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# THE WIRELESS R-EVOLUTION

***ITU - ANATEL Regional Seminar on Broadband Wireless Access (BWA)***
***23rd - 25th May, Brasília - Brazil***
***José Luiz N. Frauendorf***

# Broadband Wireless Access

- NEOTEC - BWA/MMDS in Brazil
- BWA - Evolution
- BWA - Belo Horizonte Trial
- BWA - Systems Requirements
- BWA - Alternatives
- BWA - An Integrated Platform
- BWA - Spectrum Requirements

# NEOTEC
# MMDS IN BRAZIL

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# NEOTEC

***Created in 2.001 to:***

- ***Represent the Brazilian BB wireless MMDS - 2.5 GHz Operators***
- **Establish Technology and Quality of Service Standards**
- **Assure critical mass for service and equipment providers**
- ***Create single broadband wireless network throughout the Country***
- ***Research and develop new technology sources for the 2.5GHz spectrum***
- **Become a FORUM to incentive discussions among the participants and create synergy for a constant improvement of the broadband wireless business**

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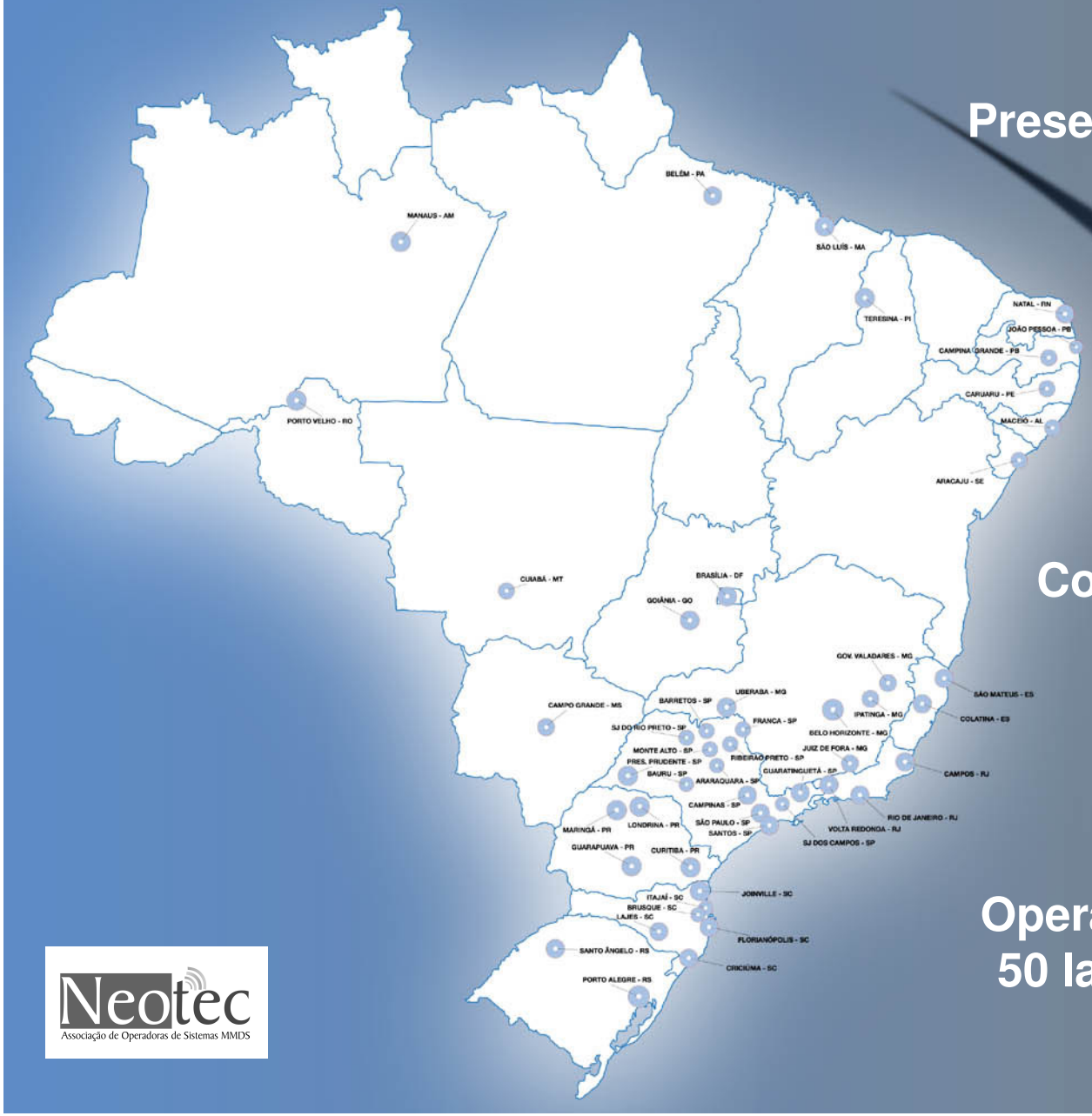
# NEOTEC PRESENCE




**Presence in 250 districts**

**Covering 15 million HH**

**Operations in 41 out of the 50 largest Brazilian cities**

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# OVERVIEW OF MMDS IN BRAZIL

- **1990 - the first Brazilian wireless Pay-TV Service starts in Brasília,DF. TV Filme (ITSA) was born,**
- **1991 - starts in São Paulo,SP - Canal +, the new MMDS operation, that became - TVA - ABRIL Group,**
- **1997 - starts in Brasília,DF the very first Brazilian BWA Service - "Link Express" - ITSA, using telephone line for the return-path,**
- **1999 - starts in Natal,RN the first terrestrial digital Pay-TV transmission service - ACOM Comunicações,**
- **2000 - the "Return Path" was granted for the MMDS. TVA starts in São Paulo and Rio de Janeiro and ITSA starts in Brasília a full BWA service using DOCSIS technology,**
- **2000 - a new digital MMDS Pay-TV operator - TELESERV - starts servicing Aracajú, SE,**
- **2003 - NEOTEC promotes, in Belo Horizonte, MG trials of NLOS - Non Line Of Sight Technologies -WCDMA and OFDM.**

