

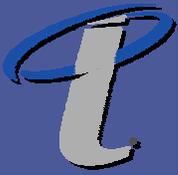


# Broadband Wireless IP Network

## Technical Presentation

Using 6MHz of channel bandwidth in the  
UHF Bands from 470-806MHz

May 10, 2005



# The Company

- TurboWave is a pioneer in broadband wireless IP network deployment since 1999.
- Our technology enables
  - live data, video and voice communications from the field to the NOC, dispatch and command centers
- Our target markets are in:
  - Public safety
  - Homeland security
  - Utilities companies
  - Emergency Management Agencies
  - Military personnel
  - Public Access to local communities



# DVB-T/RCT Value Proposition

- Our DVB-T/RCT family of products offers broadband wireless capacity in the UHF bands from 470-806MHz coexisting with TV broadcast stations.
- Using 6MHz of channel bandwidth our base stations and subscriber units delivers 24 Mbits/s of throughput up and down

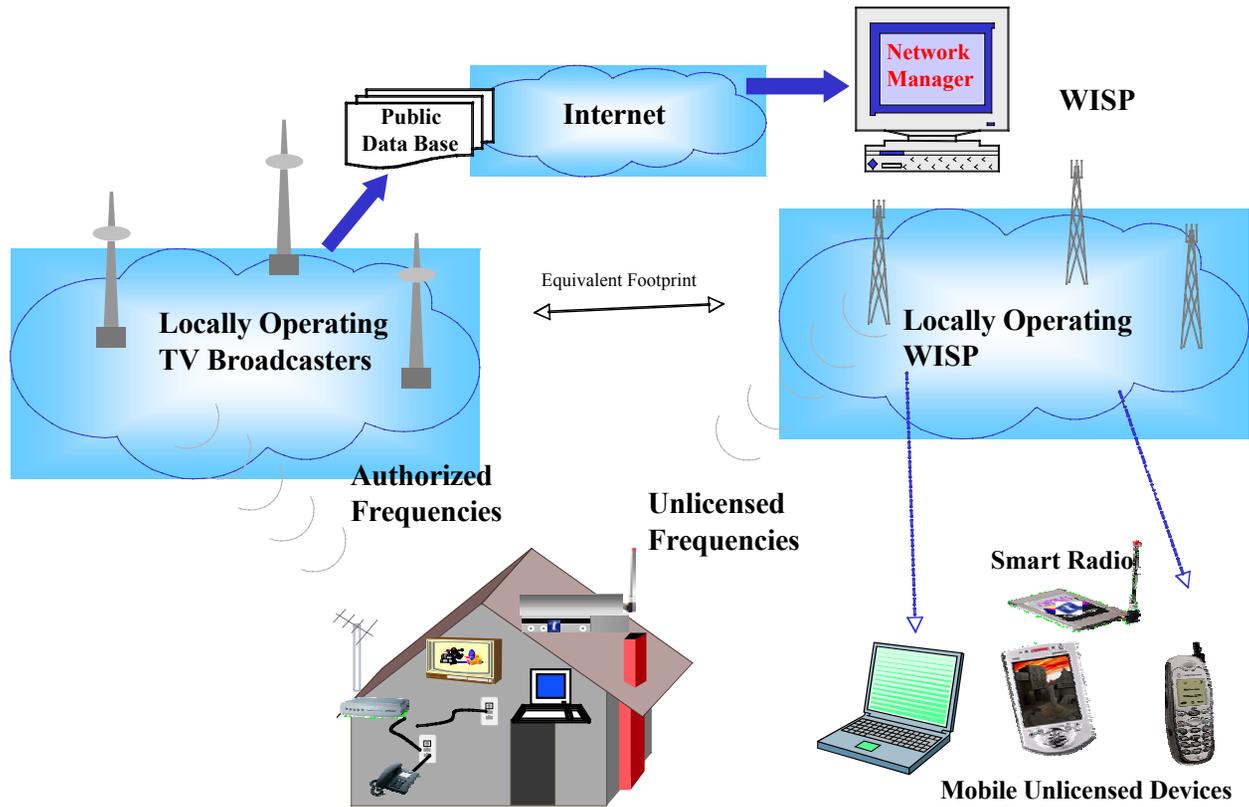


# DVB-RCT Value Proposition

- Public access to Broadband Wireless Services using Unlicensed Intelligent Devices (UID)
- Both to co-exist in the same band and space with authorized broadcasting stations
- Smart unlicensed devices automatically find unused spectrum, or “white spaces”

