IEEE802.21 and Broadcast Handovers

Burak Simsek (Fraunhofer Institute)
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Juan Carlos Zuniga (InterDigital Communications, LLC)
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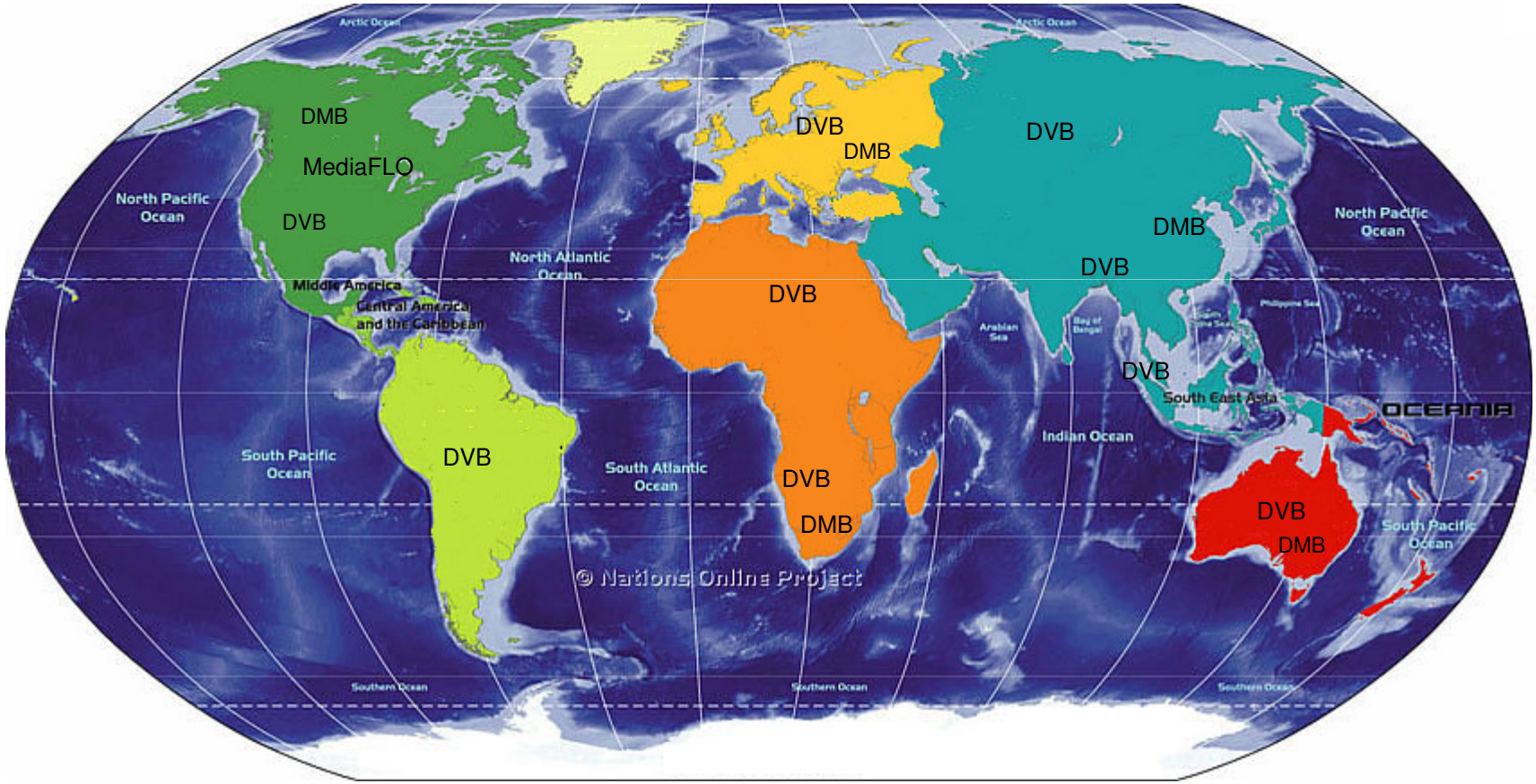
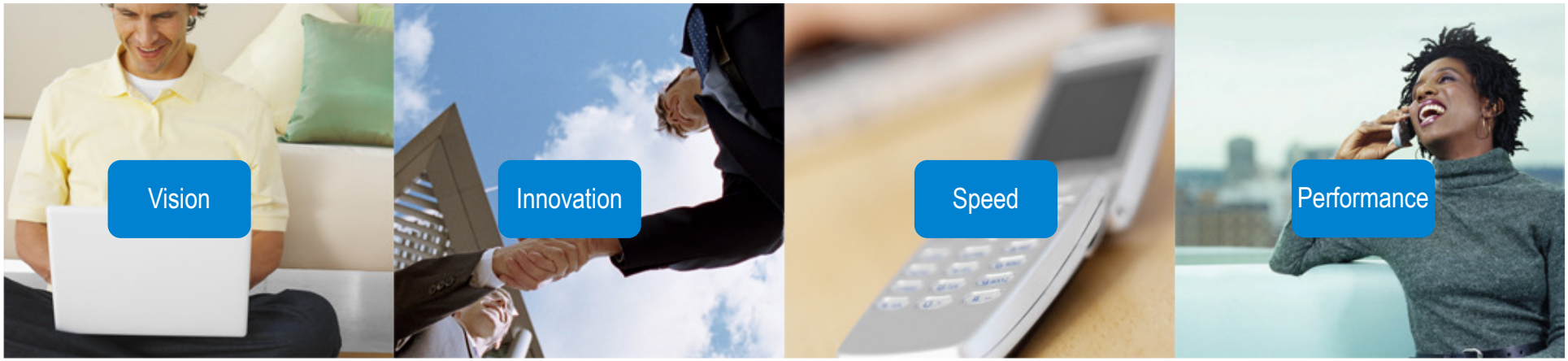
Outline

- Introduction
- Convergence of Broadcast-Mobile Technologies
  - *Juan Carlos Zuniga from InterDigital*
- DVB (Digital Video Broadcasting)
  - *Jens Johann from Deutsche Telekom*
- MediaFLO
  - *Farrokh Khatibi from Qualcomm*
- DMB (Digital Multimedia Broadcasting)
  - *Byungjun Bae from ETRI*
- Broadcast Handovers
  - *Burak Simsek Fraunhofer Institute*
- Conclusion

Broadcast World





Convergence and Handovers

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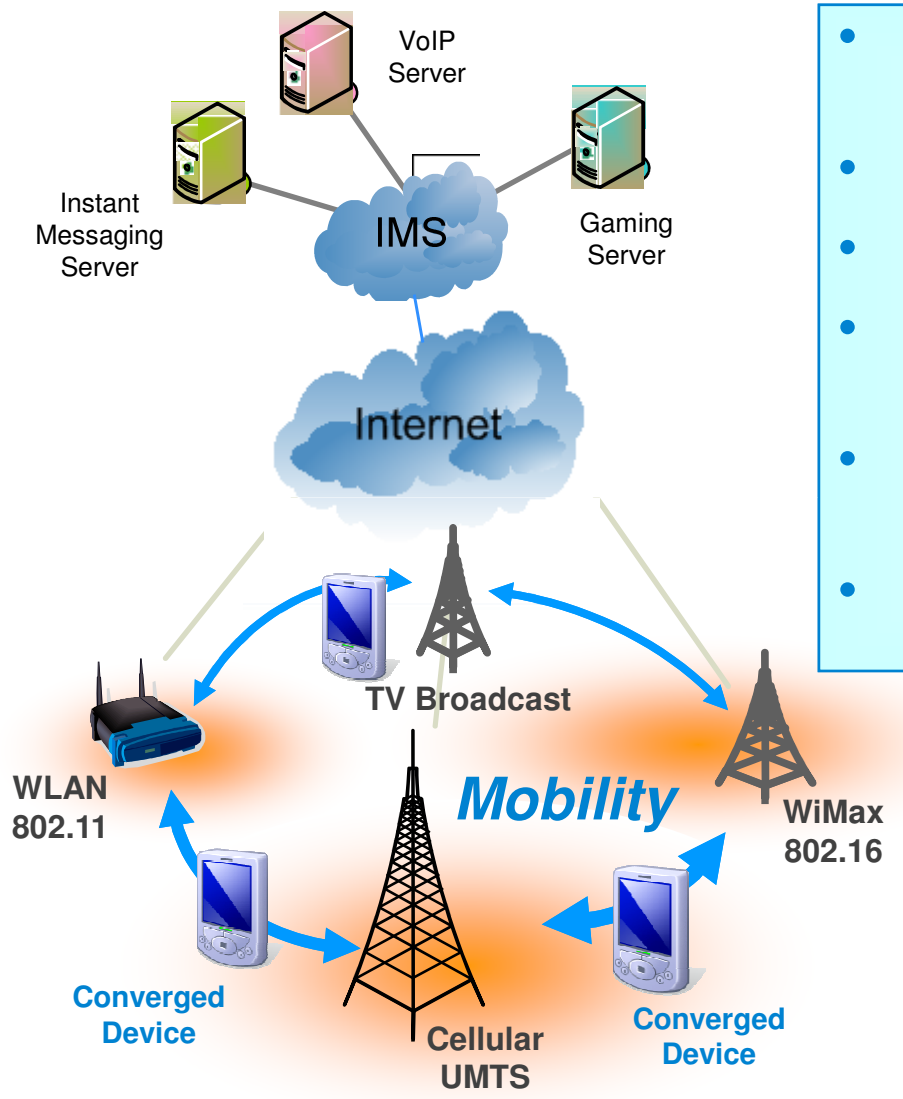
Mobility Requirements for Convergence



- Seamless mobility between multiple radio technologies
- IP-based protocols and networks
- Support for evolving usage models
- Always connected to IMS, Content and Web services
- Upgradeable for future more capable devices
- No user intervention required



InterDigital®

Hybrid Networks: Broadcast and Communications

- Both networks can benefit from each other
- WiMAX, WLAN, 3GPP/3GPP2 network operators can benefit from:
  - Multicasting with much better quality, to a larger set of customers with one transmitter
  - Market penetration with little investment
    - DVB-H supported by the EU commission as the mobile TV standard
    - 20 billion € expected revenue in 2011 (2M subscribers in 2006, 6M in 2007)
  - Use of existing broadcasting brands and new services
- Broadcast network operators can benefit from:
  - Virtual bidirectional channel
  - AAA support
  - Enabling more services as a result of interactivity
    - Customized advertisements, Mobile TV, live polls, purchase banners, interactive games, chat services, webcasting, file transfers, etc.