# BWA EVOLUTION

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# BWA - Evolution

| First Generation | Second Generation | Third Generation |
|---|---|---|
| • Analog Technology for Video transmission only - 31 / 6Mhz channels. | • Fixed LOS- Line Of Sight System,<br>• Digital Video Transmission, MPEG-2 (720x480 resolution) CBR - Constant Bit Rate, Compression Rate (5:1), 64QAM,<br>• Broadband Data Transmission 64QAM - Downstream and QPSK or Upstream (DOCSIS 1.1) including VoIP capabilities "up-stream" (DOCSIS 1.0 | • Full NOLS - Non Line Of Sight portable / mobile service,<br>• BWA + VoIP using OFDM or CDMA Modulation Technologies<br>• Multimedia IP System Video+Voice+Data. Video Broadcast VBR - Variable Bit Rate High Resolution (HDTV) MPEG-2 + MPEG-4 |

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# Broadband Wireless
# NEOTEC Trial

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# Belo Horizonte the Wireless City

## Pre-WiMAX Technology Trial
## W-CDMA & OFDM

### Third Largest City

Population: 3.2 million
Households: 0.9 million
Enterprises: 0.1 million

### Main Characteristics

Hilly
Vertical
Green

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# Belo Horizonte the Wireless City

## Why Belo Horizonte?

- The third largest city in Brazil
- Topography: - a “hilly” city
- Morphology: - a vertical extremely concentrated city
- Green city - foliage (high attenuation)
- Very competitive and mature market - great potential, reference for several services
- Evaluation valid for most of the Brazilian big cities

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# Evaluations

## Technical Evaluations:

- *Coverage (indoor e outdoor)*
- *System Throughput*
- *Mobility / Portability*
- *QoS*
- *Applications: Video Streaming (Up & Down), VoIP, Videoconference fixed / mobile*

## Market Evaluation:

- *More than 100 Friendly "heavy" users*
- *Self Installation*
- *Self Provisioning*
- *Customer´s satisfaction - installation & operation*
- *Performance - Wireless x ADSL + Cable + others*
- *User's applications*

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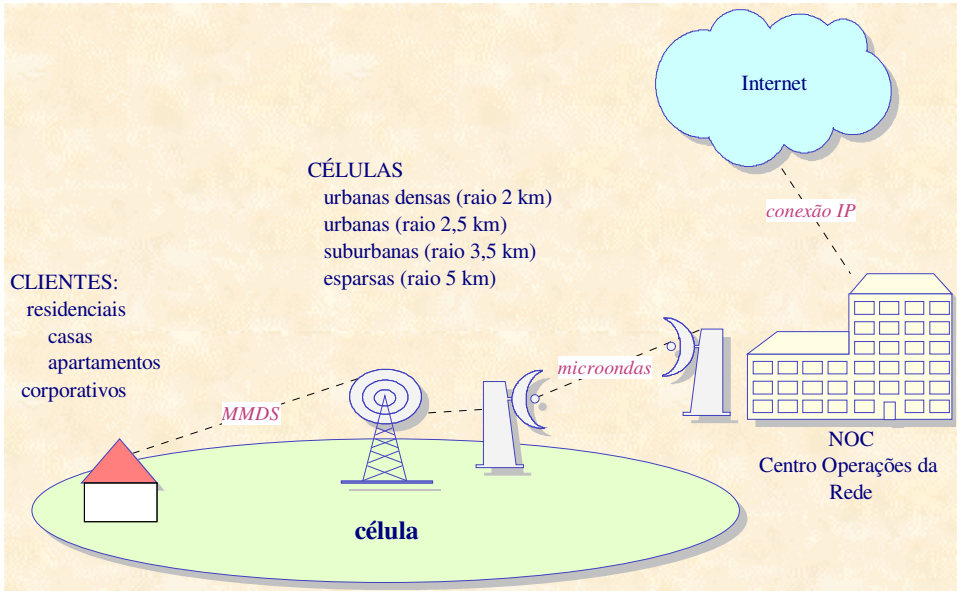
# System Concept