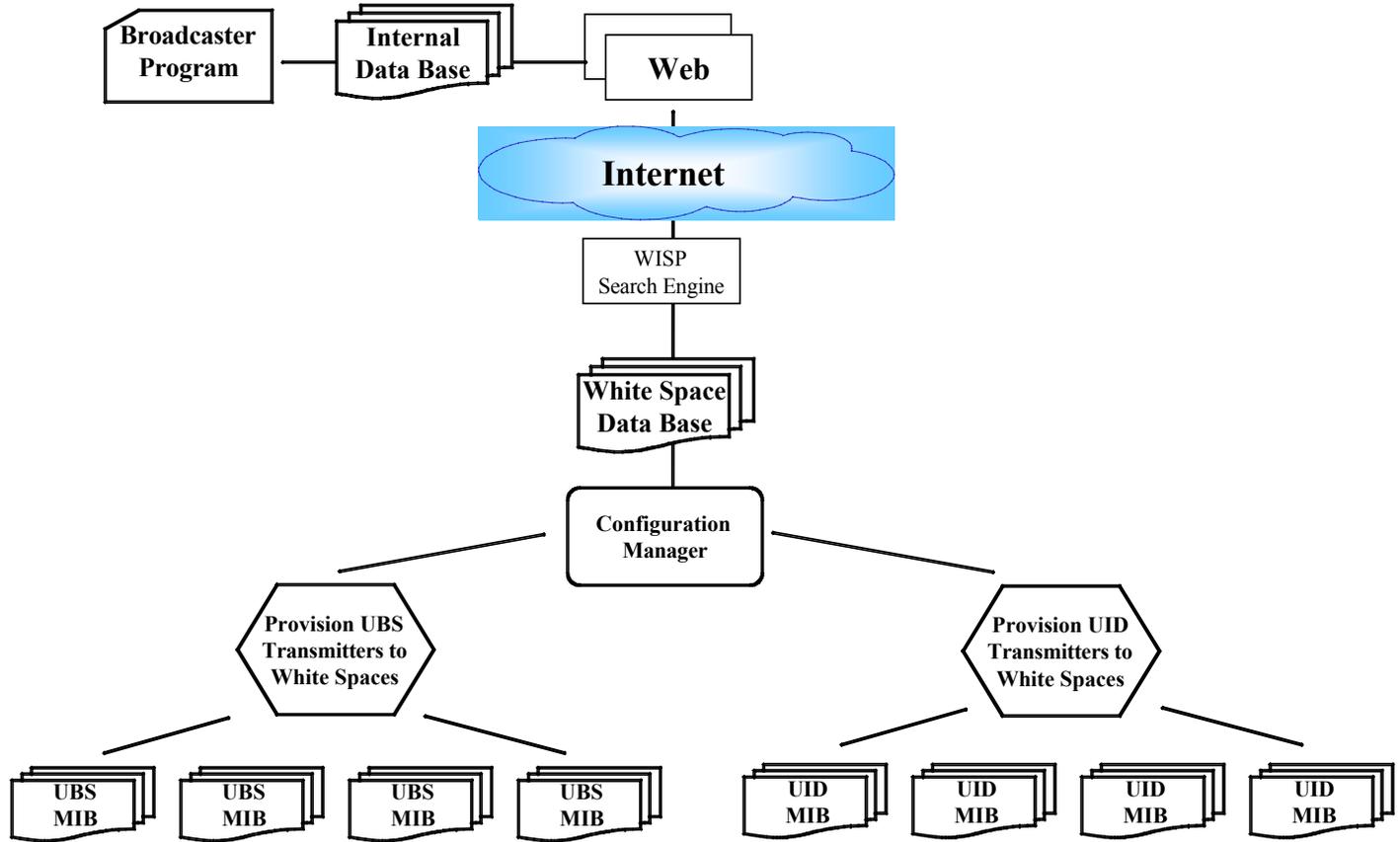


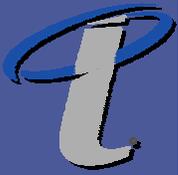
# Integrated Broadband Wireless IP Network





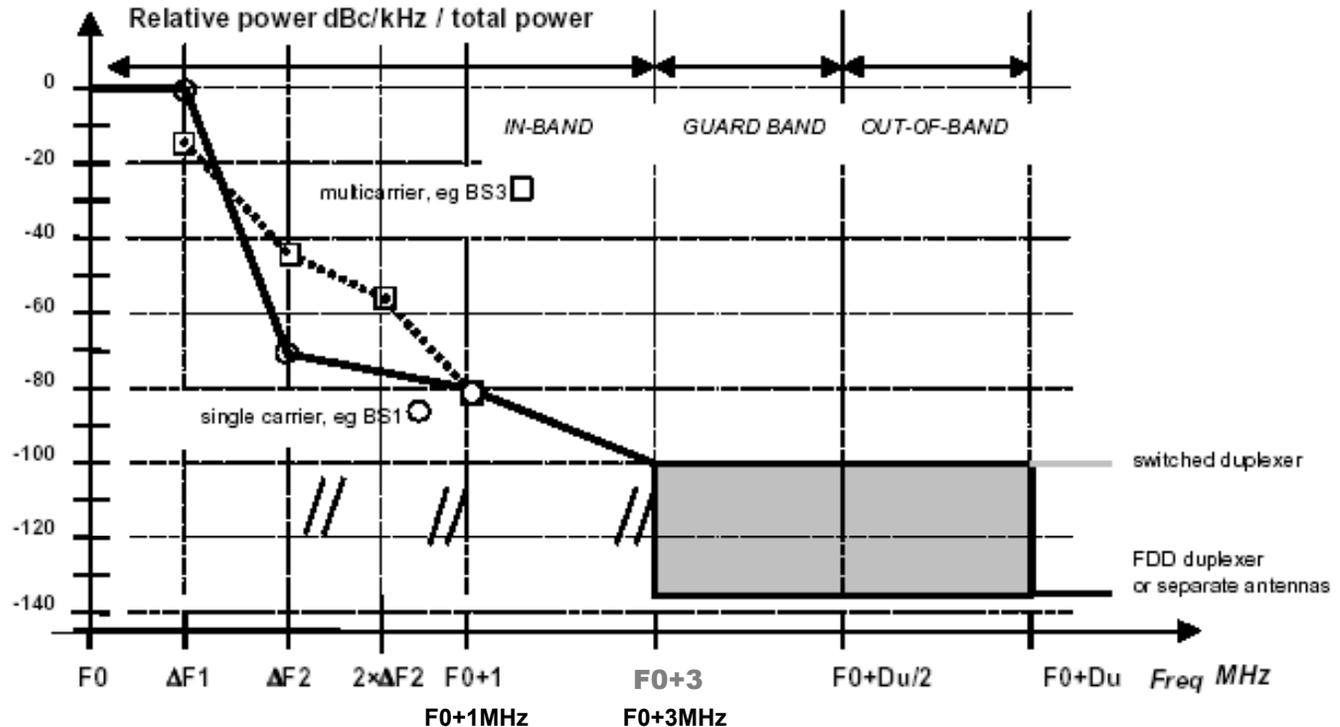
# Intelligent Process





# DVB-RCT Mask

## Upstream Spectrum Mask (ETSI EN 301 958)



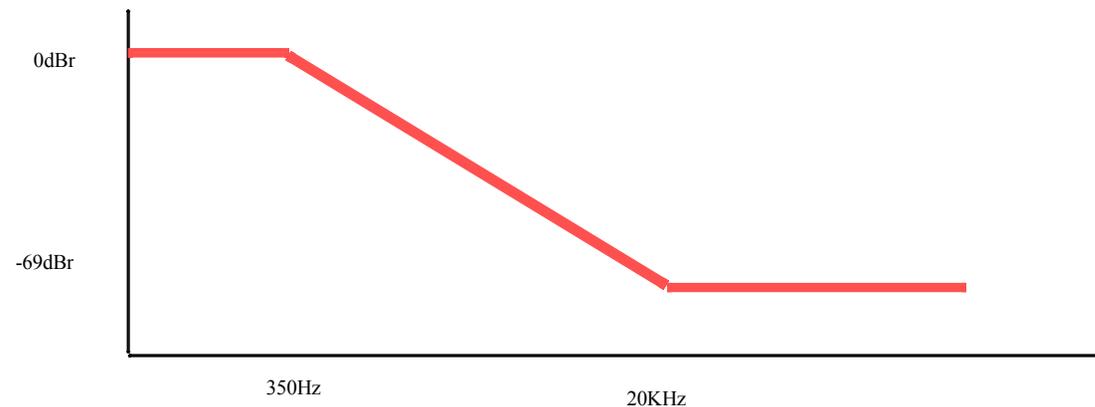
The Spectrum Mask was designed to ease sharing between digital TV reception and DVB-T/RCT transmissions with the maximum spurious out-of-band power (given at the antenna port) is within the profile shown in the figure above.