Converged Devices and Standards

- In the following years we will dominantly see more services relying on hybrid networks
- Devices capable of DVB-H, WLAN, UMTS are already available
- Fixed Mobile Convergence Alliance (FMCA) started interoperability Work Item on IEEE 802.21 MIH in June 2008
- Interactive mobile TV standard for a common user interface with a media independent Java API (JSR 272) is also there
- Open Mobile Alliance (OMA) Mobile Broadcast Services Enabler Suite (BCAST) supports DVB-H, 3GPP MBMS, 3GPP2 and mobile unicast streaming systems at the application layer

Main Broadcast Usage Scenarios

Bidirectional channels required

Mobile TV/Radio

- TV/radio transmission
- FTA (free-to-air) or encrypted transmission
- H.264 streaming

Mobile TV with synchronized, auxialiary data stream

- TV with auxiliary data i.e. text or data elements for interaction
- No synchronization of data elements with A/V stream
- Time shifting

Interactive mobile TV

- Rich media services with advanced interactivity
- A/V stream includes additional data streams
- Synchronization of data streams with A/V stream

File Download

User triggered download of any kind of content via broadcast

- Ring Tones
- Music
- Maps
- A/V clips
- Games…

Mobile TV Usage Scenarios

Usage scenarios for Mobile TV with auxiliary data link

Voting/Polling

- Voting, polling, quizzes or other games during a TV show
- Results fed in real time via the interactivity channel

Info Push

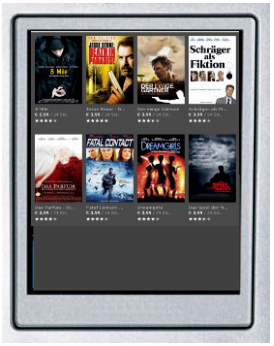
- Additional information presented in ticker format
- Ticker might contain interactive elements e.g. news, shopping

Shopping

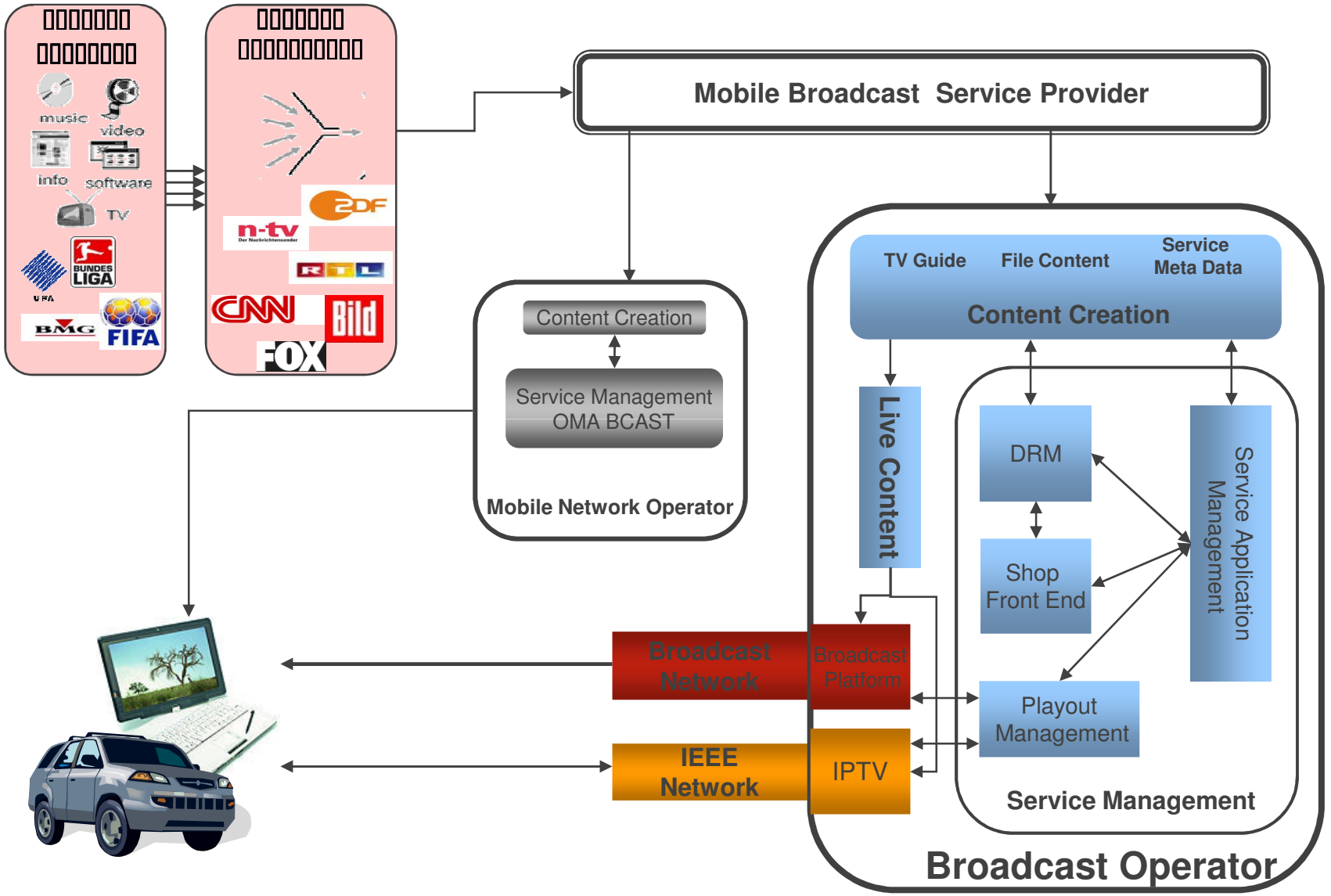
- Advertised products can be directly purchased
- Connection to a shop triggered by a link

VoD

- User can access on demand short video clips (i.e. roundups, news, shows)



Broadcast Service Network



Link Layer Handover Needs

- Interaction at L2 is missing and needed
  - IEEE 802.21 is the best candidate to fill in this gap
- Inter-technology handover requirements in 802.21 are also applicable to broadcast services
  - QoS concerns, service availability, price, power consumption, network selection, etc.
  - Coverage Problem also exists in suburban and intra-urban areas
- Automobiles equipped with DVB - UMTS- WIMAX already being tested by some manufacturers

IEEE 802.21 MIH Advantages for Mobility

- IEEE 802.21 MIH enables seamless handovers across different access technologies
- Enhances user experience during handover:
  - Optimizes Layer 3 handover (e.g. Mobile IP, Proxy Mobile IP, SIP)
  - Provides QoS continuity across different technologies
  - Minimizes service interruption
- Provides ease of implementation:
  - Thin software client on terminals
  - No radio access network modifications required
  - Addition of a single MIH server in the IP network
- Supports either network or client-controlled handovers

DVB Systems and Mobile TV

Dr. Jens Johann (Deutsche Telekom)

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IEEE 802 Meeting, Denver, 14th July '08

Deutsche Telekom

Digital Video Broadcasting

- Some Basics on the DVB Project
- Candidates for Handover Activities:
  - DVB-T
  - DVB-H
  - DVB-SH
  - DVB-IPTV
- Conclusions

The DVB Project: Basics

- Founded in '93 with office based in Switzerland
  - in a effort to provide a joint European approach to convert analogue to digital television,
  - Popularity of solutions quickly led to applications on a world-wide basis…
- 270 member organisations
  - uniquely - all elements & actors of the value chain are involved,
  - >180 meetings a year take place all over the world,
  - DVB counts approximately 1000 active participants…
- Today : 58 standards and specifications
  - Today : >200 million DVB decoders around the world…
- The DVB aims:
  - to provide standards and specification for digital television by whatever means
    - satellite, cable, terrestrial, microwave, DSL… and many others ☺!
  - to ensure all elements of the value chain are involved in the development
    - manufacturers, broadcasters, network operators, regulators

Deutsche Telekom

DVB

DVB Standards Preferred for Handover

DVB T

- Terrestrial transmission in UHF and VHF bands, support of several channel bandwidths, optimized for fixed reception, but also usable for portable and mobile reception
- Benefits of handover: Increase of coverage area, improved In-Home support

DVB H

- Terrestrial transmission to battery-powered handhelds, uses the physical layer of DVB-T, IP Datacasting, access to mobile communication networks possible
- Benefits of handover: selection of best-suited network, support of interactive services

DVB SH

- Hybrid network of satellite and terrestrial transmission constituting a Single Frequency Network, coverage of large areas
- Benefits of handover: Support of interactive services

DVB IPTV

- Digital TV using IP over bidirectional fixed broadband access
- Benefits of handover: Extension of IPTV services to handhelds in the home including interactive services