## System Architecture:

### Cells:

- ***Base Stations (BTS)***
- ***Switches***
- ***Microwave Links***

  ***(Minilinks 2 Mbps)***




### NOC - Network Operating Center

- **Servers**
- **Routers**

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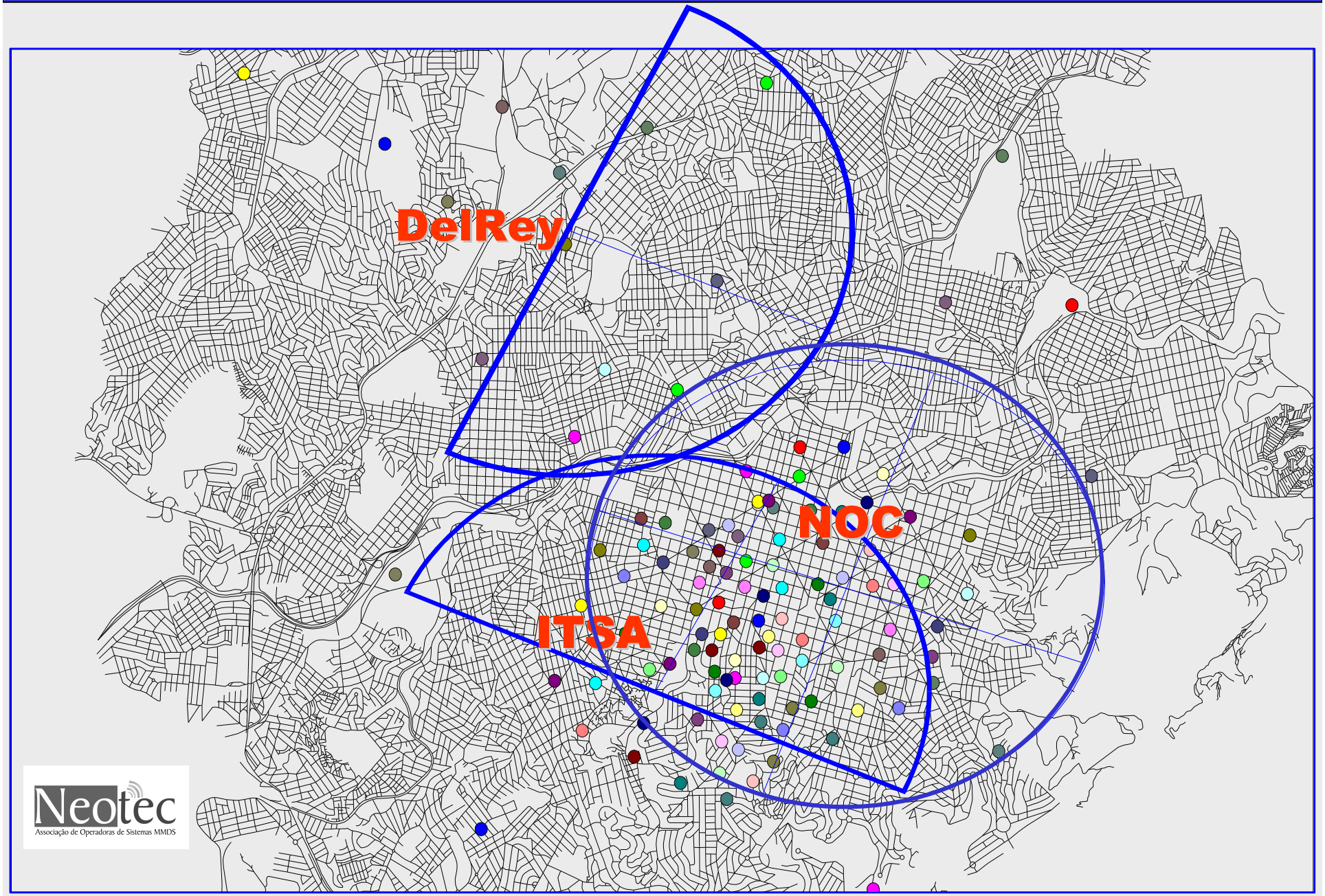
# Test Sites


DelRey
NOC
ITSA
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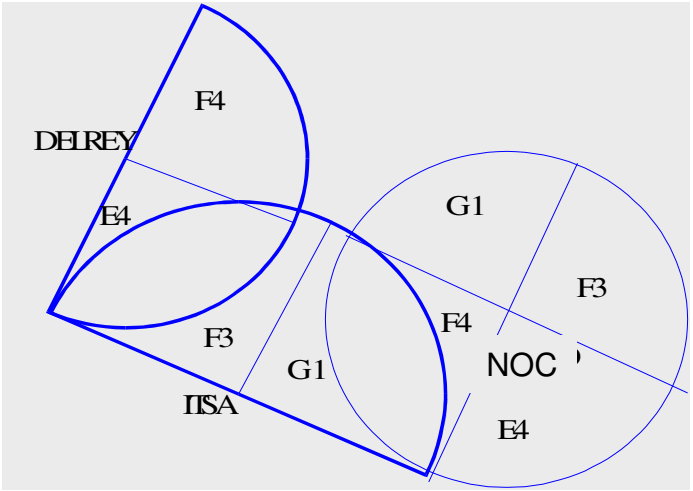
# OFDM Technology

## Number of Base Stations (BTS):

- NOC: 4
- ITSA: 2
- DelRey: 2




## Frequency Channels (6 MHz) = 4:(reuse test)

- Channel F3: 2626-2632
- Channel E4: 2632-2638
- Channel F4: 2638-2644
- Channel G1: 2644-2650

## OFDM Modulation:

- QPSK (upstream e downstream)

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# OFDM Platform


- *Base Station (BTS) connected to a 90º directional antenna (4 sectors)*
- *BTS connected to the switch through a UTP Cable*
- *A Switch combines the BTSs*
- *Typical installation in less than 6 hours*
- *Power consumption 200W*
- *Modulation OFDM:*
  - *QPSK (up e downstream)*

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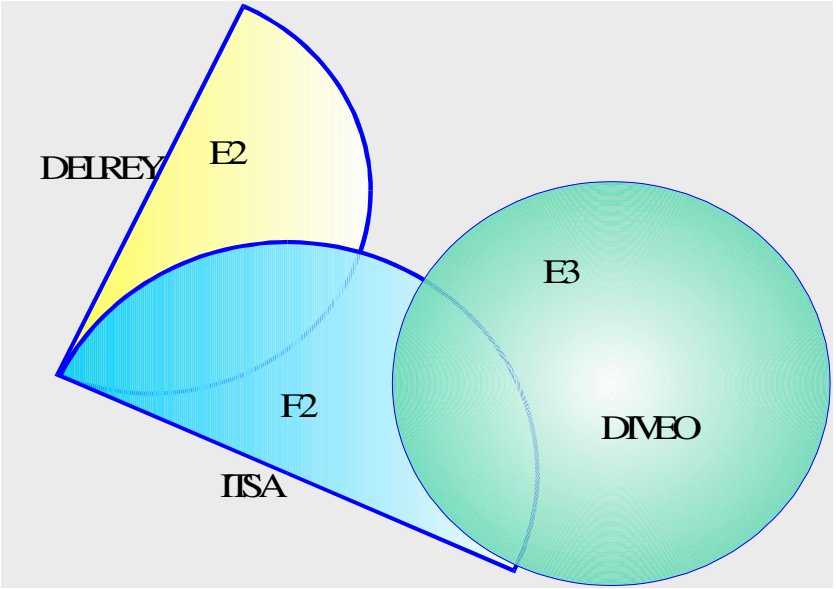
# CDMA Technology

- **Estações Base (BTS):**
  - **Diveo: 1(ominidirecional 360º)**
  - **ITSA: 1 (120º)**
  - **DelRey:1 (120º)**