# Upstream Sub-carrier Mask

## Upstream Subcarrier Mask (ETSI EN 301 958)

$ f $	Power Spectrum
Under $0,375/T_s$	$0 \pm 0,5$ dBc/Hz
at $0,5/T_s$	$-3 \pm 0,25$ dBc/Hz
at $0,625/T_s$	$< -35$ dBc/Hz
at $1,25/T_s$	$< -45$ dBc/Hz
for $1,25/T_s < f < 15 \times 1,25/T_s$	20 dB/decade decreasing until the noise floor
Above $15 \times 1,25/T_s$ (Noise floor)	$< -69$ dBc/Hz

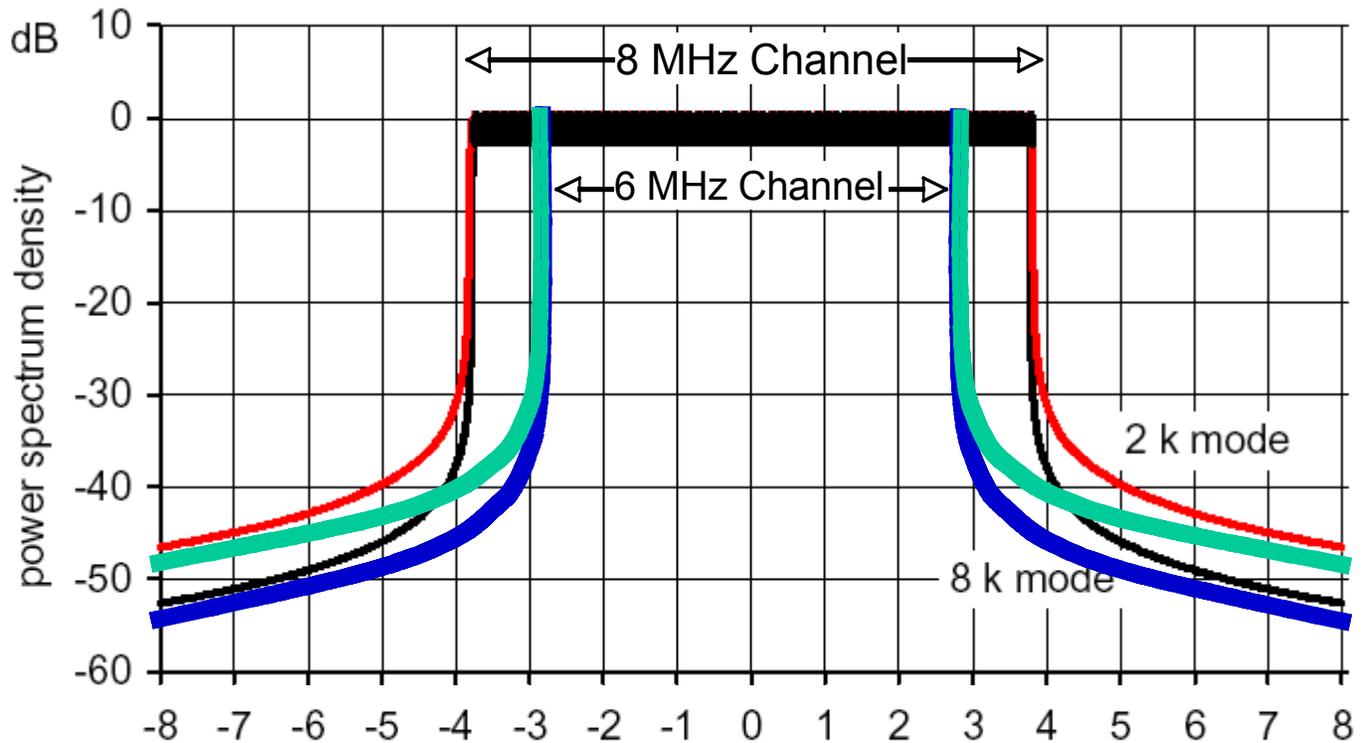




# DVB -T Mask

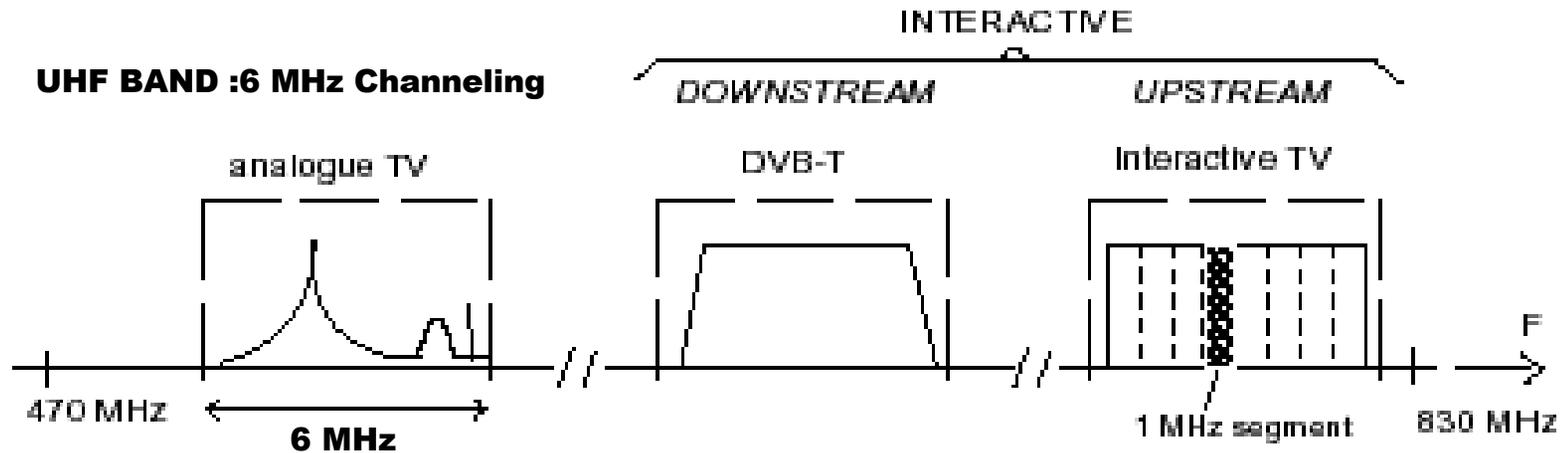
Upstream Spectrum Mask (ETSI EN 300 744)

