

# IEEE 802.16m for IMT-Advanced: The Next Step in WirelessMAN Evolution

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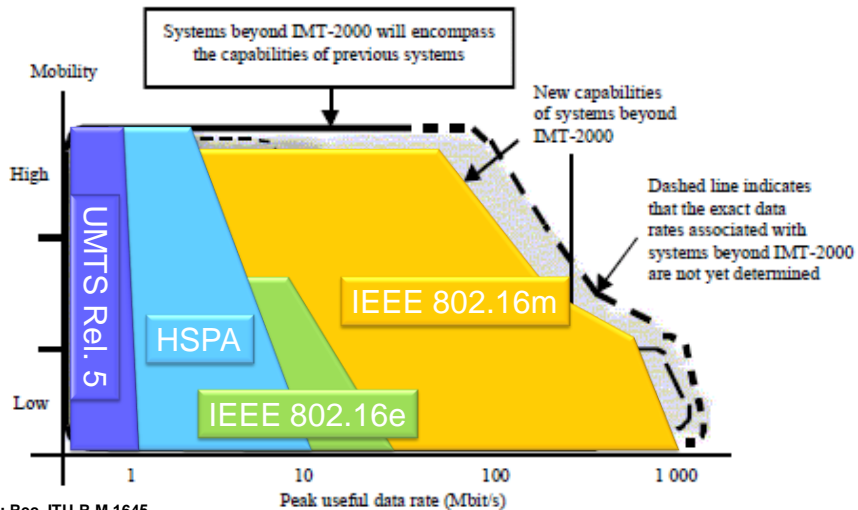
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## Outline

- Why a new WiMAX standard?
  - IMT-Advanced requirements
- WiMAX standardization
  - Standardization bodies and timeline
  - IEEE 802.16m features
- What's next?

## Why do we need another WiMAX?

### “The Van”



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## ITU-R IMT-Advanced

- Requirements

	Cell (macro)	Cell edge (macro)	Peak
DL spectral efficiency	2.2 bit/s/Hz	0.06 bit/s/Hz	15 bit/s/Hz
UL spectral efficiency	1.4 bit/s/Hz	0.03 bit/s/Hz	6.75 bit/s/Hz
DL BW with 40 MHz	88 Mbps	2.4 Mbps	600 Mbps
UL BW with 40 MHz	56 Mbps	1.2 Mbps	270 Mbps

Additionally requirements on packet and handover latency, VoIP efficiency.

Encouraged: 100Mhz carrier -> 1.5Gbps peak bandwidth.

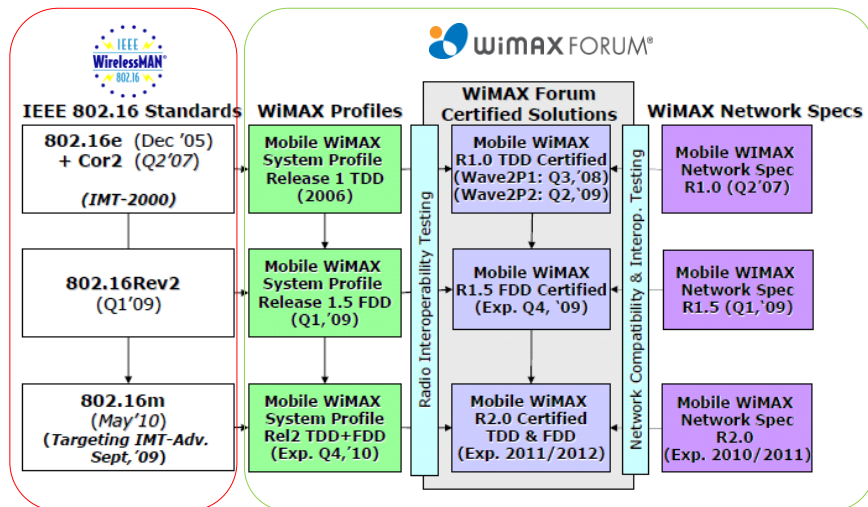
- Deadline for submission: **October 2009**

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## WiMAX Standardization Bodies and Roadmap



Source: Intel

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## What is IEEE 802.16m?