DVB-Terrestrial

- Some technical details
  - OFDM modulation with 2k or 8k carriers
  - Selectable Guard Interval to fight multi-path propagation
  - Robust channel encoding by concatenation of Reed-Solomon and Convolutional Encoding
  - Transmission bandwidths and signal patterns (pilots, transmission parameters) are adaptable to 5, 6, 7, and 8 MHz radio channels
  - Typical user data rate in a 8 MHz channel: approx. 20 Mbit/s
- On the horizon: DVB-T2
  - Higher user data rate aiming at terrestrial HDTV transmission
  - Support of data broadcast
  - More flexible distribution of services within the available bandwidth
  - Improved channel encoding algorithms

A typical portable DVB-T receiver

The street price of this receiver is 140 €

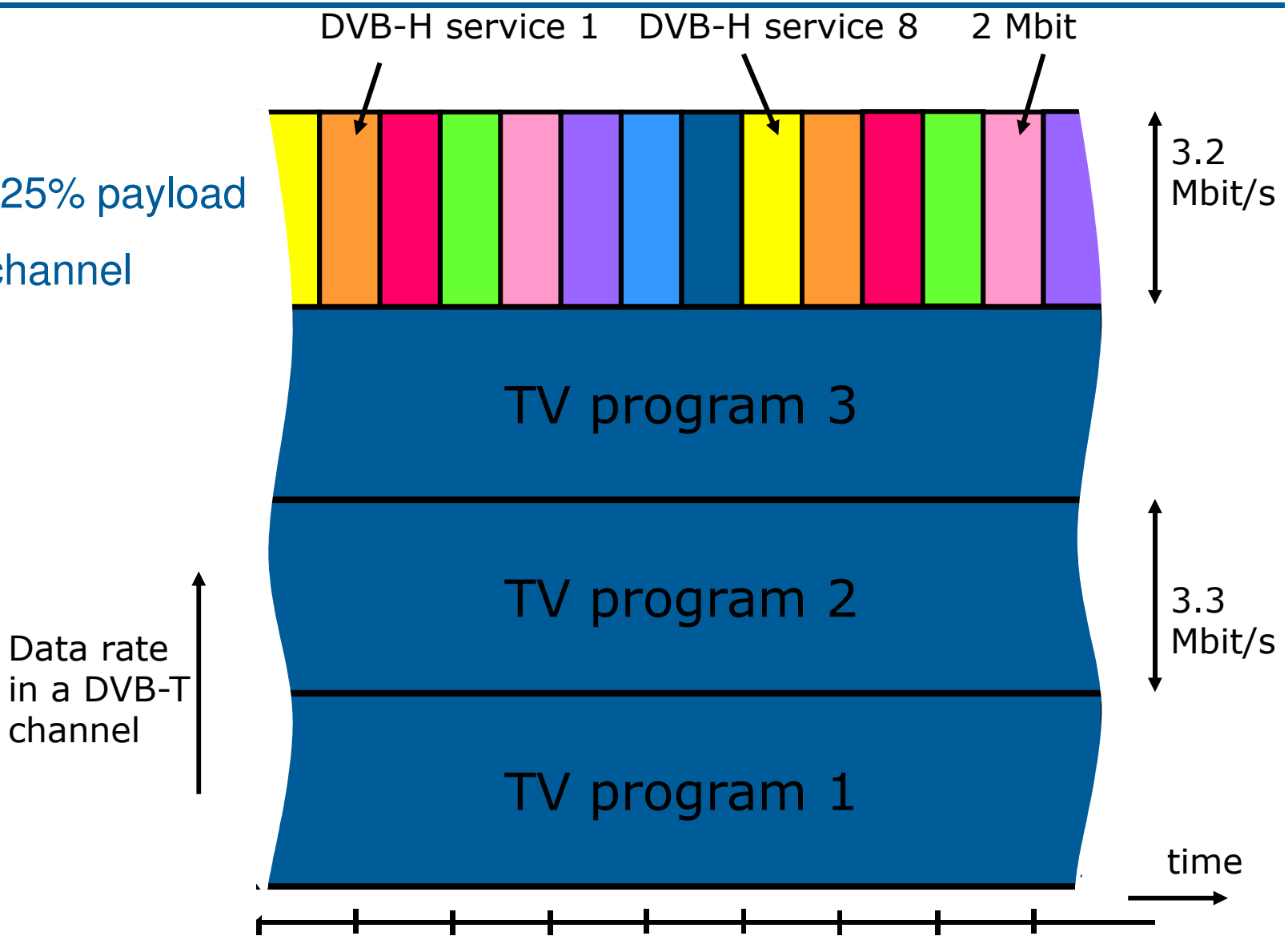
DVB to Handhelds

- Some technical details
  - Additional OFDM mode: 4k carriers as option – but currently not in use
  - The input data is formatted as IP packets
  - Multi-Protocol Encapsulation (MPE) is used to encapsulate these packets into the well-known MPEG Transport Stream
  - Typical DVB-H devices have built-in antennas → to fight the low antenna gain an additional level of FEC was developed: MPE-FEC
  - Typical DVB-H devices are battery-powered → Time slicing reduces power consumption by supporting burst transmission
  - Selectable DVB-H parameters
    - Service data rate, multiplex data rate
    - For MPE-FEC: Frame size, code rate
    - For time slicing: Burst size or duration or play-out data rate, cycle time, duty cycle
  - DVB-H uses DVB-T transmission parameters

DVB to Handhelds: Power Saving by Time Slicing

DVB-H as a 25% payload

in a DVB-T channel



Satellite Services to Handhelds

- Some technical details
  - DVB-SH combines satellite and terrestrial transmission
  - Support for multi-beam satellites
  - Terrestrial transmitters are able to work as SFN
  - Two architectures: DVB-SH-A uses OFDM on both, the satellite link and the terrestrial link whereas DVB-SH-B uses TDM on the satellite link and OFDM on the terrestrial link
  - Channel encoding is common for OFDM and TDM
  - FEC with the help of a 3GPP TurboCode over input blocks of 12282 bits
  - Preferred Frequency Bands: 1 … 3 MHz
  - Supported bandwidth: 1,75 MHz, 5 / 6 / 7 / 8 MHz
  - OFDM sizes: 1k / 2k / 4k / 8K
  - Modulations:
    - On OFDM: QPSK, 16 QAM, Hierarchical
    - On TDM: QPSK, 8 PSK, 16APSK

Satellite Services to Handhelds

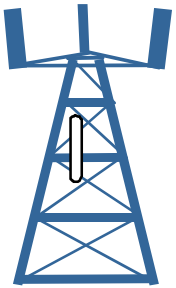
DVB-SH targets S-Band (2,2 GHz), which is some 50% higher than L-Band and 4 times as high as UHF

Satellite

OFDM modulation In S-Band

Terminal

Satellite Earth Station

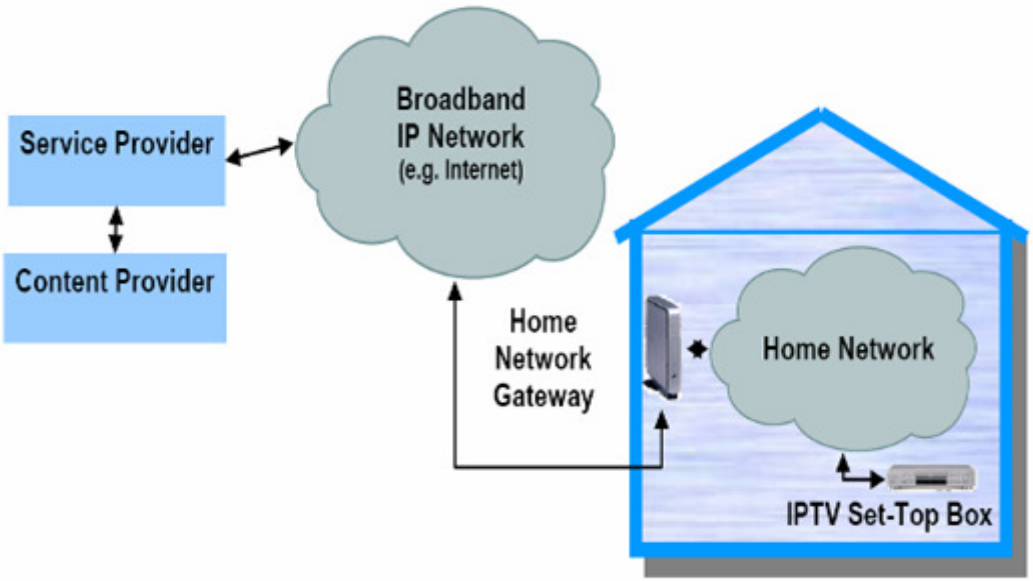


Terrestrial Gapfiller

OFDM-modulation in S-Band

DVB-IPTV

- DVB-IPTV is the collective name for a set of technical specifications, that facilitate the **delivery of digital TV using Internet Protocol over** bi-directional fixed **broadband**



DVB-IPTV Phase 1.x				DVB-IPTV Phase 2
Reference Model MPEG2-TS encapsulation on IP Service Discovery & Selection RTSP Client for delivery of broadcast and on demand services	Support of Advanced Video Codecs Broadband Content Guide	Application Layer FEC Regional services Logical Channel Numbering Service Transport with RTP optional	Remote Management Content Download mechanisms for non real time services Network Service Provider applications Profiles Home Network	Integration of IPTV with traditional IP Services including pure IP based transport
Q1'05 TS 102 034 V1.1.1	Q2'06 TS102 034 V1.2.1[1]	Q1'07 TS 102 034 V1.3.1[2]	Q4'07	Started

Conclusions

- Mobile networks can offer a Mobile TV experience but they are resource-limited
- Broadcast systems are available to help out
- Several DVB systems together with IP Datacasting are available to support a converging market
- Both types of systems can help with the deployment of interactive services
- On June 26th the Steering Board of the DVB Project approved a new work item on a collaboration between the DVB Project and IEEE 802.21
- ….okay, let's start with the work

Deutsche Telekom

DVB

More Media. More Mobile. More You.

