Project	**IEEE 802.20 Working Group on Mobile Broadband Wireless Access** **<http://grouper.ieee.org/groups/802/20/>**	
Title	**IEEE C802.20-11/85** **Multi-antenna Support for Air Interface Specifications in 802.20**	
Date Submitted	2005-NOV-09	
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Re:	MBWA Call for Contributions	
Abstract	This partial proposal proposes the use of physical and MAC layer concepts and functionality within the 802.20 air interface in order to facilitate the use of multi-antenna systems (MAS) within a TDD 802.20 air interface.	
Purpose	An 802.20 Partial Proposal	
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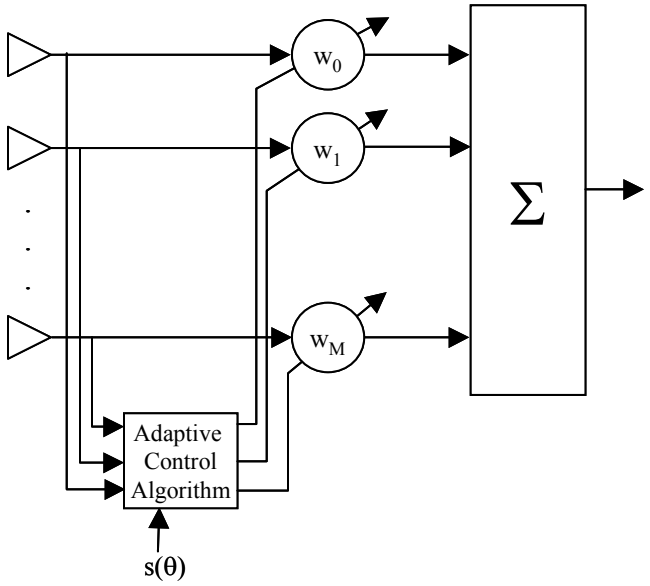
Scope

- This is a partial proposal
- Proposes the use of physical and MAC layer concepts in order to facilitate the use of multi-antenna systems within an 802.20 air interface
- Applicable to TDD and FDD with multiple antennas at the BS or Terminal
- Requires careful incorporation into other proposals

Multi-antenna Operation

- Could be at BS or Terminal
- For example…



Benefits of Multi-antenna Operation

Gain	System-Level Significance
User Selective Uplink Gain	Increased Range, Improved Coverage, Increased Link Margin
Uplink Interference Mitigation	Improved Signal Quality
Selective Downlink Gain	Increased Range, Coverage, Link budget
Downlink Interference Mitigation	Improved Signal Quality

Principles

- Design objective is to provide “hooks” for extraction of channel state information (CSI) for effective operation of multi-antenna systems
  - Known transmitted waveforms in both directions
  - Estimate downlink CSI from uplink training sequences is a core concept in this partial proposal.

Comments

- Spatial Division Multiple Access (SDMA).
- Multiple antennas can be at either or both ends of the links
  - Does not require use of multiple antennas at the subscriber terminal
    - Cost and Form Factor Flexibility