- From the Project Authorization Document (PAR):

***Purpose: The purpose of this standard is to provide performance improvements necessary to support future advanced services and applications, such as those described by the ITU in Report ITU-R M.2072.***

- Addendum to IEEE 802.16 Revision 2

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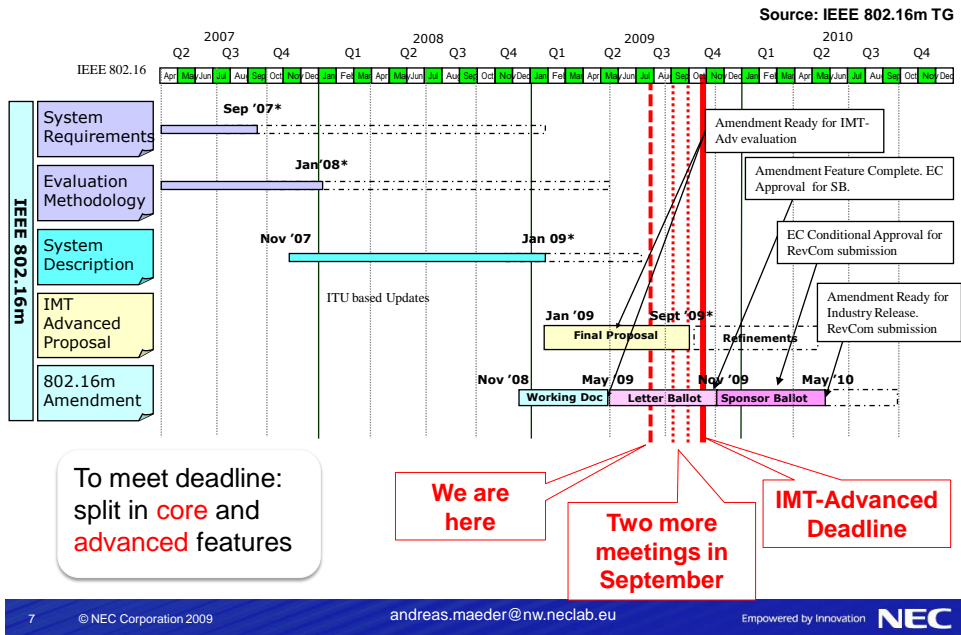
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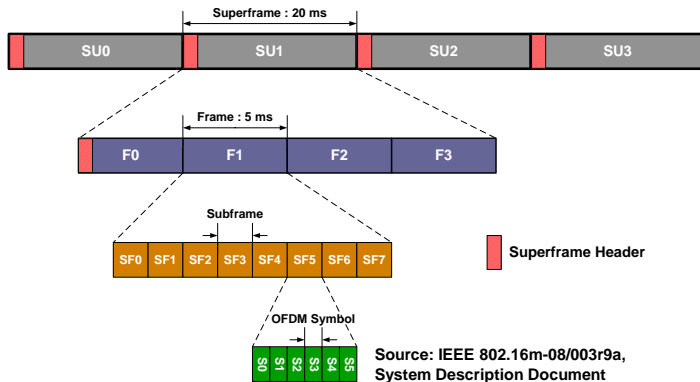
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# IEEE 802.16m Timeline