- **Freqüências:**
  - **DelRey: Canal E2 (2608-2614)**
  - **ITSA: Canal F2 (2614-2620)**
  - **Diveo: Canal E3 (2620-2626)**

- **Modulação TD-SCDMA:**
  - **Adaptativa (QPSK, 8QAM e 16QAM)**

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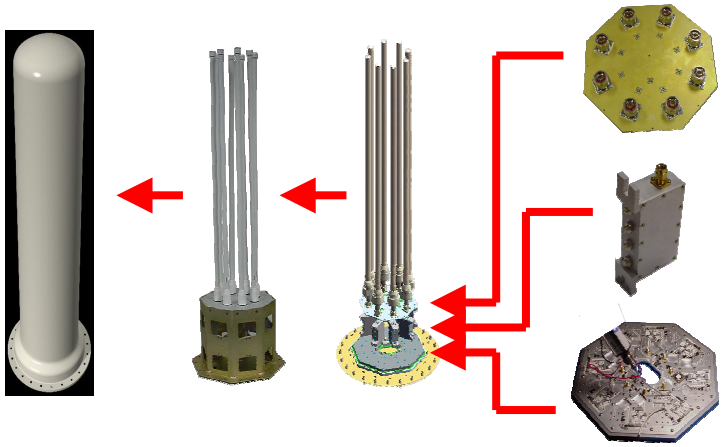
# CDMA Platform

- *Smart Antenna*
- 9 coax cables interconnecting BTS to the antenna
- TD - SCDMA Modulation:
  - Adaptive (QPSK, 8QAM e 16QAM)



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# Coverage Test

- 110 test points within the coverage area
- “Outdoor” and “indoor” tests performed
- Tests at remote areas, with low buildings density and central areas extremely dense, streets covered with trees and hilly surface
- 93% coverage achieved - up and downlink

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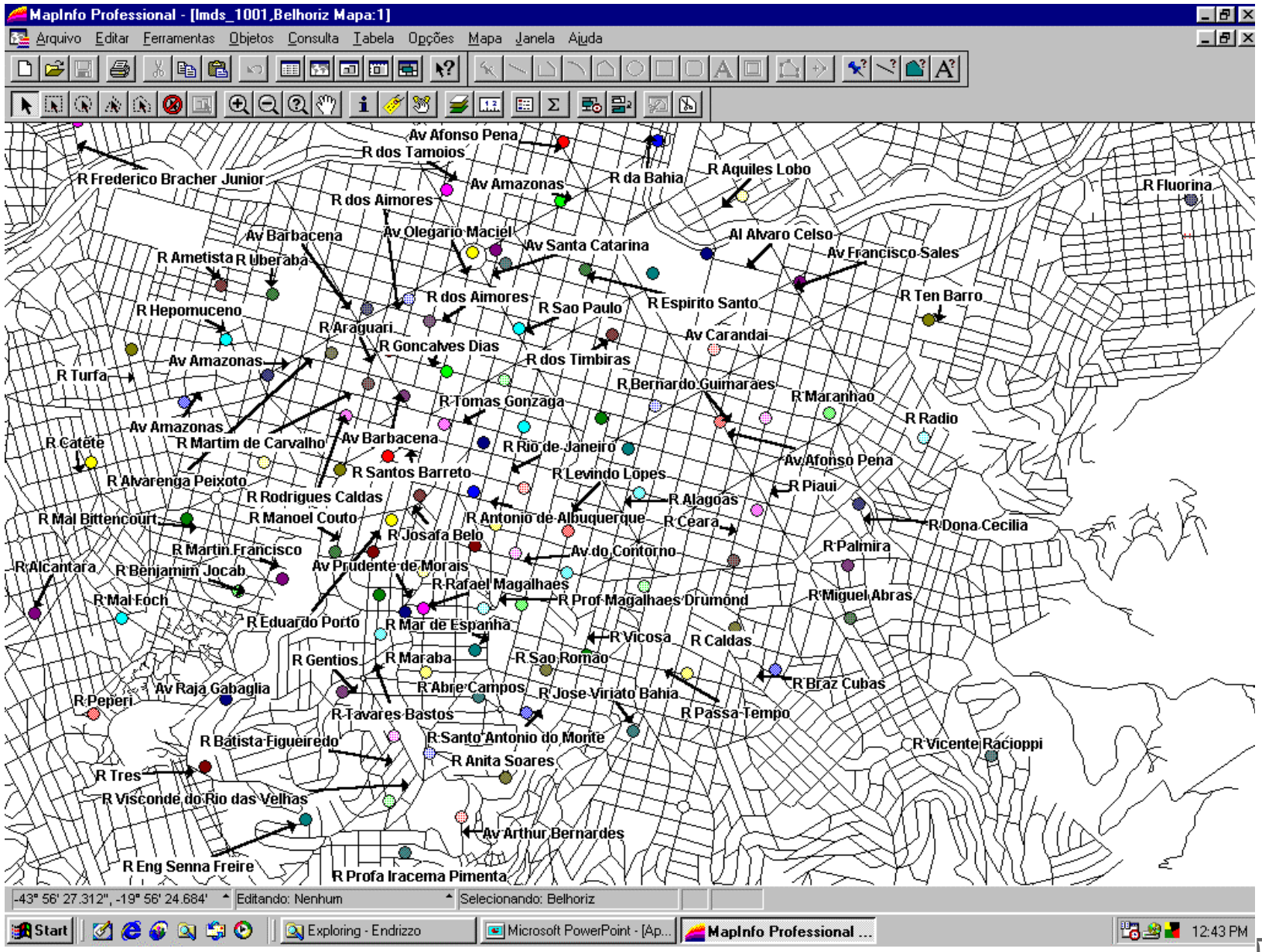
# Coverage Test