MediaFLO™ Overview

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QUALCOMM®

QUALCOMM®
MediaFLO™

Agenda

MediaFLO*

- FLO Forum
- Service Introduction
- Technical Characteristics

* For a more detailed technology overview, please visit:
http://www.mediaflo.com/news/pdf/tech_overview.pdf

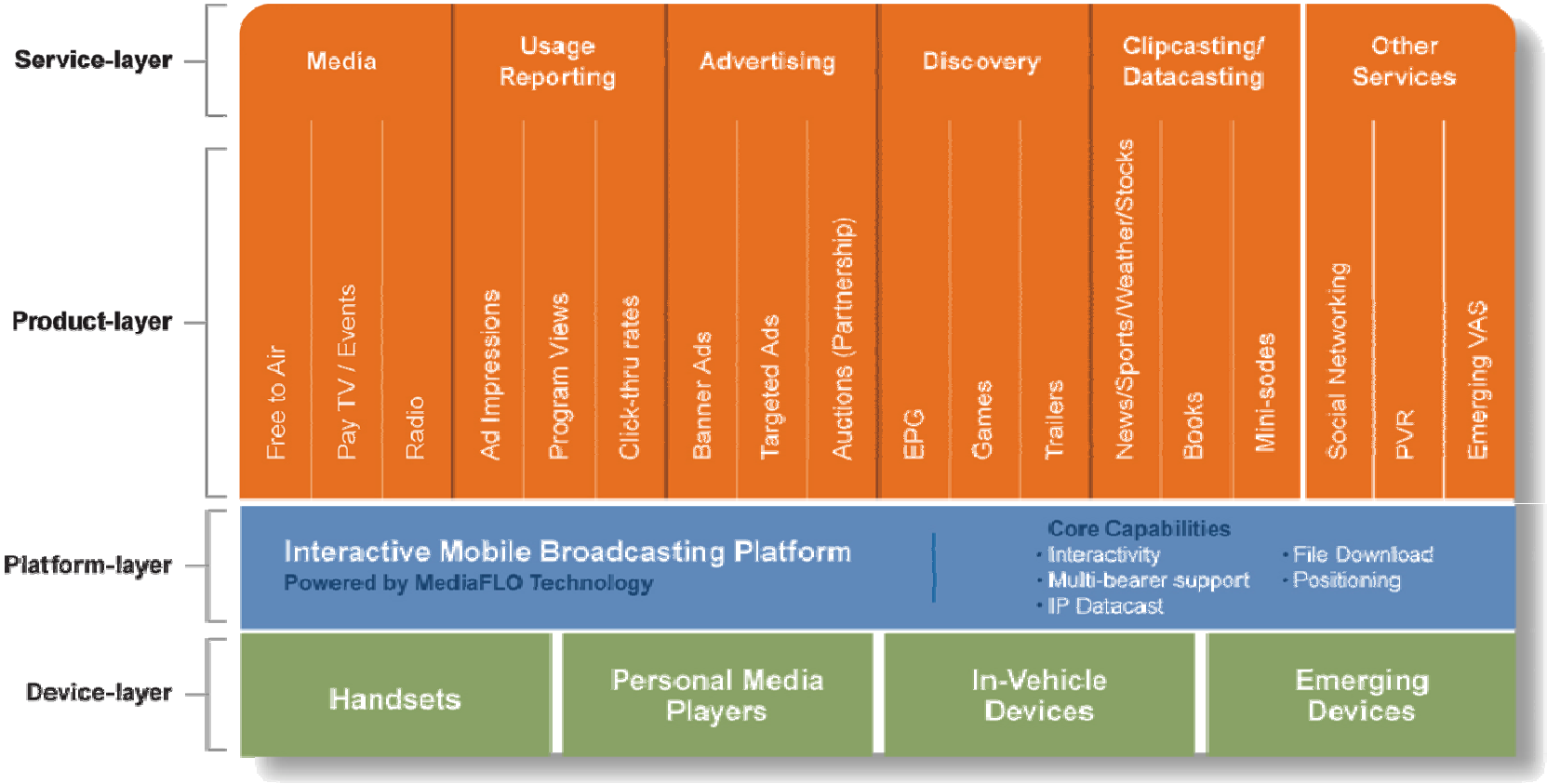
FLO Forum and FLO Specifications

- FLO Forum: 97 member companies, 10+ pending
  - Mission:
    - Promote FLO technology standardization globally
    - Support efforts for acquisition and clearing of spectrum globally for Mobile TV
    - Promote the development and certification of FLO products and services
  - Major completed and ongoing technical spec work in FLO Forum
    - FLO Air Interface Specification Rev. 1.0 and 2.0
    - FLO System Information spec (completed in 2006)
    - OpenFLO – open specification framework to enable commercial FLO eco-system
    - Open Conditional Access Rev 2.0
- Published FLO-Related Standards
  - TIA-1099: FLO Air Interface Specification
  - TIA-1102: FLO Device MPS (Minimum Performance Spec)
  - TIA-1103: FLO Transmitter MPS
  - TIA-1132: FLO Repeater MPS
  - TIA-1104: FLO Test Application Protocol
  - TIA-1120: FLO Transport Specification
  - TIA-1130: FLO Media Adaptation Layer Specification
  - TIA-1146: FLO Open Conditional Access
  - ETSI: ETSI TS 102 589 (FLO AIS)– ongoing approval cycle for current draft spec
  - ITU-R SG6 WP6M – FLO as Multimedia System M

MediaFLO Service

- Mobile entertainment and information platform, offering
  - Subscription-based service
  - QVGA live streaming video, up to 30 frames per second
  - Clipcasting™ – network scheduled media
  - Datacasting – phone as lifestyle management device
  - Interactive services for two-way exchange
- Commercial traction
  - USA: Verizon Wireless (03/07 launch) and AT&T (2Q/08 expected launch)
  - UK: Cambridge and Manchester trials held with BSkyB
  - Japan: interest of Japan operators to explore the possibility of providing services using MediaFLO™ technology in Japan
  - Ongoing business development in many other countries: e.g. Chile, Taiwan, Hong Kong, Malaysia

Services Delivery Platform



P.5

Clipcasting™, Datacasting, and Interactivity

Mobile phones become a lifestyle management device

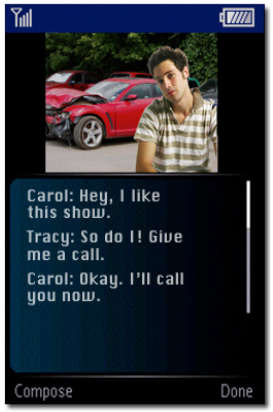
Clipcasting

Distribution Window indication in Program Guide to enable power savings

Datacasting

Integrated, easy-to-use continuous TV experience

Invitation never overlaps TV show

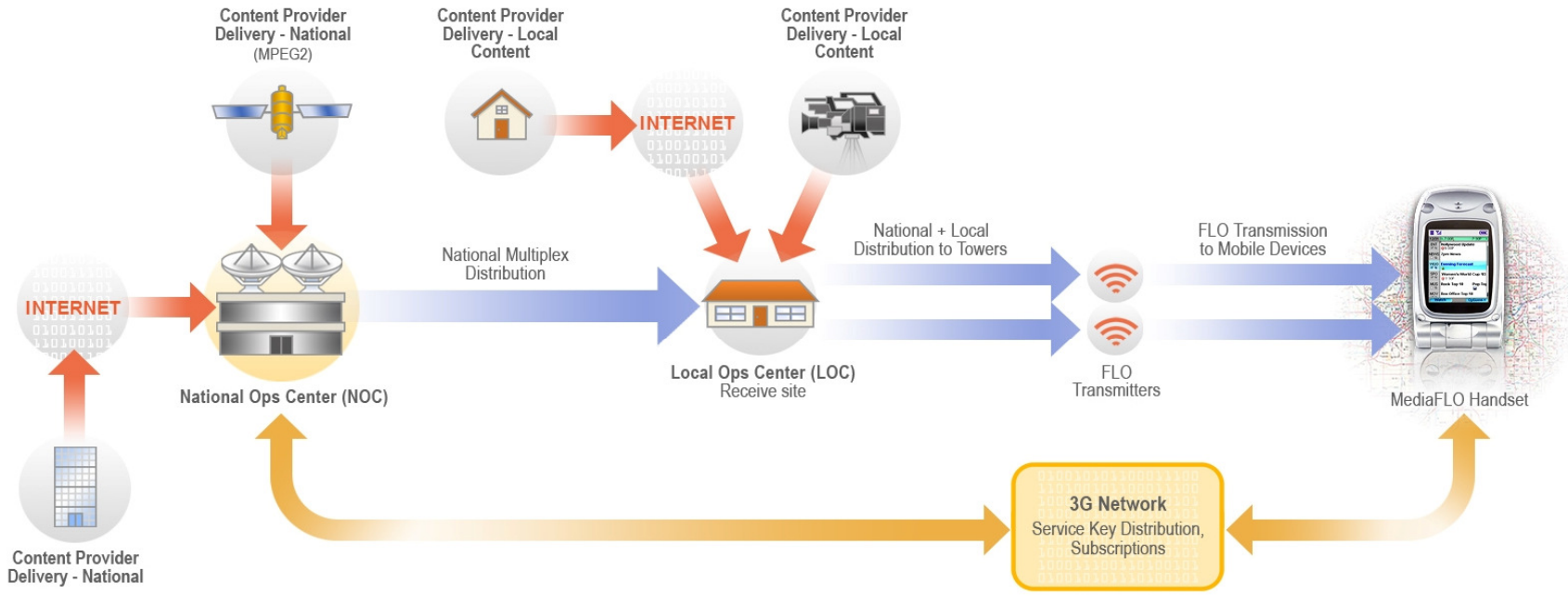


TV Chat

Voting

Simple, easy-to-use integration with TV player

MediaFLO Architecture



End-to-end MediaFLO network architecture:

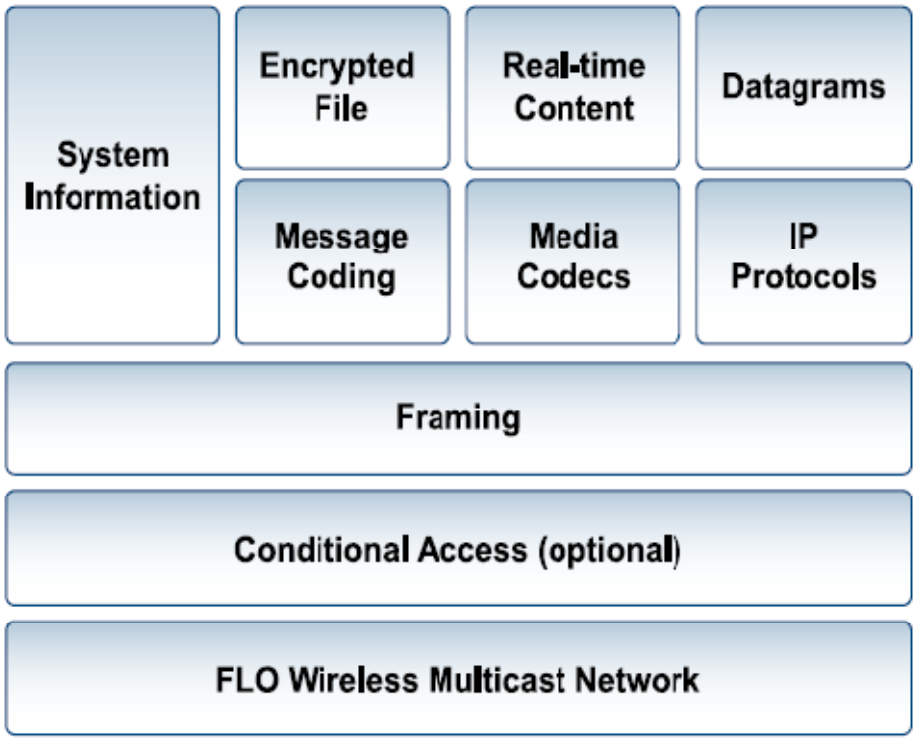
MediaFLO Technology Highlights

Higher Efficiency with Optimum Capacity & User Experience Simultaneously

- **OFDM-based broadcast technology**
  - Spectral efficiency of 1-2 bit per second per Hz
  - 4096 (4k) subcarriers
- **Various modulation techniques**
  - QPSK/16-QAM, various code rates
  - Layered modulation for extended coverage
- **Virtual and dynamic channelization**
  - Quality of Service – video quality can be adapted for media types
  - Increased capacity gain – statistical multiplexing
- **Superior mobility**
  - Robust operation at low and vehicular speeds > 200 kph
- **National and local area services**
  - Delivered in one RF channel
- **Lower power consumption**
  - 4+ hours of battery time on a standard battery
- **Fast acquisition (channel change)**
  - ~ 2 seconds channel switching time

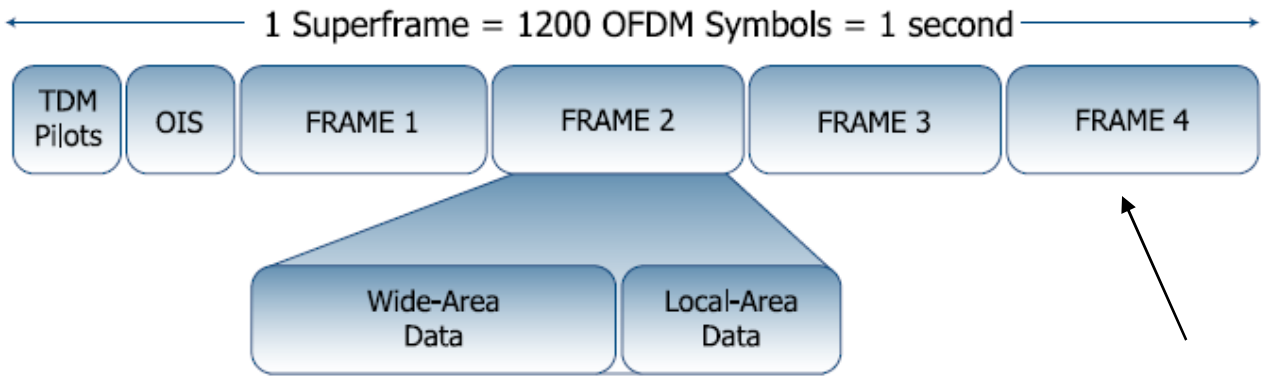
FLO High Level Protocol Stack

- FLO Protocol stack is variable according to data type i.e. SI, streaming, clipcast, or IP services.
- The needs of each data type are optimized.
  - PER requirements for files are generally more stringent than streaming.



FLO Super Frame Structure

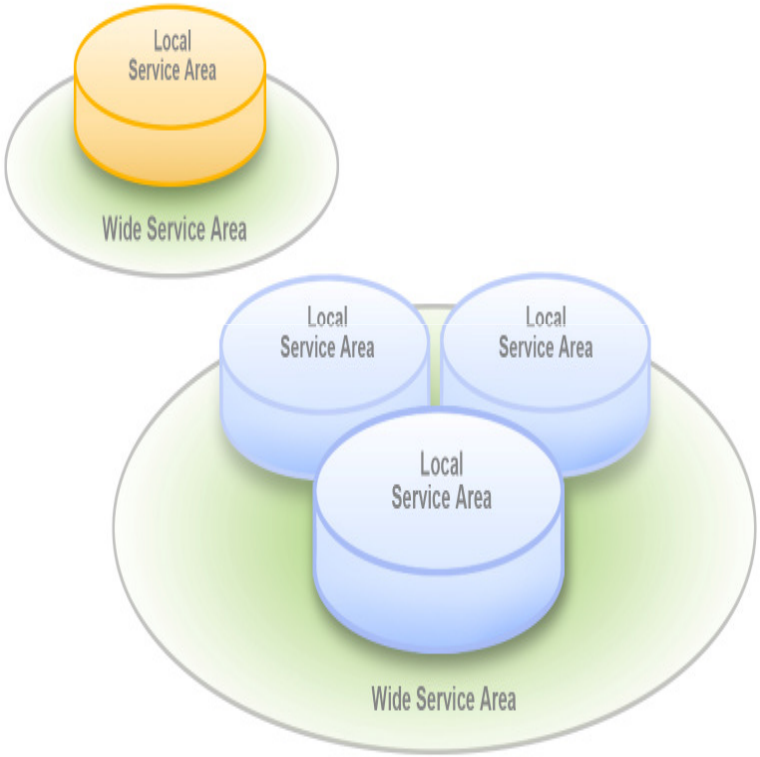
- A FLO Superframe is comprised of three sections
  - TDM Pilots are used for acquisition and cell identification
    - 98% of the available symbols carry system traffic
  - The Overhead Information Symbols (OIS) defines the desired data location within each frame
    - OIS and TDM pilots consume 2% of the total symbols
  - The balance of the superframe is traffic data or parity
    - Typically for RS(16,12) frames 1-3 are data and frame 4 is parity



Power off, when the first 3 frames are correct

Wide Area and Local Area Services

- Within one FLO channel, resources can be flexibly divided between
  - Wide-area services - multicast in all service areas
  - Local-area services - specific to a particular service area
- Wide-area services do not experience degradation at the boundary of local service areas



MediaFLO Delivers without Compromise

- Quality vs. Capacity
  - At same link margin MediaFLO can deliver more than 2x the amount of content
  - Clipcasting™ and Datacasting can be jointly optimized with linear programming
- Channel Switching vs. Battery Life
  - Replication of in-home viewing experience – MediaFLO achieves channel switching of 1.5 to 2 seconds
  - Efficient power consumption won't negatively impact core voice/data business
  - MediaFLO can deliver 4+ hours of consecutive viewing at QVGA video and stereo audio with an 850 mAh battery
  - Customer satisfaction and 3G revenue remain high with fast channel switching and extended battery life
- Perceived Network Quality
  - Graceful service degradation through layered modulation for improved user
  - Mid-stream service loss unacceptable for video entertainment
  - Layered modulation enables enhanced mobile experience

MediaFLO Drives the Most Compelling and Sustainable Long-Term Competitive Position