$$Pk(f) = \left[ \frac{\sin \pi * (f-f_k) * Ts}{\pi * (f-f_k) * Ts} \right]^2$$





# The DVB-T/RCT Spectrum Masks



The TurboWave technology complies with the Upstream and the Downstream masks of the DVB-T/RCT standard designed to avoid interference with existing analog TV transmissions and operate at a power level 20 dB less than analog TV systems.

Another key commercial advantage is that interactive TV Service Providers can be assigned their own 1MHz of spectrum remaining independent of one another.



# DVB-RCT/OFDM Robustness

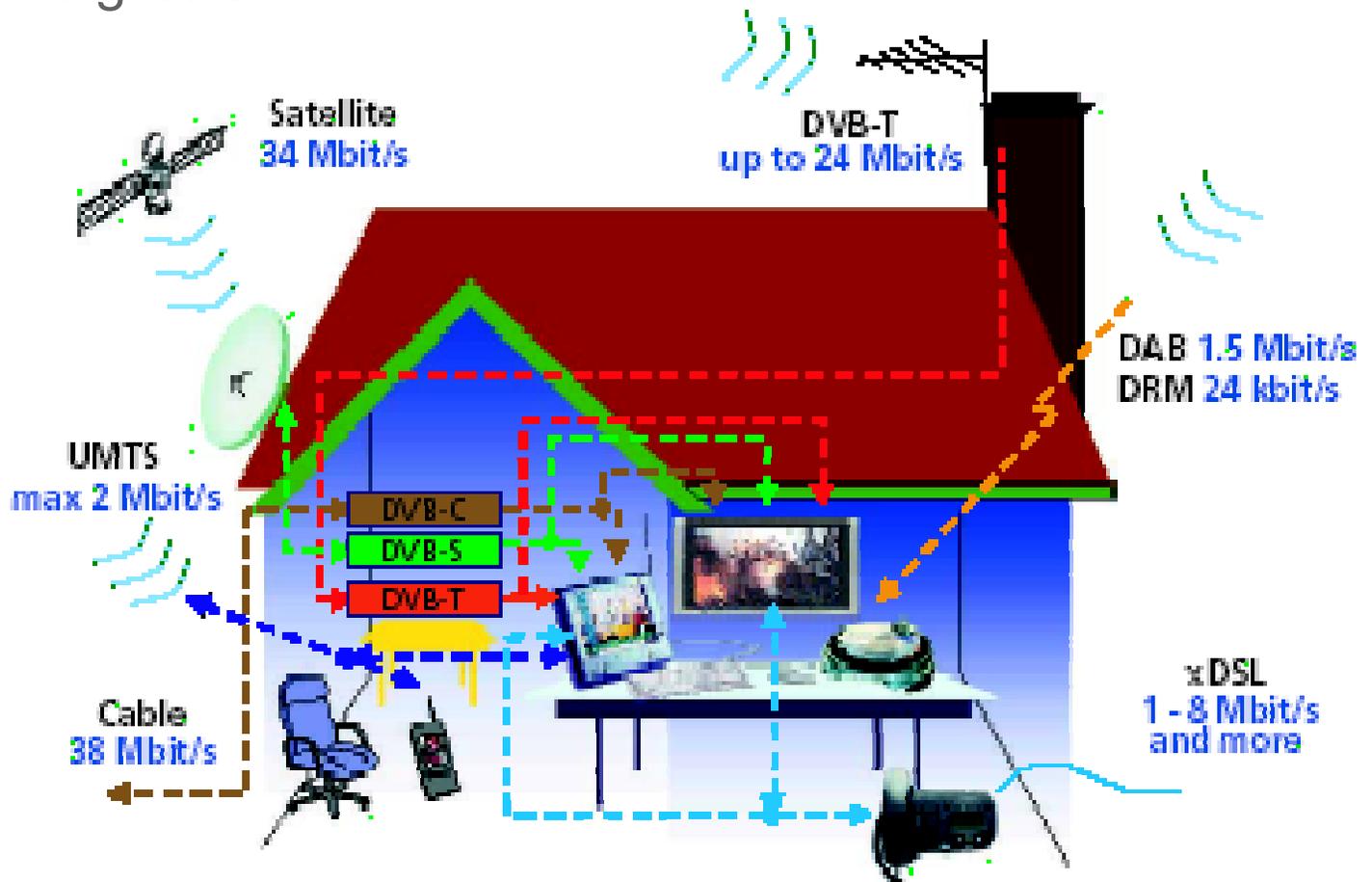
- DVB-T system based on OFDM performance:
  - is very robust against co-channel and single tone interference.
  - At 16 QAM the performance is limited only by the ability of the modem to synchronize correctly.
  - The carrier to noise ratio (C/N) at which the system will operate is 10 db.
- Operate at very low power
  - Transmission power below 3W
  - Distance can exceed 5 Km



