  – With MediaFLO the air interface is particularly tailored for mobile media.
    • Highly Immune to multi-path
    • High bandwidth
    • Excellent in-building penetration
    • Designed for an interference free single frequency network.
    • Graceful degradation
Superframe – (Time Domain)

- This is how MediaFLO data packets are constructed (time domain)
- One each second
- 5.5 Mb/s payload (Mode 7)
- TDM
- FDM
- Synchronization and Overhead

- Typically up to 20 Linear Video Services
- Typically up to 10 Linear Audio Services
- Clip services
- Program Guide
- Access Control Support
- Interactivity hooks
- Transmitter / Location ID
OFDM: Orthogonal Frequency Division Multiplex
For MediaFLO the OFDM is made up of 4096 individual carriers at 1.35KHz spacing.
Each modulated carrier carries QPSK modulation for two bits per symbol at a minimum.
OFDM Signal – Very High Level – Frequency Domain

Or it could be QAM-16, for 4-Bits/Symbol
Typically each carrier can peel off 4 bits per symbol with QAM-16 – standard stuff
4 Bits in each symbol – 2 more robust than the others
As path degrades... only 2 bits are resolvable
Interleaving Base and Enhanced Bits

- One difference between MediaFLO and 8VSB (or anything else you are familiar with) is that at the digital cliff, it does not necessarily go away, key data can be preserved.
- Penetration is everything in Mobile TV.
Construction of the OFDM waveform

- Why OFDM?
  - Multipath
  - Single Frequency Network
OmniVore – One of the tools

- This is a Superframe.
- Presents the interleaves and data packets.
MediaFLO Operations Center
San Diego
Last Year
Last Year
Last Year
• Core Processors
• Cold Row
New Uplink
Central Technical Architecture
Architecture – Full Redundancy
Architecture – Sniffer Amp
The Transmission System
Typical Market Population Density

Graphic of United States may not necessarily depict actual transmitter sites.
Graphic of Untied States may not necessarily depict actual transmitter sites.
<table>
<thead>
<tr>
<th>Technology</th>
<th>MediaFLO (719 MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Covered</td>
<td>2.4 million</td>
</tr>
<tr>
<td>Sites / Height Above Average Terrain (HAAT)</td>
<td>3 total, 168.51 m, 312.09 m, 212.88 m HAAT</td>
</tr>
<tr>
<td>Effective Radiated Power (ERP)</td>
<td>50 kW ERP each</td>
</tr>
<tr>
<td>Telecomm Interconnectivity (per MFTS site)</td>
<td>1 satellite receive only terminal, typically 1-2 meter diameter</td>
</tr>
<tr>
<td># of Real-time Video Channels</td>
<td>15-20 (enhanced H.264)</td>
</tr>
<tr>
<td># of Real-time Stereo</td>
<td>7-8 (HEAAC v2)</td>
</tr>
<tr>
<td>Resolution / Frame Rate</td>
<td>QVGA at up to 30 fps</td>
</tr>
</tbody>
</table>
Typical Transmitter
Opportunities
http://www.qualcomm.com/careers/