T-DMB System and Service

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ETRI

IEEE 802 Meeting, Denver, 14th July 2008

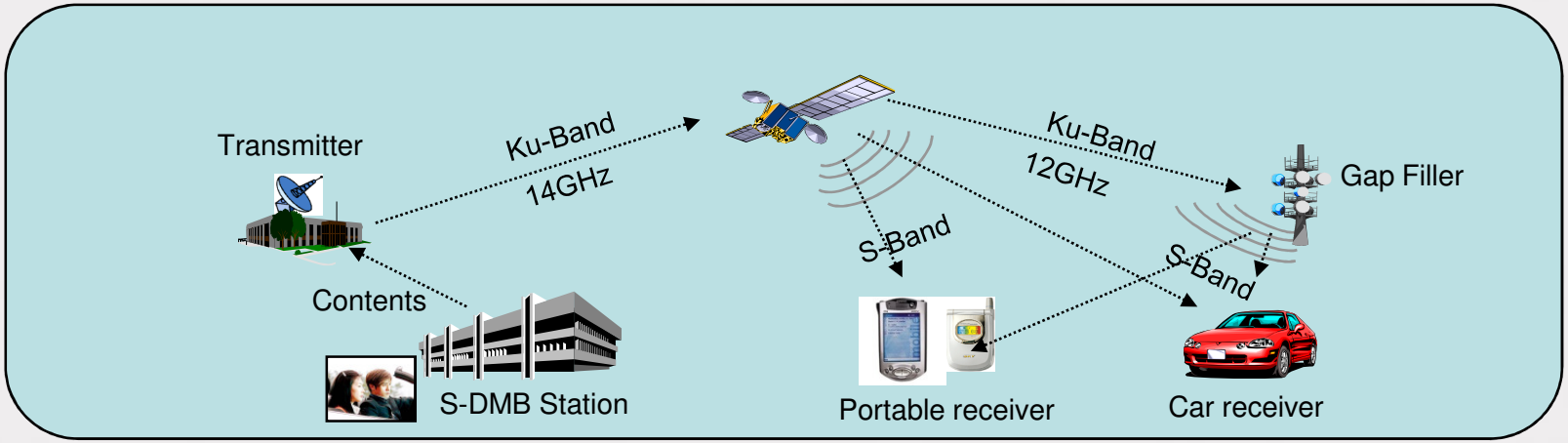
Contents

DMB Overview (I)

- **DMB(Digital Multimedia Broadcasting) Requirement**
  - Provide CD-like audio quality service
  - Provide QVGA-like video quality service
  - Provide Various service in single frequency band
  - Support easy program selection (Text/Menu base)
  - Guarantee stability of mobile reception
  - Support additional data services
    - Video, image, text etc.
    - Good service extension

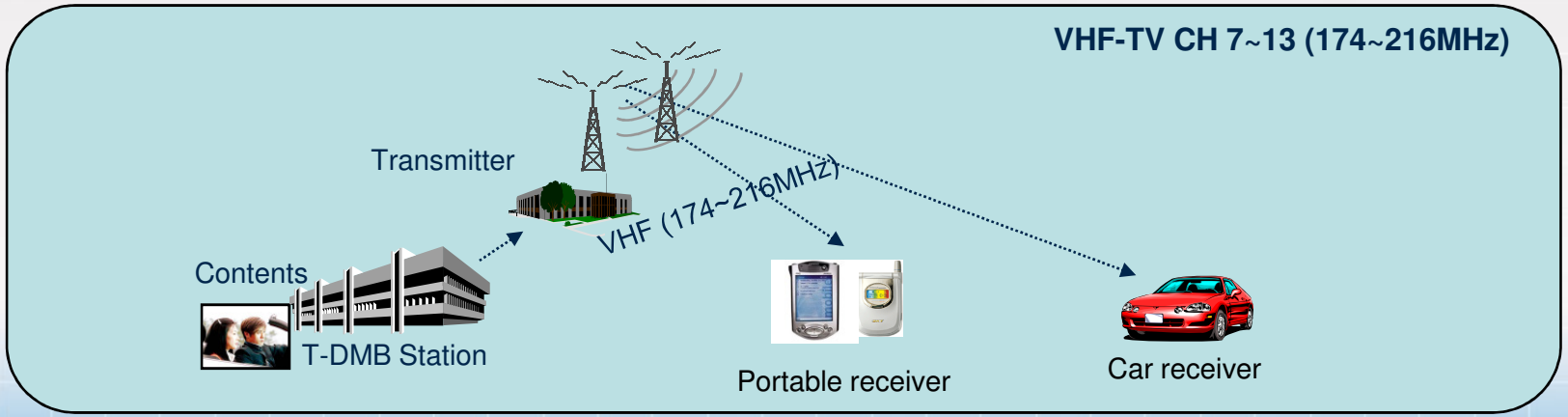
DMB Overview (II)

S-DMB (Satellite DMB)



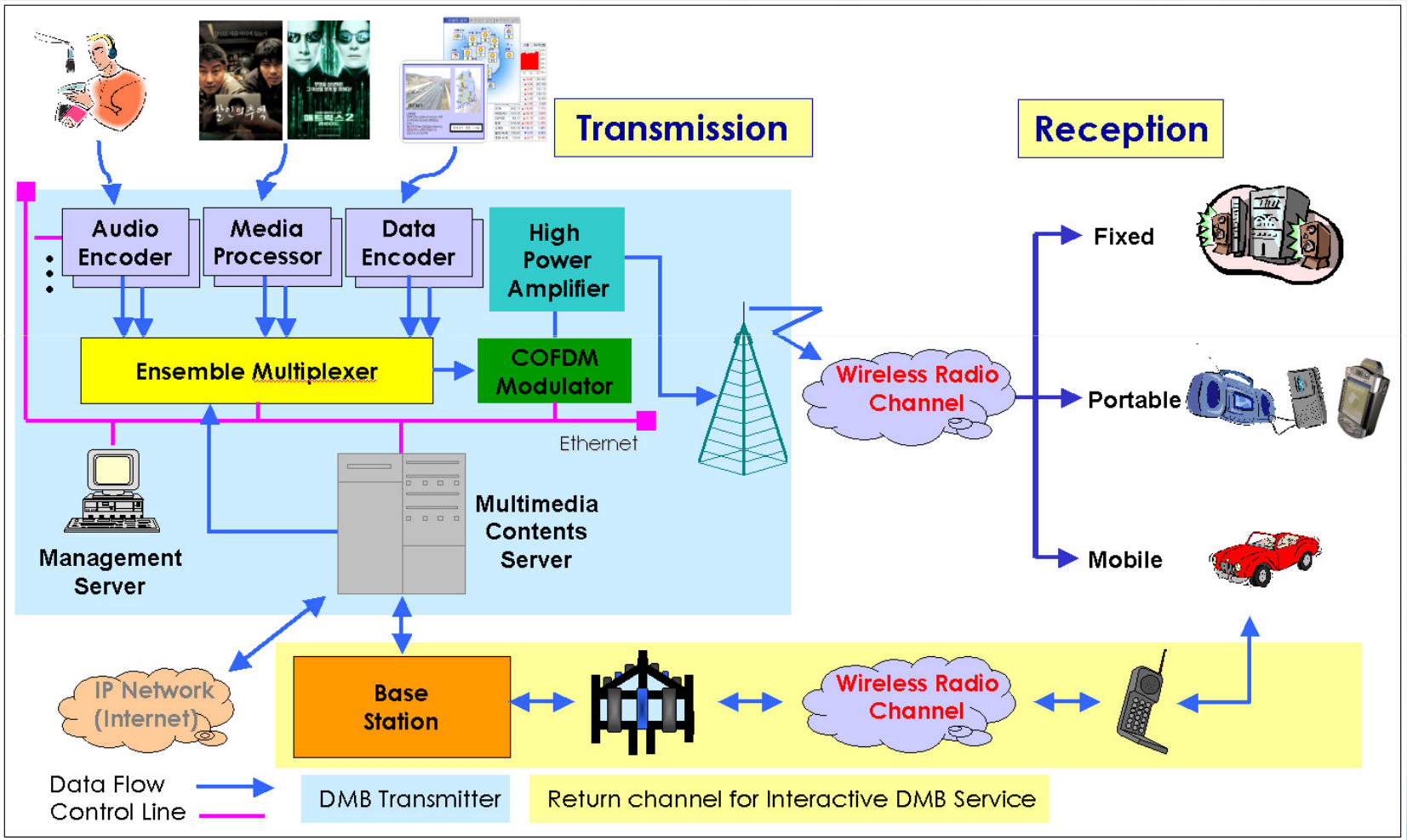
※ S-Band frequency band: 25MHz (2.605~2.630GHz)

T-DMB (Terrestrial DMB)



T-DMB Concept

- Extends the concept of Eureka-147 DAB to T-DMB



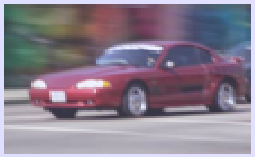
T-DMB Characteristics

Personal Broadcasting

Personalized services by handheld receivers

- Cellular phone, PDA, notebook, PMP etc.

Mobile Broadcasting



Overcomes the mobility limit of existing broadcasting

- Excellent video quality during high speed movement

Interactive Broadcasting

Interactive services in conjunction with mobile comm. network

- TTI, TV E-learning, on-line shopping etc.