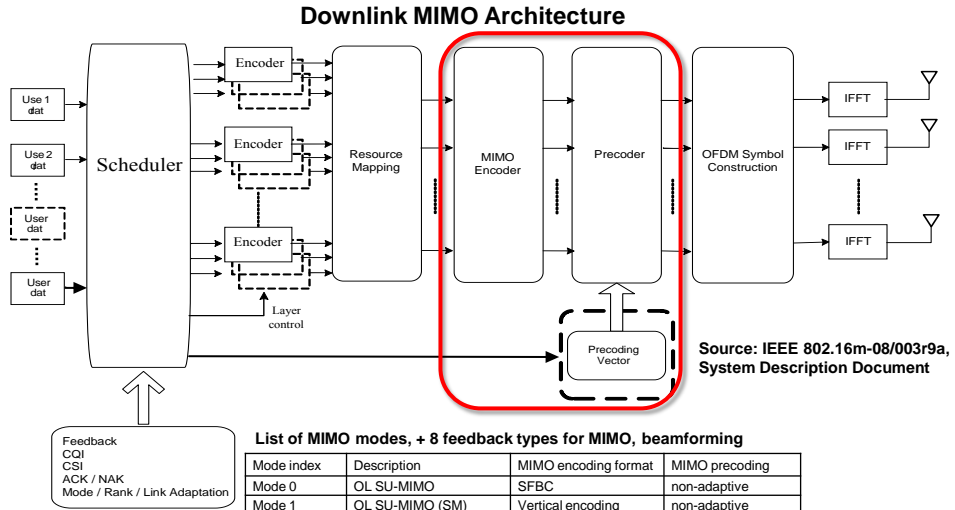


## Core Features – Frame Structure



- Support localized and distributed resource units
- Group and persistent allocations (e.g. for VoIP)
- Exact allocation methods are not yet decided