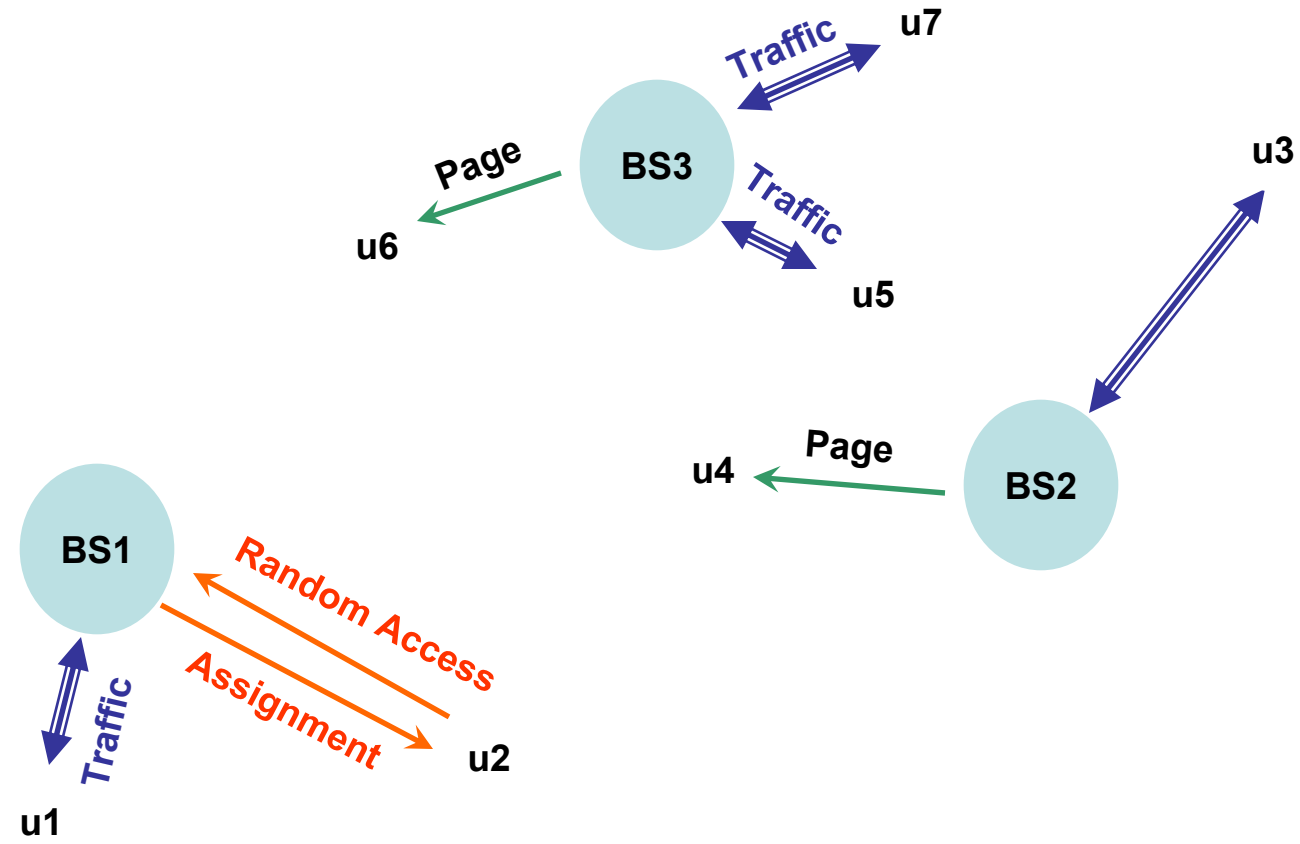
Separation of Directive and Non-directive channel

- Important to design logical channels to take into whether spatial selectivity is possible or necessary
  - Some information (eg. on traffic channels) is amenable to spatial selectivity – “directive spatial processing”
  - Some information (eg. on broadcast channels) requires spatial non-selectivity – “non-directive spatial processing”