Personal Bidirectional Mobile Multimedia Broadcasting Service ➡ T-DMB

TTI : Traffic and Travel Information, PMP: Personal Multimedia Player

T-DMB Standard Overview

Transmission Technology

OFDM
- high mobility reception quality

Error Correction Technology

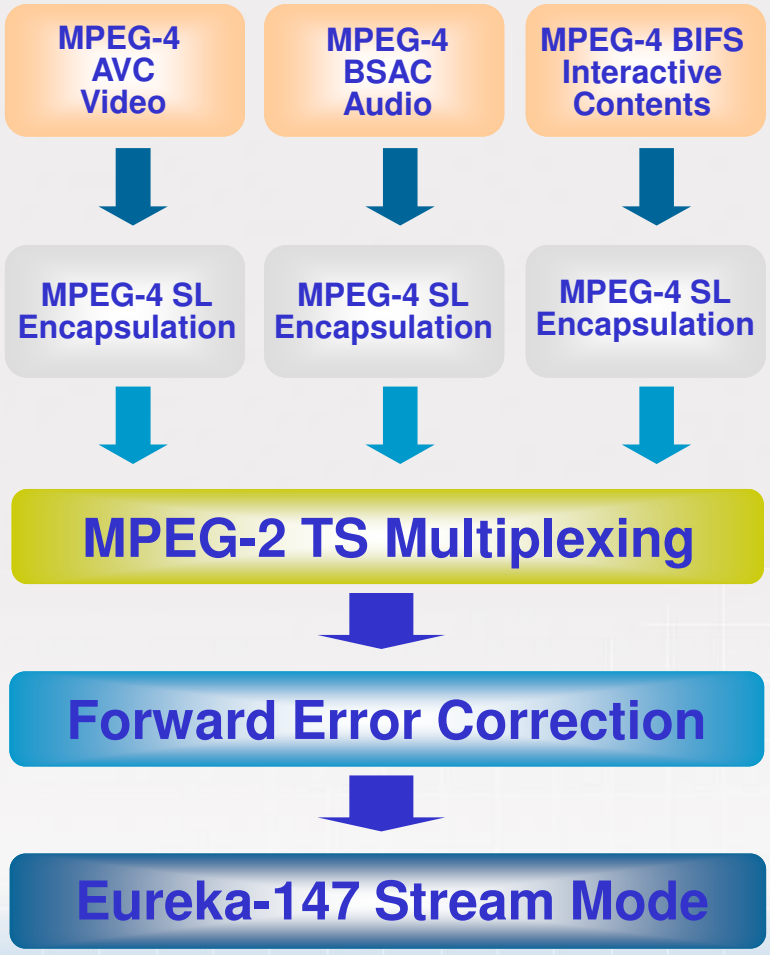
Adds RS-Coding
- high quality audio/video

Video Compression Technology

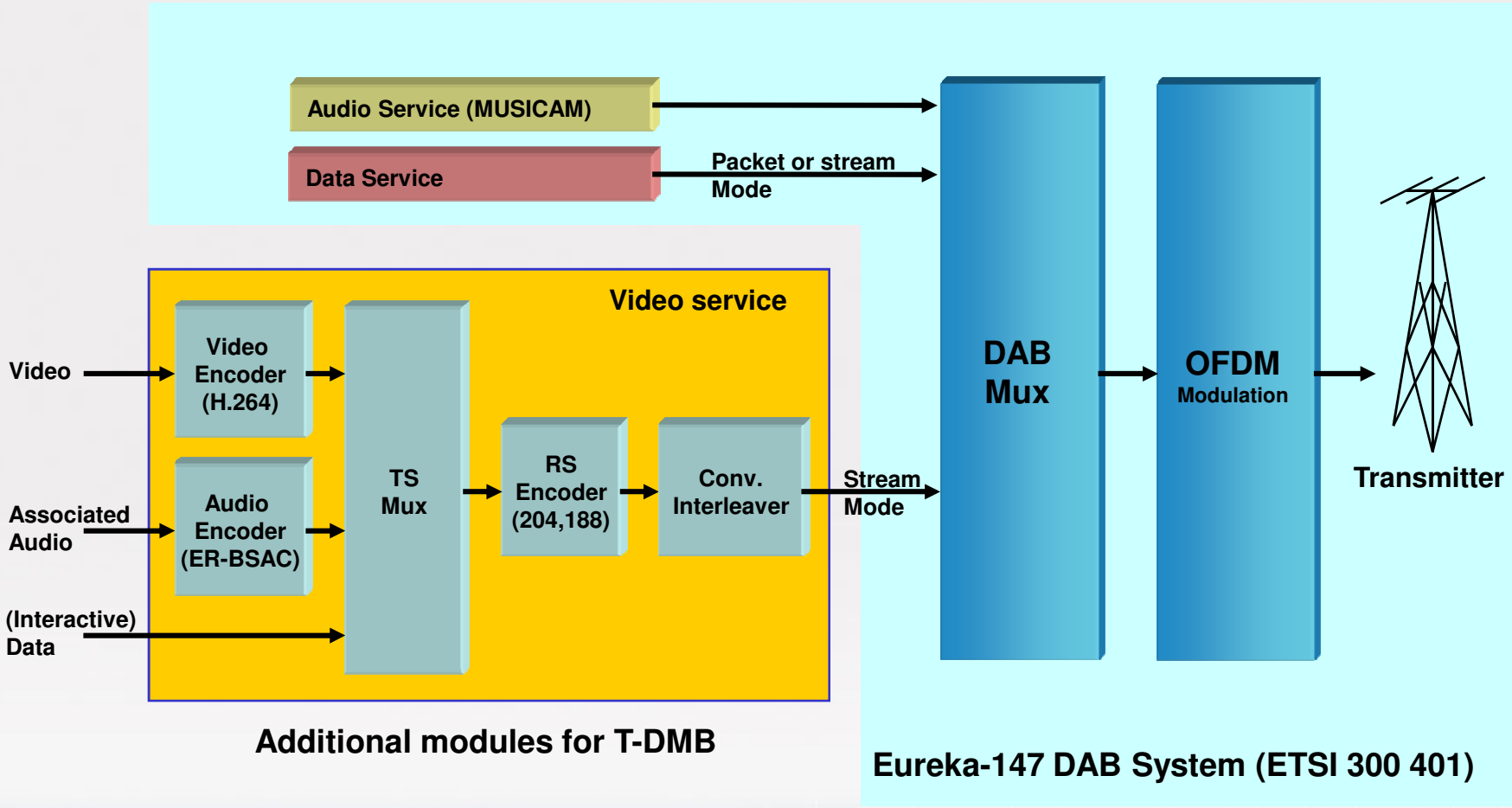
Adopts MPEG-4 Part 10 AVC(H.264)
- freq. efficiency increase

Data Processing Technology

Adopts MPEG-4 BIFS
- program associated data service



T-DMB System Structure



T-DMB Receiver Status

Various kinds of receivers

- ❖ LG Electronics
- ❖ Samsung Electronics
- ❖ Iriver, , …

➡ Maximize user convenience with diverse forms of devices

T-DMB Standardization Status

Domestic Standardization

- 2003.01 : started domestic T-DMB standardization
- 2004.08 : released domestic T-DMB standard

ETSI Standardization

- 2004.08 : submitted T-DMB standard document to the WorldDAB forum
- 2004.12 : approved of T-DMB standard document by the WorldDAB forum
- 2005.07 : released as the ETSI standard

ITU Standardization

- 2004.11 : approved ITU-R report on T-DMB standard
- 2007.12 : released as the ITU-R standard

T-DMB Service Plan in Korea

Year 2005

❑ 2005.12 : Commercial T-DMB services launch
- Audio services
- Video services

Year 2007

❑ Unidirectional T-DMB services
- Audio services
- Video services
- Local Interactive Data services : second half of 2007

Year 2009

❑ Bidirectional T-DMB services
- Audio services
- Video services
- Bidirectional / Remote Interactive Data services

Conclusion

- T-DMB, new paradigm of mobile multimedia broadcasting
  - Personalized mobile multimedia
  - Convergence multimedia
  - Interactive multimedia
- Foundation of ubiquitous infrastructure through broadcasting and communication convergence services
  - By harmonizing broadcasting and telecommunication
    - ✓ Protocol alignment among T-DMB, DVB-H, WiBro and 3G etc.
- Contributes activation of broadcasting related industry
- Many countries are planning to launch T-DMB services
- www.t-dmb.org

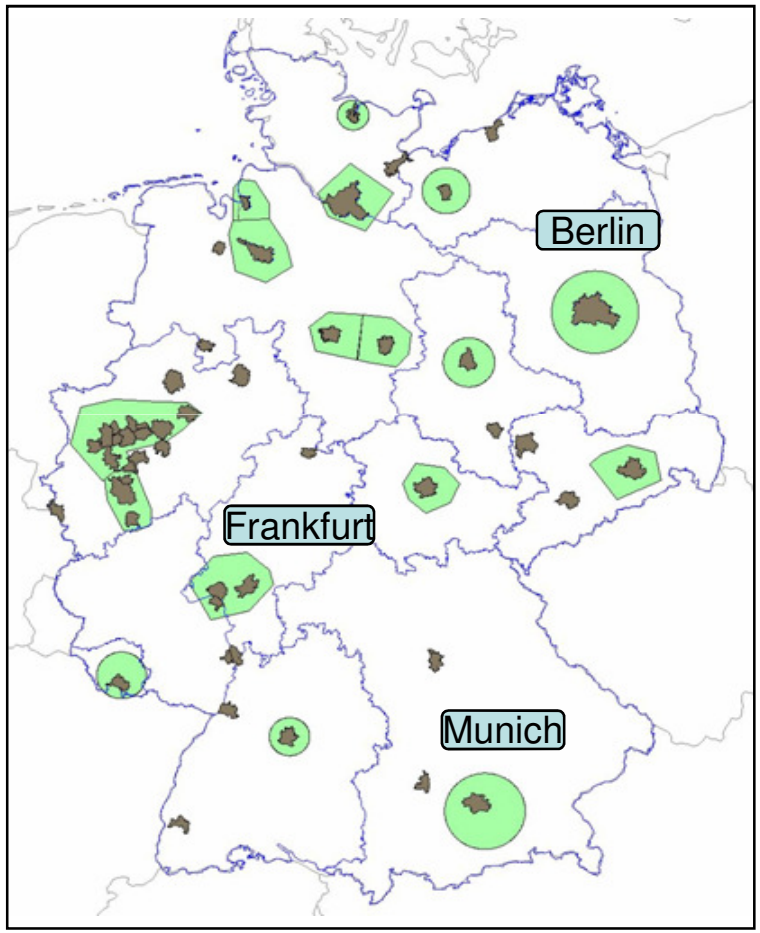
Fraunhofer FOKUS Network Research
Institute for Open Communication Systems