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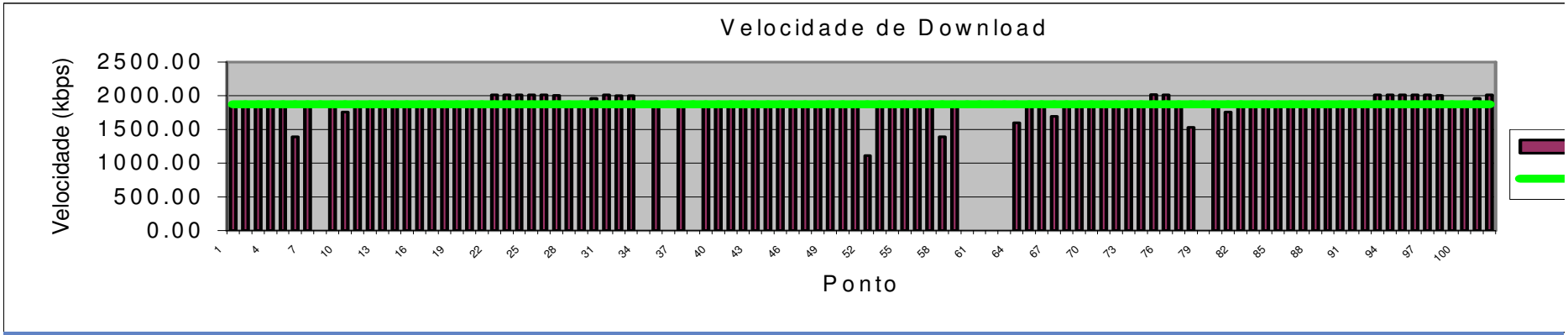
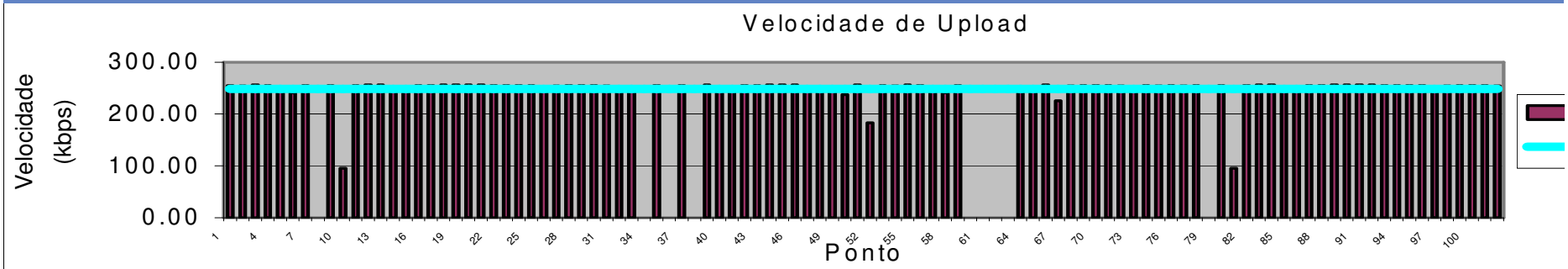
# Coverage Test Results




**Downstream Transmission Rate - Outdoor test**




**Upstream Transmission Rate - Outdoor test**

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# Applications Tests

## Internet access:

- Downstream up to 2 Mbps - QoS
- Upstream up to 800kbps - QoS

## VPN - Virtual Private Network

## VoIP - Voice over Internet Protocol (fixed and mobile)

- Intranet voice communication
- Access to Public Network - local and international

## Video Conference (fixed and mobile)

## Videostreaming (with Microsoft)

- Downstream 1,0 - 1,5 Mbps - MPEG-4 / Windows Media
- Upstream 500 - 800 kbps - MPEG-4 / Windows Media

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# Broadband Wireless Requirements

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# Broadband Wireless Requirements

## System Requirements are:

- *IP Native*
- *Non Line of Sight - Self install / indoor operation*
- *"Open platform" concept, based on international standards*
- *Affordable cost for the infrastructure and CPE*
- *Scalable and modular - able to grow according to market requirements*
- *Portable & mobile services*
- *VPN - ability to provide point-to-point connection services*
- *Multimedia service - webcasting, VoIP, video-conferencing, etc*
- *Cellular format - allowing maximum sectorization and frequency reuse*
- *Cell coverage - 2 to 5 km of radius, for urban / up to 35Km for rural areas*

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# Market needs

## Mass Market:

- *Product must compete with ADSL,*
- *One stop shop: Data, Entertainment, Telephony (VoIP)*

## Niche market:

- *Public Safety*: mobile and fixed applications for the police department
- *Traffic Department::* monitoring, communication and remote operations
- *Public Transportation::* monitoring, advertisement, communication

## Government:

- *Education:* connecting public schools, access to content
- *Health Care Department::* supporting applications and connection

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# Triple Play Service

## More Than 50% of European Broadband

## Subscribers Dissatisfied with

## Customer Service

### 66% Believe VoIP, Video and High-Speed Data from One Service Provider

### Will Improve Their Experience

*Broadband World Forum, Venice, Italy - September 20, 2004 — SupportSoft, Inc. Survey among European broadband subscribers*

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# Triple Players

## Who can provide?

- Data, Voice and Video (entertainment & education)?

- ***Brazilian Cable (HFC) Plant (too small?)***

- ***Telephone / ADSL (infrastructure?)***

- ***Wireless Broadband Service:***
  - ***Sufficient coverage, bandwidth and technology!***

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# Broadband Wireless Alternatives

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# Wireless Alternatives

| Technology | Standard | Usage | Throughput | Range | Frequency |
|---|---|---|---|---|---|
| UWB | 802.15.3a | WPAN | 110-480 Mbps | Up to 30 feet | 7.5 Ghz |
| Wi-Fi* | 802.11a | WLAN | Up to 54 Mbps | Up to 300 feet | 5 Ghz |
| Wi-Fi | 802.11b | WLAN | Up to 11 Mbps | Up to 300 feet | 2.4 Ghz |
| Wi-Fi | 802.11g | WLAN | Up to 54 Mbps | Up to 300 feet | 2.4 Ghz |
| WiMAX | 802.16d | WMAN | Up to 75 Mbps (20 Mhz BW) | Typical 4-6 miles | Sub 11 Ghz |
| WiMAX | 802.16e | Mobile WMAN | Up to 30 Mbps (10 Mhz BW) | Typical 1-3 miles | 2-6 Ghz |
| WCDMA/UMTS | 3G | WWAN | Up to 2 Mbps (Up to 10 Mbps with HSDPA technology) | Typical 1-5 miles | 1800, 1900, 2100 Mhz |
| CDMA2000 1 x EV-DO | 3G | WWAN | Up to 2.4 Mbps (typical 300-600 Kbps) | Typical 1-5 miles | 400, 800, 900, 1700, 1800, 1900, 2100 Mhz |
| Edge | 2.5G | WWAN | Up to 348 Kbps | Typical 1-5 miles | 1900 Mhz |