# DVB-C/S/T Technologies

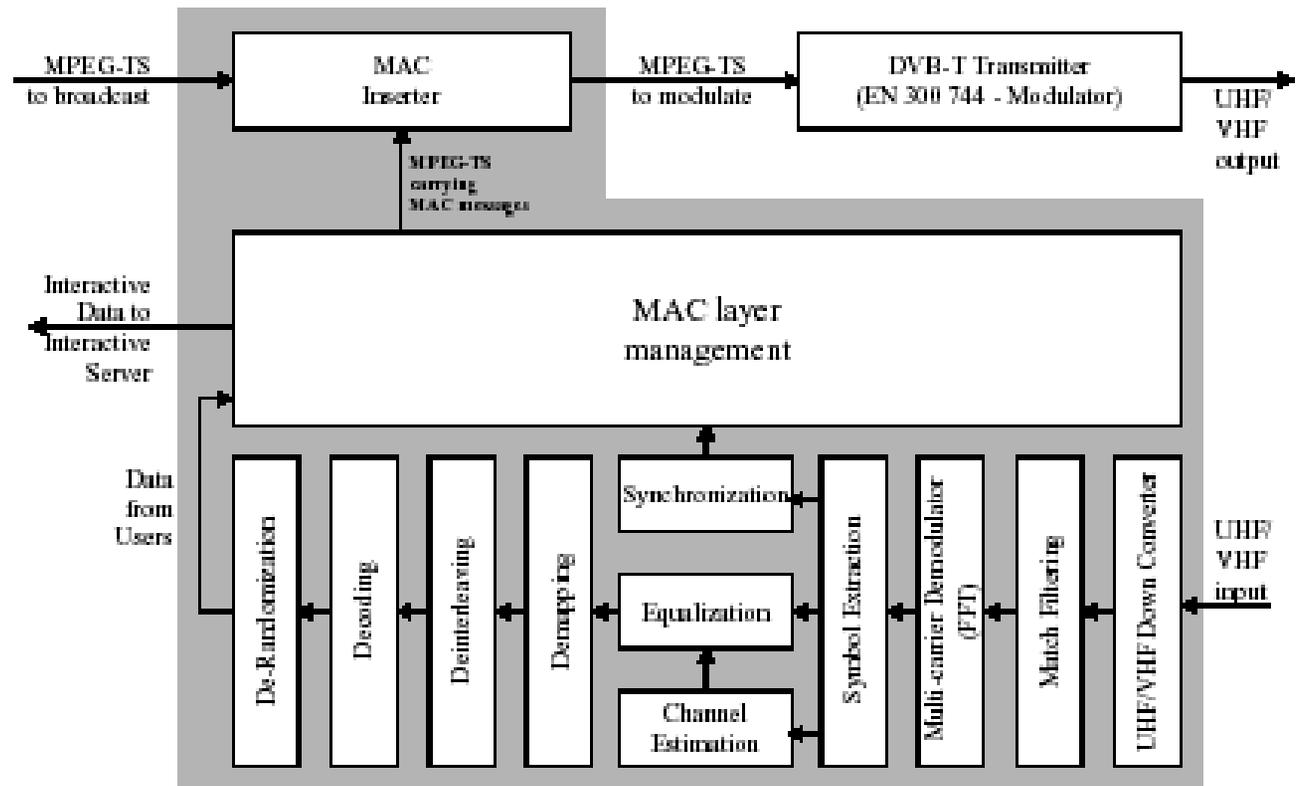
The DVB-S/T Technologies are in deployment in:

1. digital Satellite and
2. digital CATV





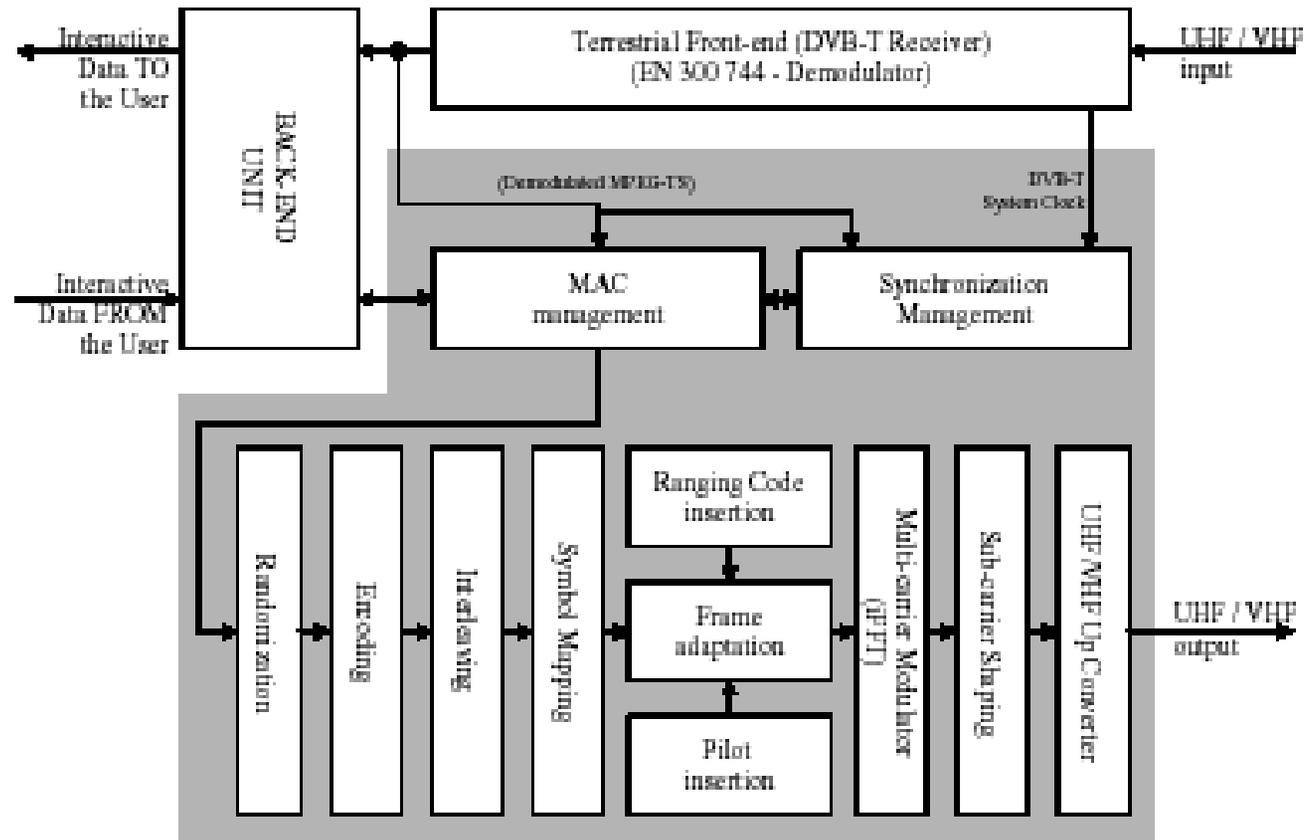
# DVB-T/RCT Base Station Block Diagram



Base Station



# DVB-RCT Subscriber Unit Block Diagram



Subscriber Unit



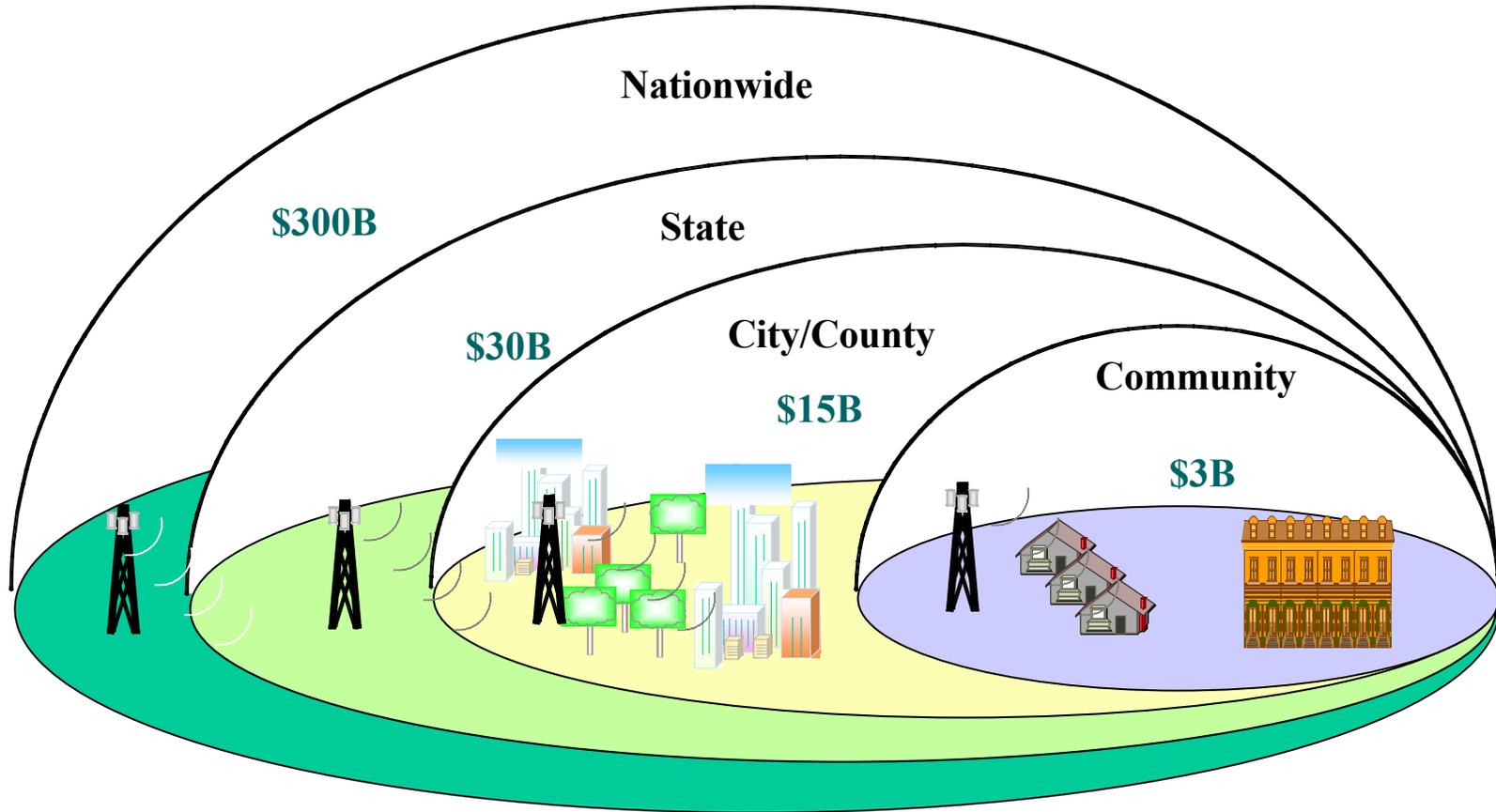
# DVB-T/RCT Data Rates

<b>6 MHz DVB-T COFDM Payload Data Rates</b>		
<b>Useable Symbol Rate</b>	<b>5.0625</b>	<b>Msym/s</b>
<b>OFDM Bandwidth</b>	<b>5.70871</b>	<b>MHz</b>

<b>Modulation</b>	<b>Code</b>	<b>Guard Interval</b>			
		<b>1/4</b>	<b>1/8</b>	<b>1/16</b>	<b>1/32</b>
<b>Type</b>	<b>Rate</b>				
<b>QPSK</b> <b>2</b> <b>Bits/sym</b>	<b>1/2</b>	3.732	4.147	4.391	4.524
	<b>2/3</b>	4.976	5.529	5.855	6.032
	<b>3/4</b>	5.599	6.221	6.587	6.786
	<b>5/6</b>	6.221	6.912	7.318	7.54
	<b>7/8</b>	6.532	7.257	7.684	7.917
<b>16-QAM</b> <b>4</b> <b>Bits/sym</b>	<b>1/2</b>	7.465	8.294	8.782	9.048
	<b>2/3</b>	9.953	11.059	11.709	12.064
	<b>3/4</b>	11.197	12.441	13.173	13.572
	<b>5/6</b>	12.441	13.824	14.637	15.08
	<b>7/8</b>	13.063	14.515	15.369	15.834
<b>64-QAM</b> <b>6</b> <b>Bits/sym</b>	<b>1/2</b>	11.197	12.441	13.173	13.572
	<b>2/3</b>	14.929	16.588	17.564	18.096
	<b>3/4</b>	16.796	18.662	19.76	20.358
	<b>5/6</b>	18.662	20.735	21.955	22.62
	<b>7/8</b>	19.595	21.772	23.053	23.751
		<b>Payload Data Rates Mbit/s</b>			



# The Scope of the Market



**Total potential market in excess of \$300B!**



# Market Opportunity

- Triple Play
  - Fixed, Portable and Mobile
  - Voice, Internet and Video
  - Business, Information and Entertainment
- User Requirements
  - Telco grade voice, Virtual Radio
  - Interactive Web Browsing. Instant download
  - TV Broadcast, DVD quality
  - Two way, real time operation control
- Mobility
  - Home, work, outdoor/indoor public place, vehicle, train, bus, plane, helicopter, boat etc...