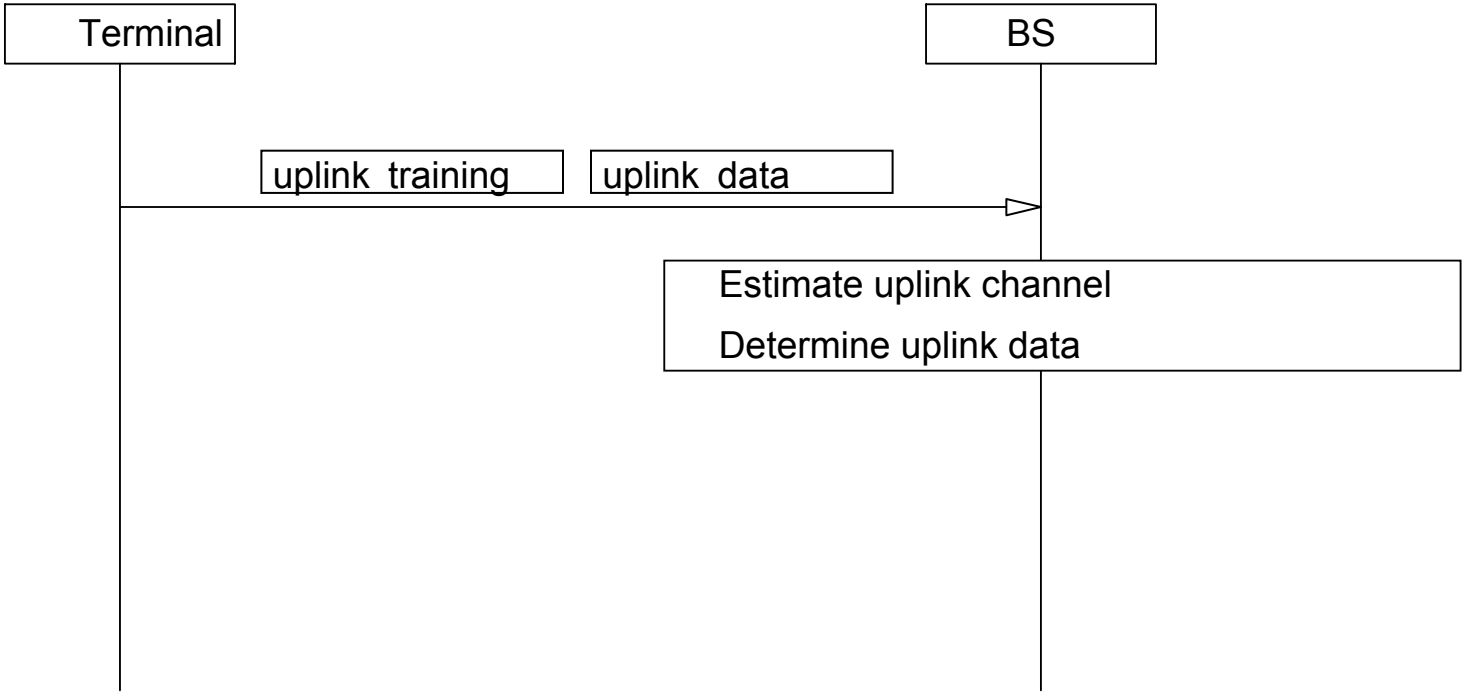
Directive and Non-directive Channels

Channel	Direction	Typical Function	Spatial Processing Type
Uplink Traffic Channel	Uplink	Traffic exchange on uplink	Directive
Downlink Traffic Channel	Downlink	Traffic exchange on downlink (coupled with uplink training)	Directive
Broadcast Channel	Downlink	Cell and System information	Non-directive
Paging Channel	Downlink	Paging to initiate downlink data.	Directive or Non-directive
Uplink Resource Request/Assignment	Bidirectional	Request to initiate uplink traffic transfer and subsequent resource assignment	Directive

The Goal


Traffic
u7
Page
BS3
Traffic
u6
u5
u3
u4
Page
BS2
BS1
Random Access
Assignment
Traffic
u2
u1