***Source: INTEL / WiMax Forum***

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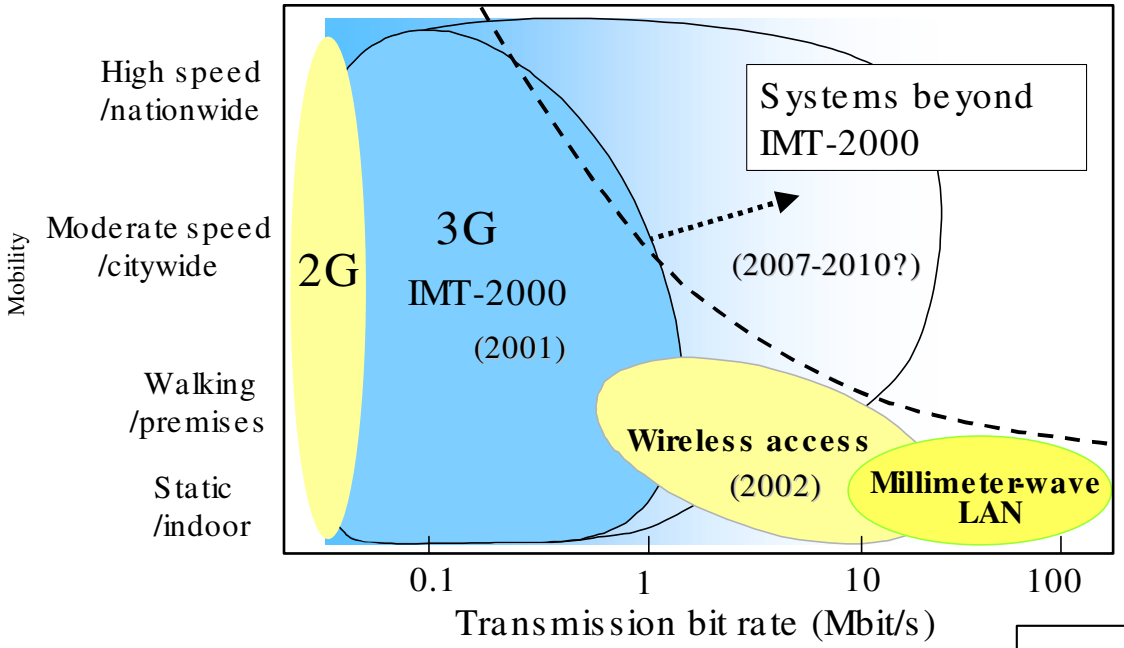
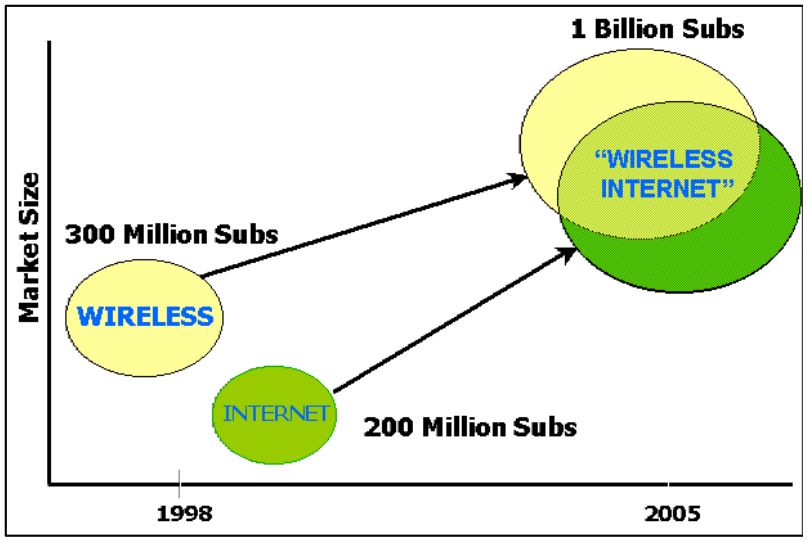
# Technology Trend