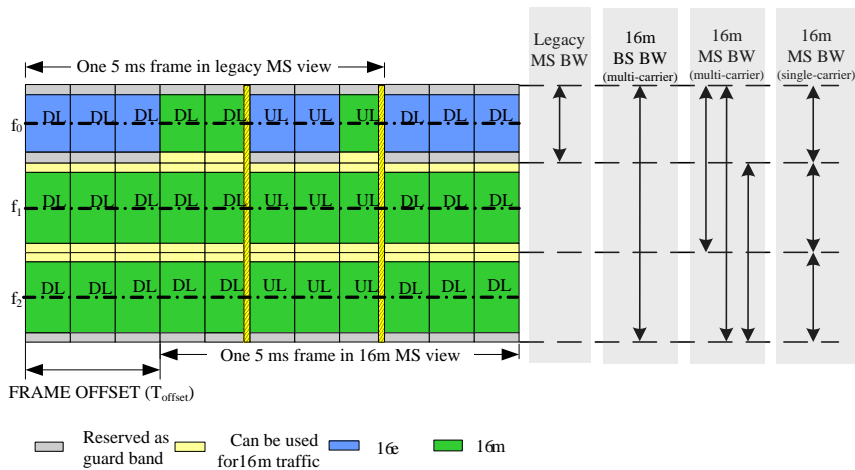
# IEEE 802.16m: Core Features - PHY



List of MIMO modes, + 8 feedback types for MIMO, beamforming

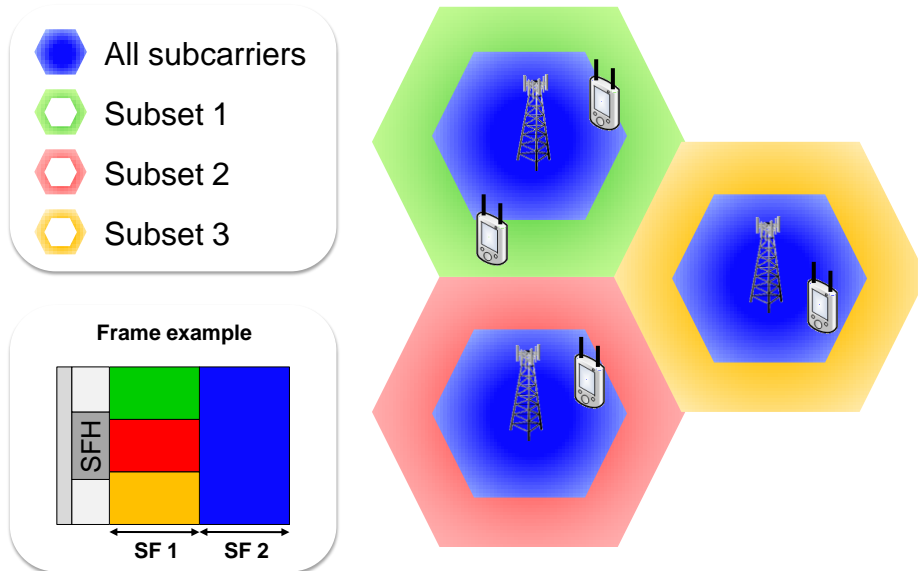
Mode index	Description	MIMO encoding format	MIMO precoding
Mode 0	OL SU-MIMO	SFBC	non-adaptive
Mode 1	OL SU-MIMO (SM)	Vertical encoding	non-adaptive
Mode 2	CL SU-MIMO (SM)	Vertical encoding	adaptive
Mode 3	OL MU-MIMO (SM)	Horizontal encoding	non-adaptive
Mode 4	CL MU-MIMO (SM)	Horizontal encoding	adaptive

## Core Features – Multi Carrier Operation



Source: IEEE 802.16m-08/003r9a, System Description Document

## Core Features – Fractional Frequency Reuse



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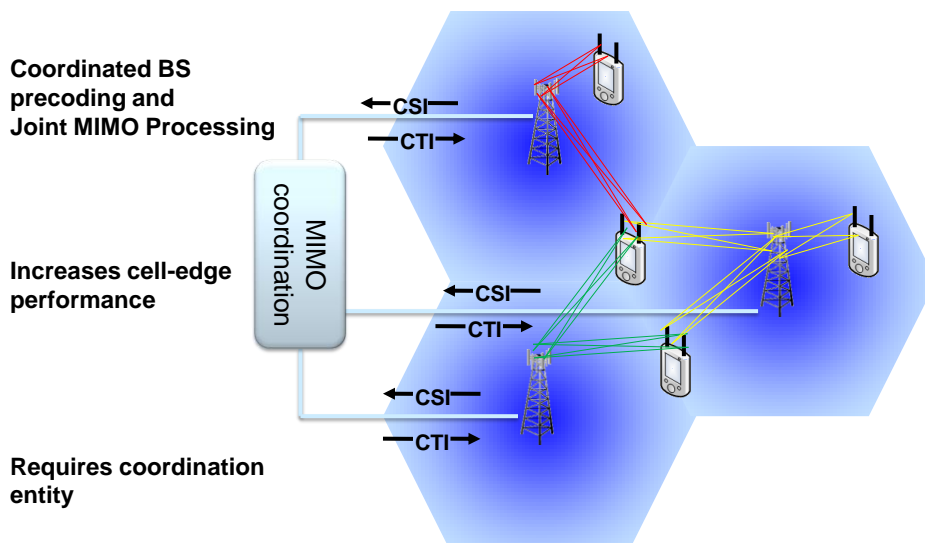
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## Advanced Features – Multi-BS Collaborative MIMO



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## Advanced Features – Support for Femtocells

- Femtocells: light-weight, cheap base stations for home deployment
  - Backhaul connection via DSL
  - Managed (partially) by the operator
  - Challenges: Interference, security, configuration, “churn”, ...



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## What is coming next?

- In IEEE 802.16:
  - Drafting of additional features: SON, Relay, E-MBS, LBS, ...
  - Refinements and clean up
- Unlikely to achieve large gains on PHY in the future
  - MAC: Cognitive Radio, Information Centric Networking
  - Integration, coordination, cooperation of heterogeneous radio technologies

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- ITU-R, *RECOMMENDATION ITU-R M.1645*, June 2003.
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# Advanced Features – Self-Organizing Networking

## Motivation

- Minimize Network O&M costs
- Increase system efficiency
- Increase system reliability