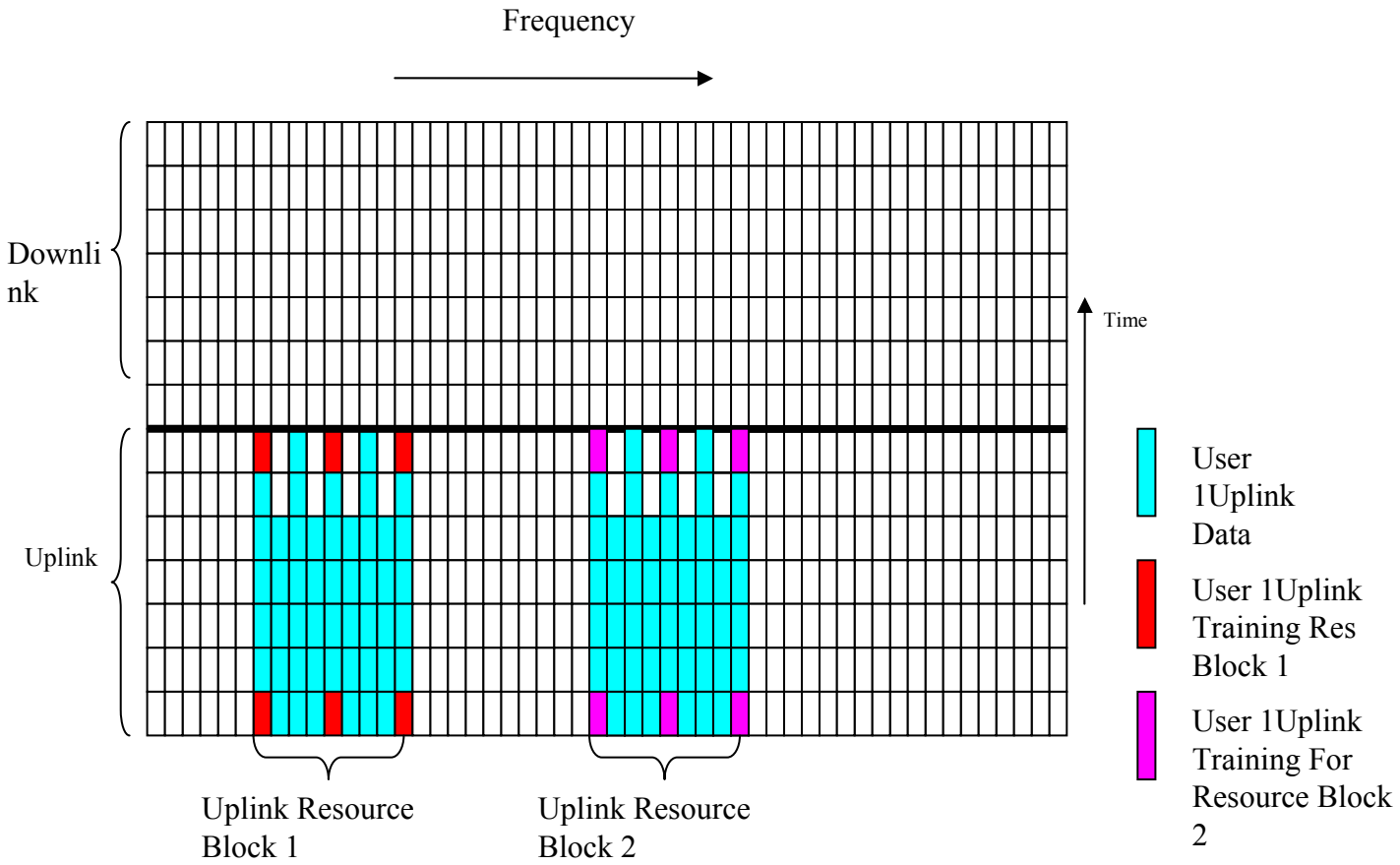
Uplink Training



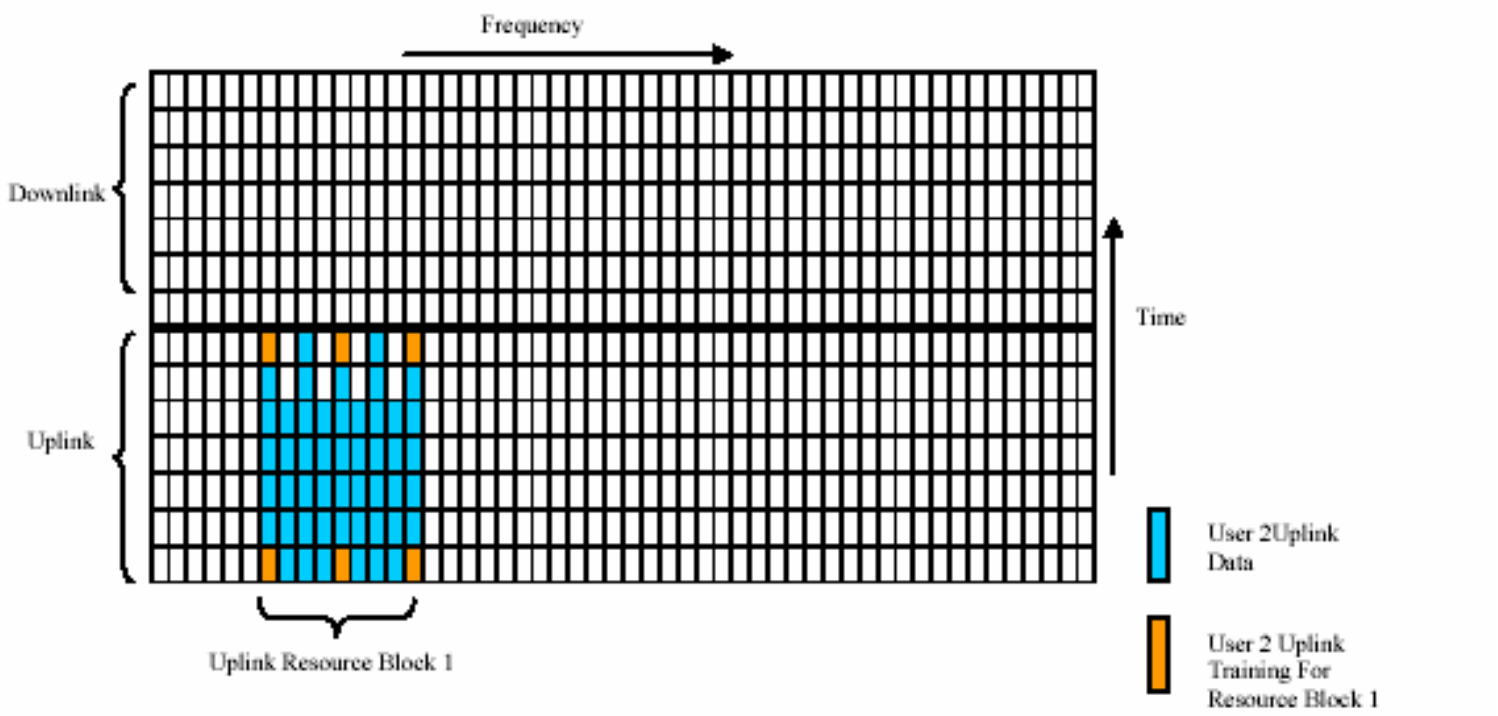
Uplink Training

- Uplink training enables estimation of channel state