*Source: ITU - Systems Beyond IMT-2000*

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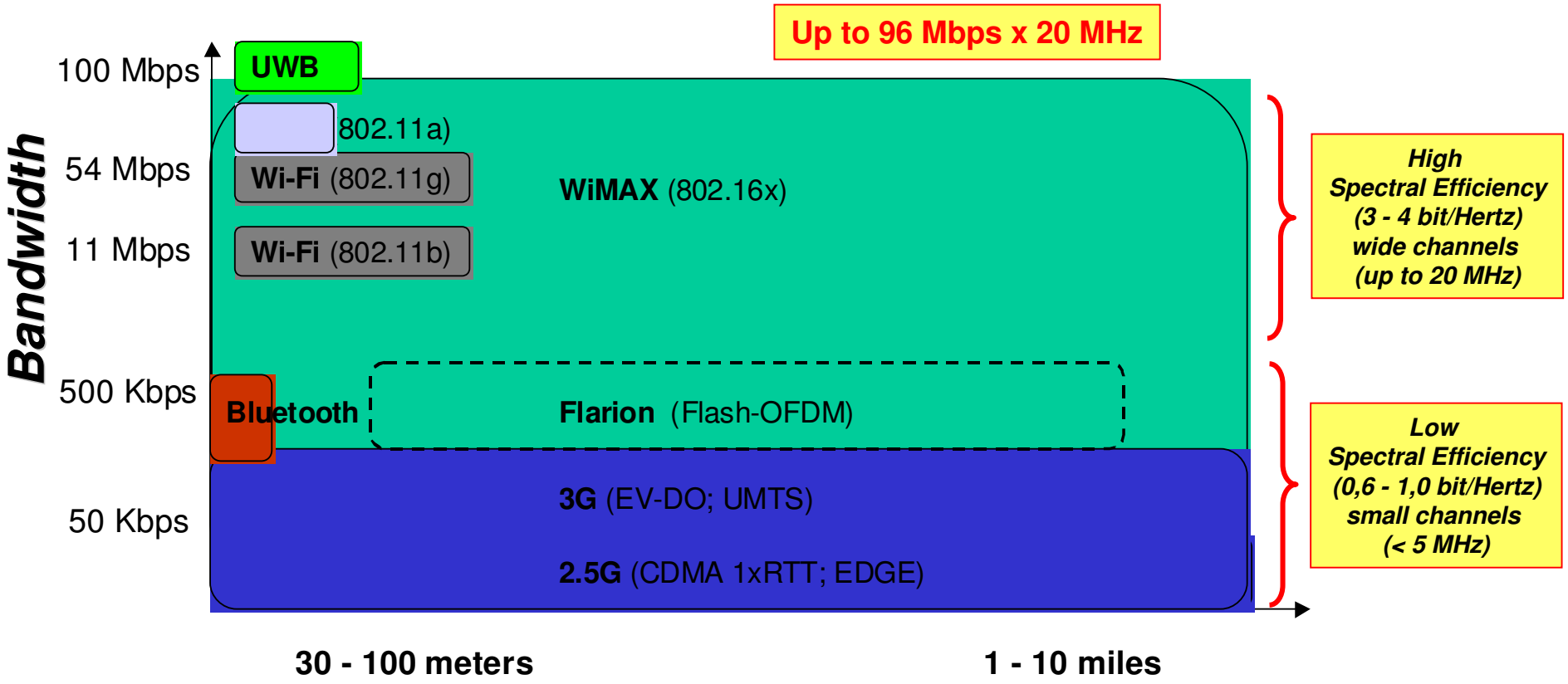
# Technology Alternatives

## Comparing Technologies




**Source: bytelevel** / *research*
***www.bytelevel.com***

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# Wireless Evolution

| Parameter | IMT-2000 | Systems Beyond IMT-2000 | Pre-WiMax | WiMax Standard |
|---|---|---|---|---|
| Spectral Efficiency (bits/Hertz) | 0.6 - 0,8 | ---- | 1,5 - 2 | 3 - 4 |
| Adaptive Modulation + Adaptive Coding | No | Yes | Yes | Yes |
| Time Division Duplex (TDD) | No | Yes | Yes | TDD/FDD |
| OFDM Modulation | No | Yes | OFDM or CDMA | Yes |
| Adaptive Antennas / "Smart Antennas" | No | Yes | Yes | Yes |
| Multiple-Input / Multiple-Output (MIMO) | No | Yes | No | Yes |
| Native "IP" | No | Yes | Yes | Yes |

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# A Single Platform for IP and Video Broadcasting

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# *Video Broadcasting x Video Multi/Unicast*

***Video Broadcasting*** **- a single medium transports several programs:**

**(Typical point-to-multipoint topology):**

- **Cable System - HFC - 50 to 550/750/850 MHz - Downstream**
- **Direct To Home - DTH - > 200 MHz - Downstream**
- **MMDS - up to 186 MHz - Downstream**

***Video Multi/Unicast*** **- a single medium transports only a few programs:**

**(Typical point-to-point topology):**

- **Digital Subscriber Line - DSL - 2 to 8 Mbps**
- **General Packet Radio Service - GPRS - up to 170kbps**

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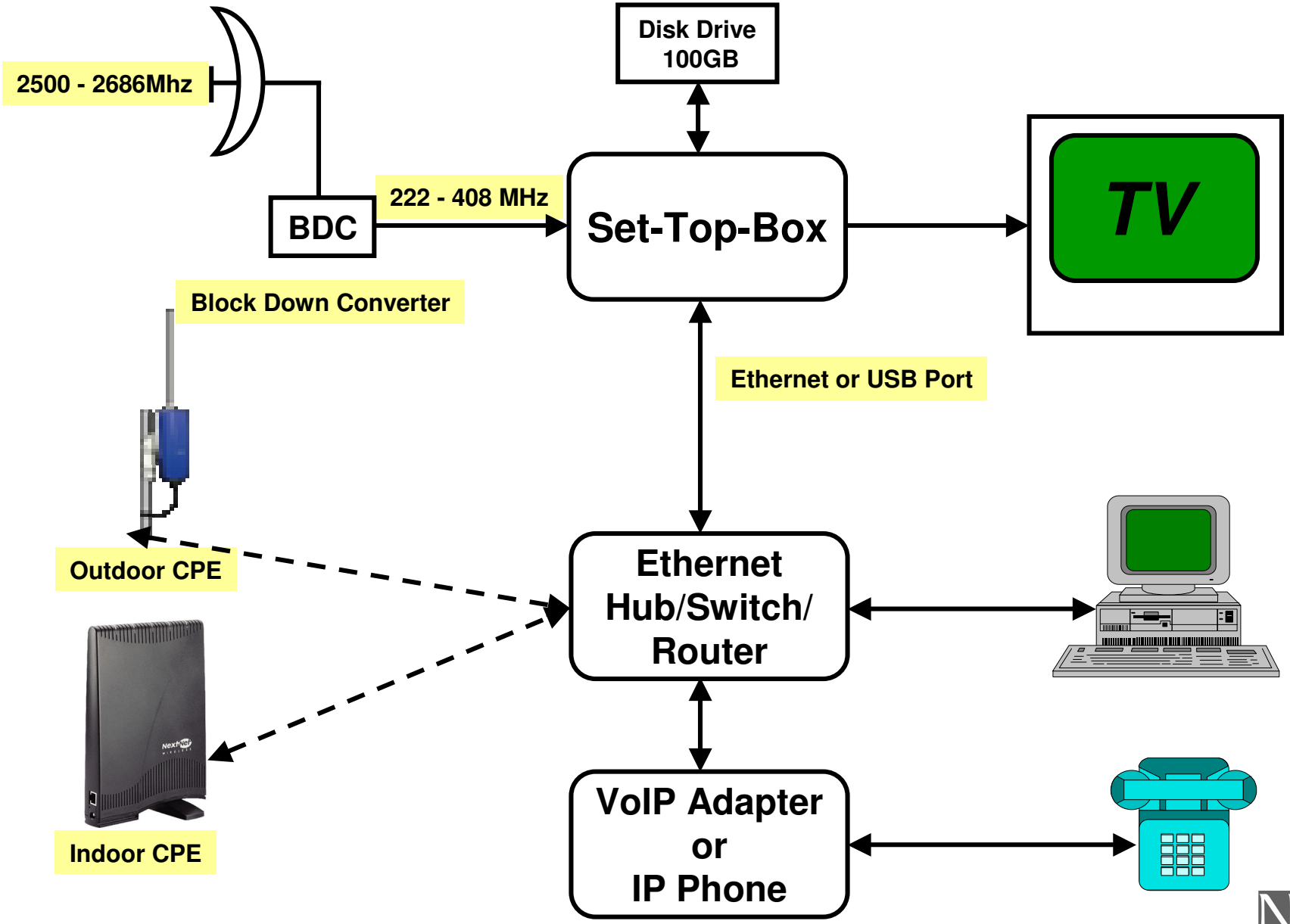
# Video Broadcasting + IP