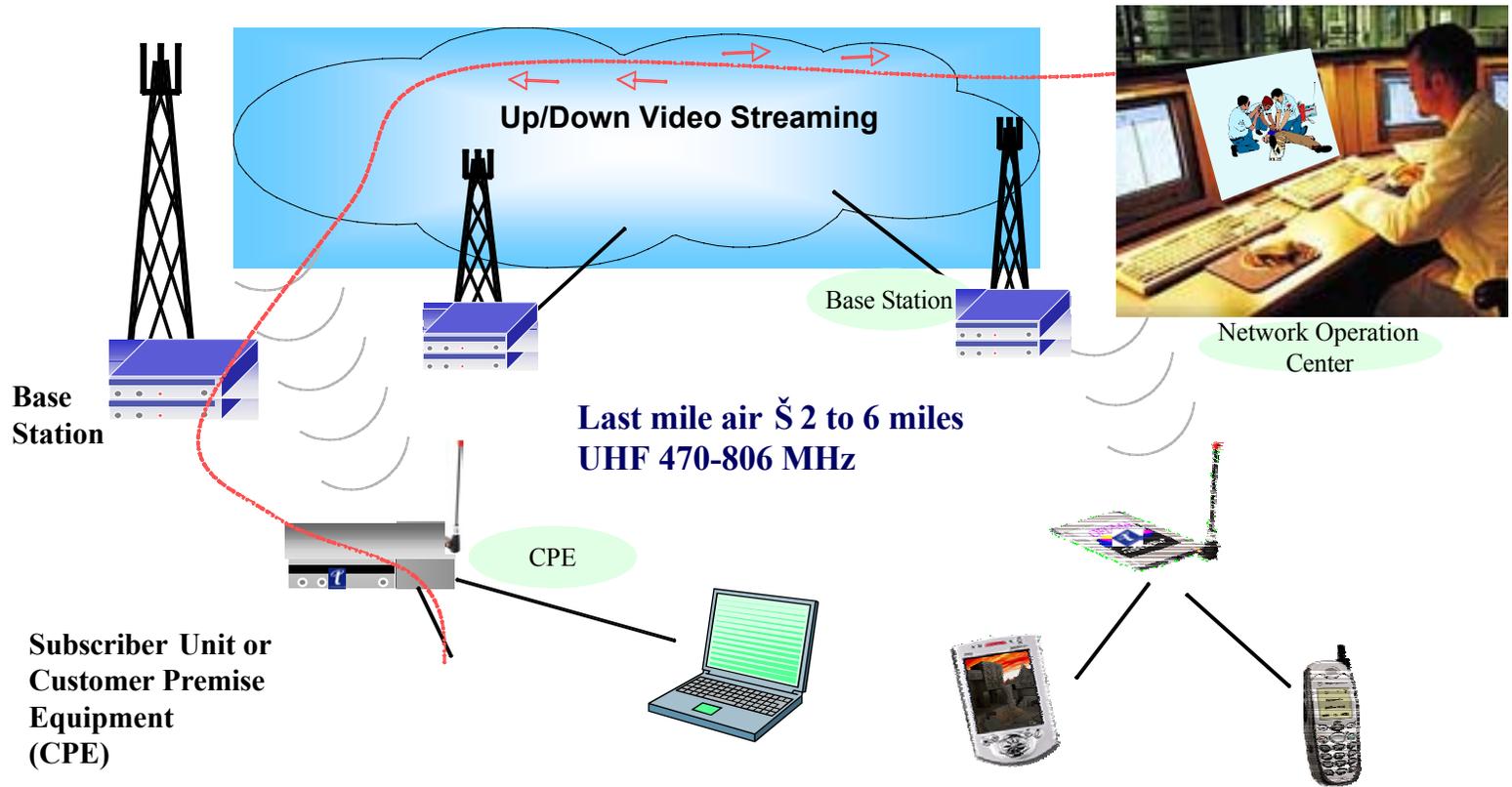


# TurboWave Advantages

- TurboWave is first to deliver
  - Public safety & Security users have tested our system and love it
  - We have years of experience in broadband wireless technology
  - We define the system requirements based on users needs
  - Local Customers are ready to purchase and deploy
- Offices
  - Salt Lake City, UTAH – Headquarters
  - Orem, Utah - Sales Office
  - Israel - R&D
  - Virginia - Federal Government Liaison
- Technology – OFDMA – DVD-T/RCT
  - Fully compliant to ETSI DVB standard at UHF with 6MHz channels
  - Management Control
  - Mesh Networking with automated Handoff Control: Robust