Broadcast Handovers

Burak Simsek
Fraunhofer Institute

Fraunhofer FOKUS Network Research
Institute for Open Communication Systems

DVB-H coverage planning Germany (1)



Introduction Scenario

- Introduction is planned in September 2008
- To cover 15 regions of Germany
- Coverage mode: portable indoor
- About 20% population coverage (15-16 Mio people)

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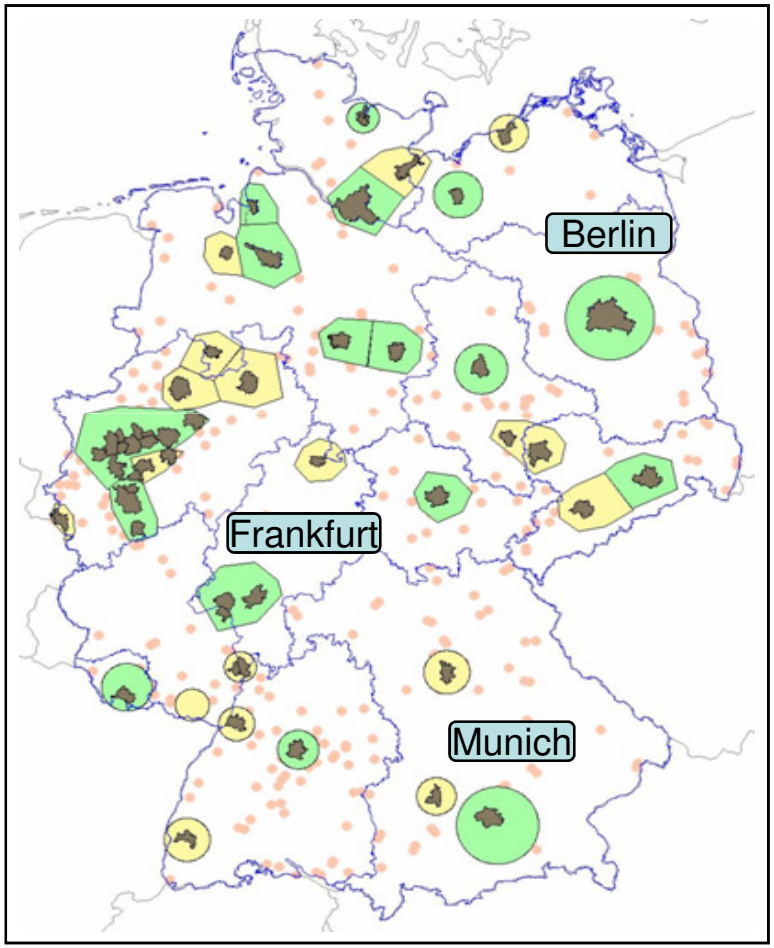
DVB-H coverage planning Germany (2)



Interim target scenario

- Should be realized until 2011
- To cover 36 regions of Germany and some smaller areas
- About 45% population coverage (36 Mio people)
- A nation wide DVB-H coverage is not planned

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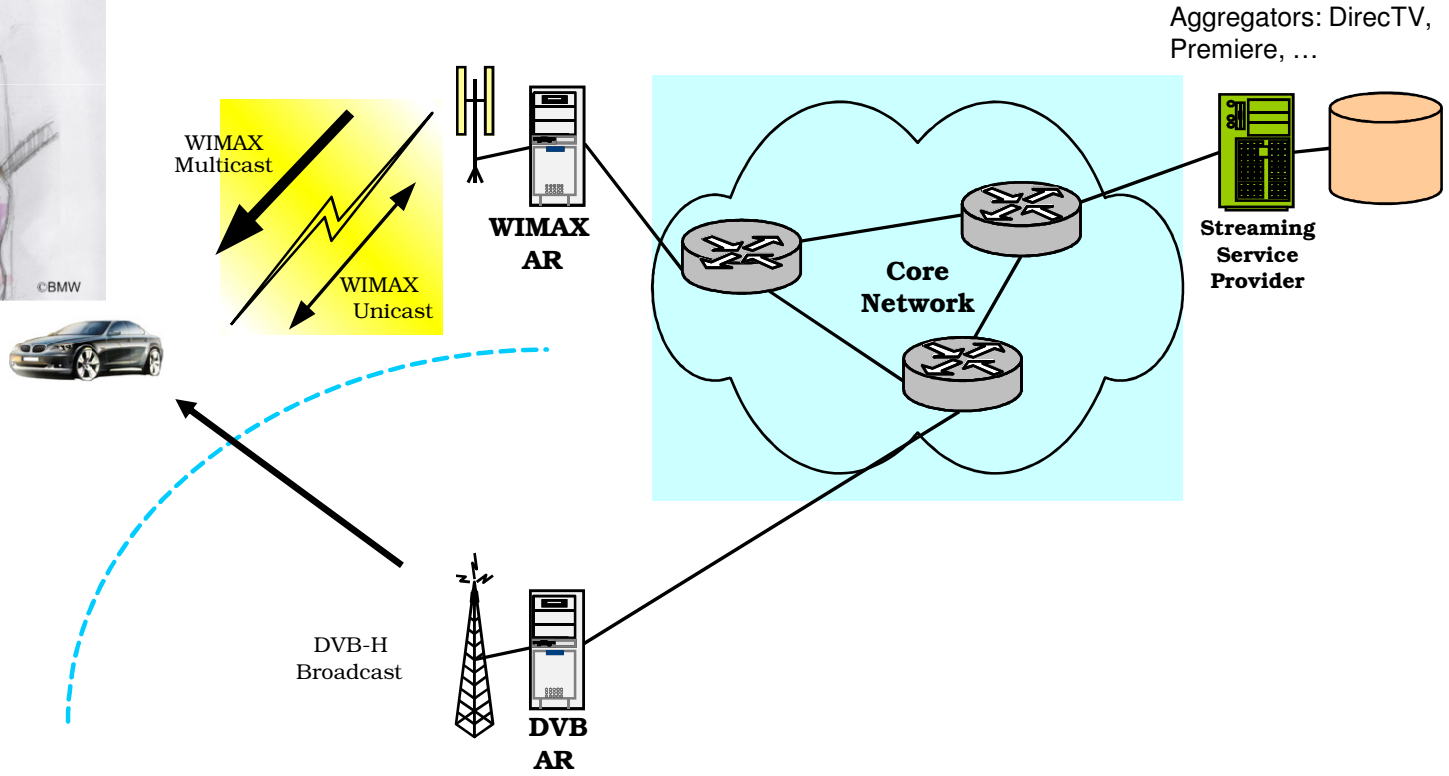
Scenario 1

- Family Jonas has two children. They are traveling from Bonn to Berlin for visiting their grandparents during the Christmas holiday…
- Anna is 5 years old and is a fan of “Sesame Street”
- Sesame Street is free to air and will be offered via broadcast channel in a few minutes
- Their car is equipped with TV sets on the back sides of the front seats,
  - A unidirectional broadcast receiver
  - A bidirectional WIMAX/UMTS receiver
- Anna turns on the TV and starts watching “Sesame Street” as they are still within the city boundaries of Bonn

Scenario 1

- Free to Air TV starts using DVB as default
- In 15 minutes they are approaching to the borders of the BONN DVB Coverage
  - There is a cheaper network providing the service for less price
  - Battery Level does not support the use of multiple interfaces simultaneously, where telephone connection cannot be sacrificed…



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Scenario 2

- Family Jonas also has a flat rate video service from their mobile service providers.
- The brother of Anna, Michael, is a football fan and do not want to miss European football championship during this long journey
  - The game between Russian and Spain is starting
- Since the video service is a service of mobile service provider, initially service is started over UMTS or Wimax…

Scenario 2

- Near Dortmund, service operator becomes aware of the fact that there is a sufficient number of customers watching the games.
- Hence, start NIHO, so that the games are multicasted over broadcast channel.
- For the next 40km, Michael uses DVB without being aware of it…

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Scenario 3

- Mrs. Jonas is joining to an online interactive lecture periodically which will enable her to promote in her career
- Although the lecture is broadcasted, she needs uplink channel for asking questions
- MIH User on the car determines that the service is available for free over broadcast, but needs uplink channel for uplink data transfer. By the use of MIIS, MIH user determines the most appropriate uplink channel for the lecture. Service starts…
- During their journey, both uplink and downlink channels change for different reasons and MIH user is able to manage both connections simultaneously so that the service is offered in a seamless manner

Scenario 4

- In 20 minutes, the game between Turkey and Germany starts, which is watched by more than 20 million people simultaneously in Germany,
  - bandwidth is required for the game, the lecture of Mrs. Jonas should be transferred
  - hence DVB initiates NIHO
  - Mrs. Jonas starts using WIMAX/UMTS for the lecture

Conclusion

- Hybrid Broadcast/Mobile Networks technologies have significant financial advantages for all mobile network operators
  - Initial mobile TV services using hybrid networks in different countries have shown that customer acceptance is very high
  - We will witness more and more hybrid networks in the following years
- Hybrid Networks need even more cooperation among different technologies than vertical handovers do
  - IEEE 802.21 is a good candidate to provide with the required cooperation facilities
- An amendment of IEEE 802.21 supporting vertical handovers with broadcast technologies will have high impact on offered services, hence on the market value of hybrid networks!

Next Steps

- Finish PAR/5C until September
  - A generic approach for broadcast handovers followed by individual contributions from each technology
- DVB Steering Board already approved a work item on the integration
  - Sign a liaison until September
  - Work together to produce an amendment for DVB Project
- IEEE802.21 participants from DMB and MediaFLO are also working on the integration
  - Inclusion of all other broadcast technologies are contribution based

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Thank You for Your Interest

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