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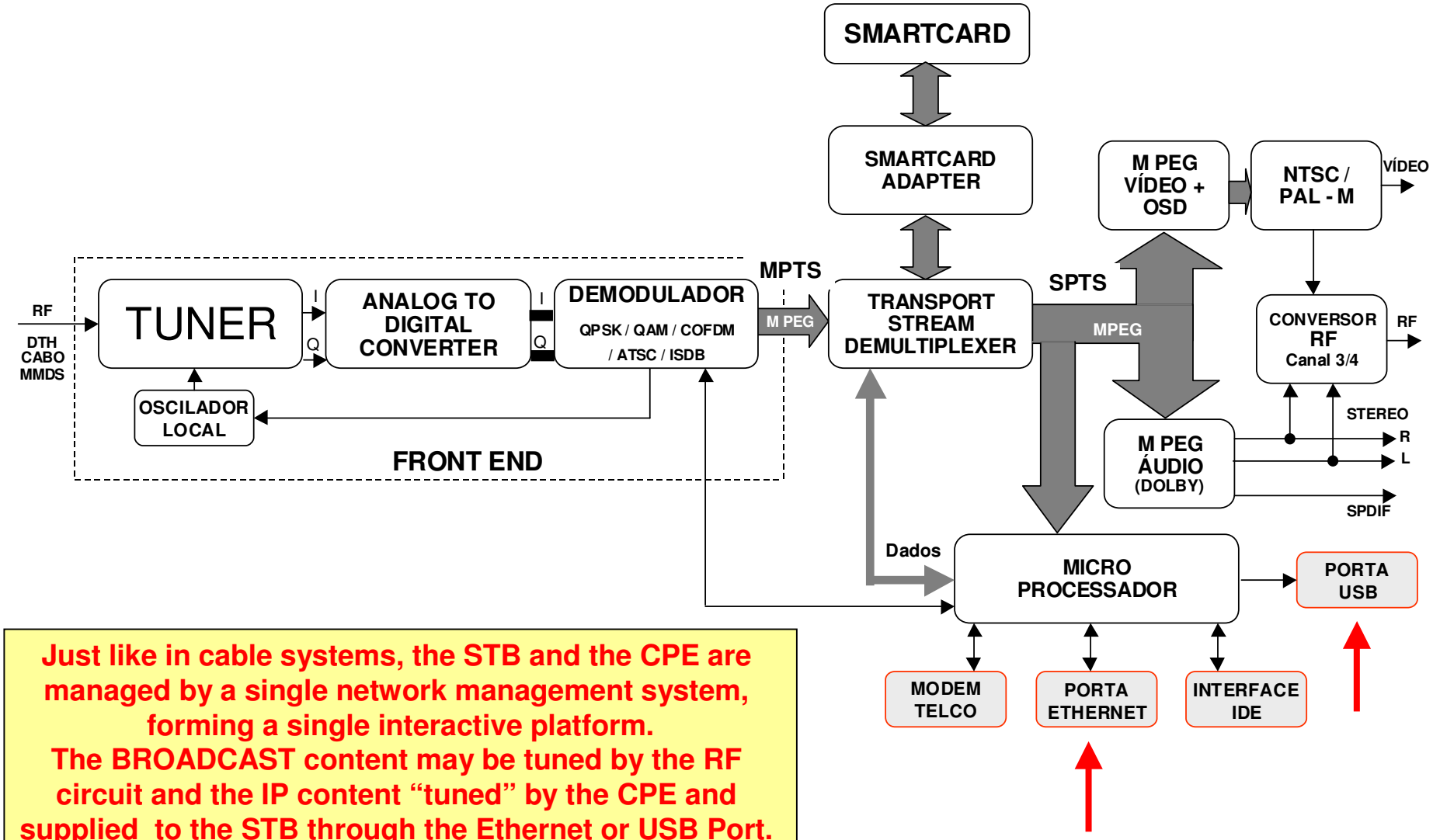
# Video Broadcasting + IP

## Digital SET-TOP-BOX Block Diagram




**Just like in cable systems, the STB and the CPE are managed by a single network management system, forming a single interactive platform.**
**The BROADCAST content may be tuned by the RF circuit and the IP content "tuned" by the CPE and supplied to the STB through the Ethernet or USB Port.**
**Both MPEG contents are decoded by the same STB processor.**

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# THANK YOU!

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