# The Network Concept



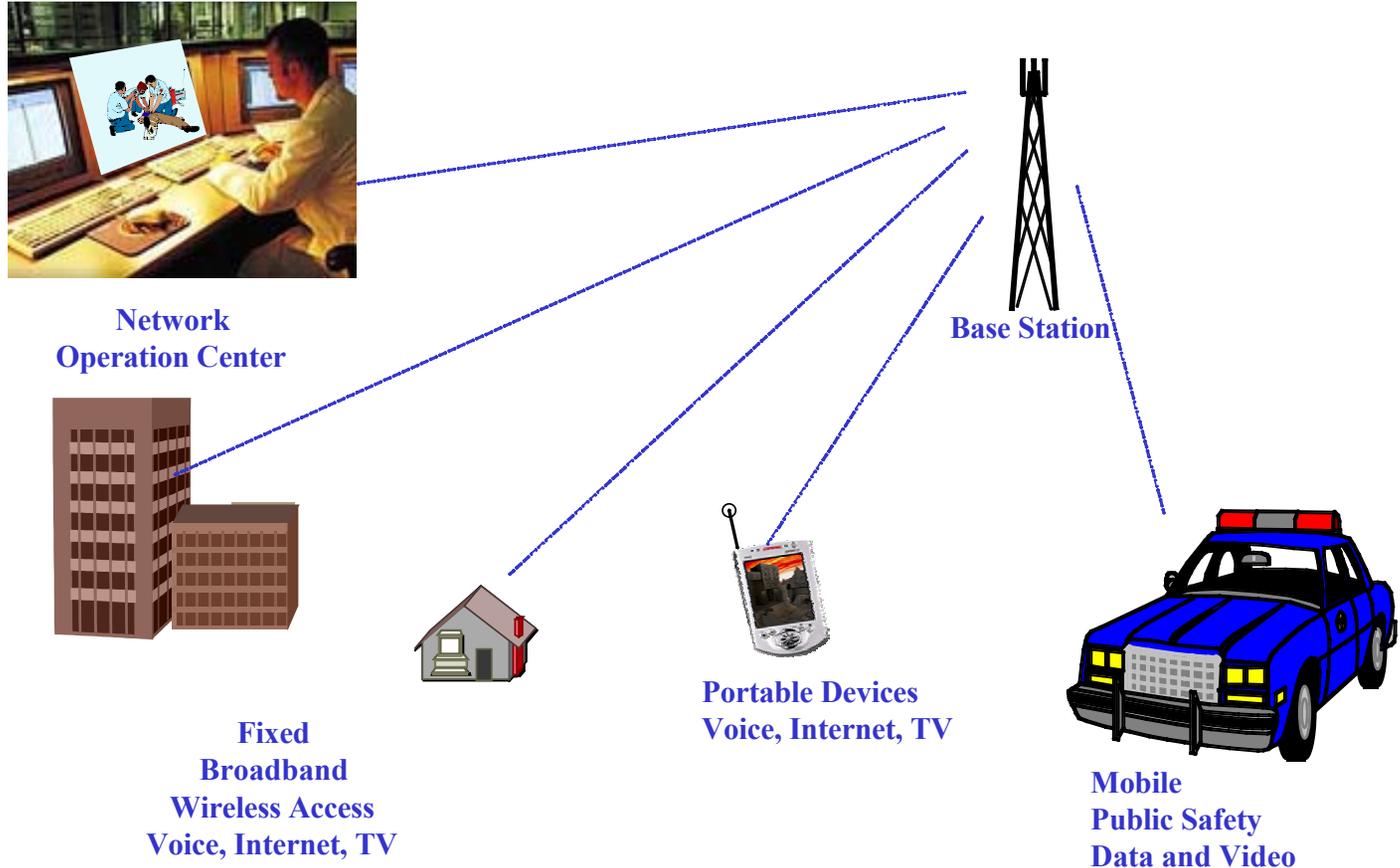


# The Product Offering

- Base Station
  - Equipment to be installed in a shed
  - Base Station Directional Antenna
  - Interface: Ethernet 10/100 RJ45
  - 4-8 Watts Amplifier
- Subscriber unit
  - Subscriber unit to be installed in vehicles, boats or planes
  - Omni-directional Antenna
  - Interface: Ethernet 10/100 RJ45
- Network System
  - Centralized Web-based management
  - Bandwidth management
  - Auto Provisioning
  - Ad hoc mobile network
  - Multi-Point Relay routing protocol
  - Reservation protocol for QoS
  - Roaming



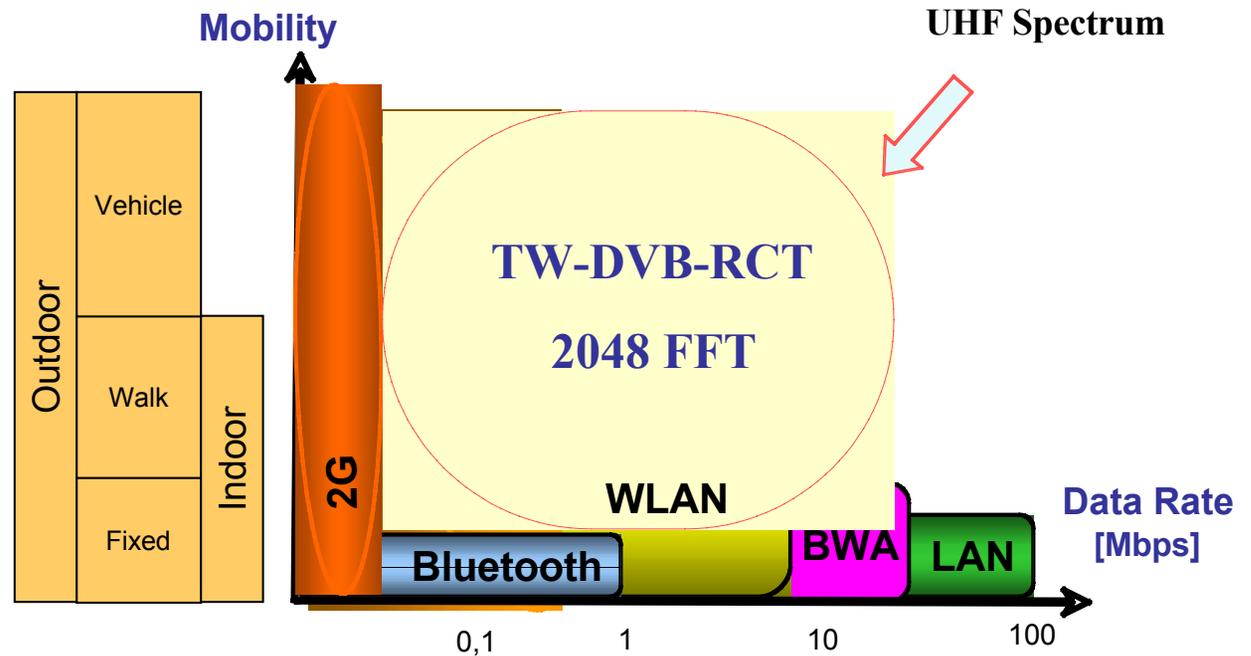
# Mobile and Fixed Applications





# The DVB Technology

With UHF we can move faster,  
deliver more bandwidth and reach farther!





# Partners

- Novell
  - Identity management and Security
  - Provisioning and Service automation
- Runcom
  - OFDMA chip sets
- Kansas City plant (U.S. DOE)
  - Prototyping, miniaturization & manufacturability
- Hexagon
  - Wireless Network Planning tools

**Novell.**