information for the user transmitting data
  - Enables spatial selectivity

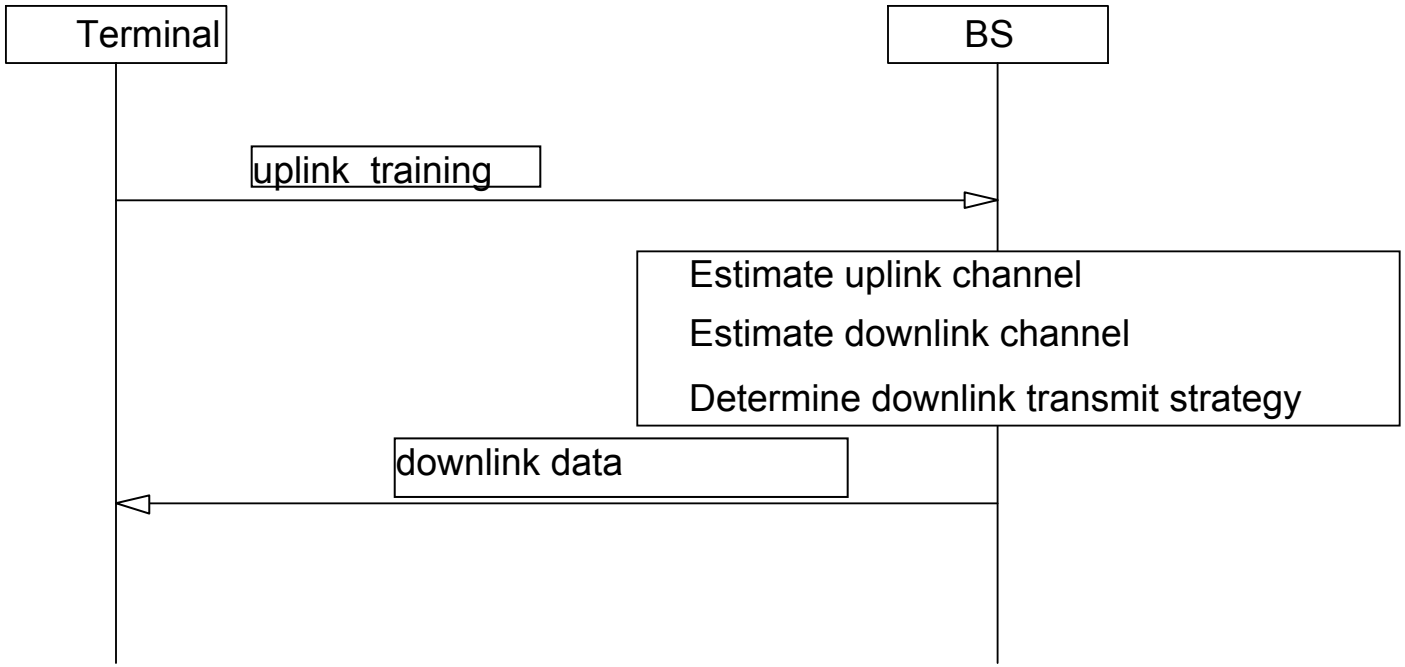
Uplink Training – User 1



Uplink Training – User 2



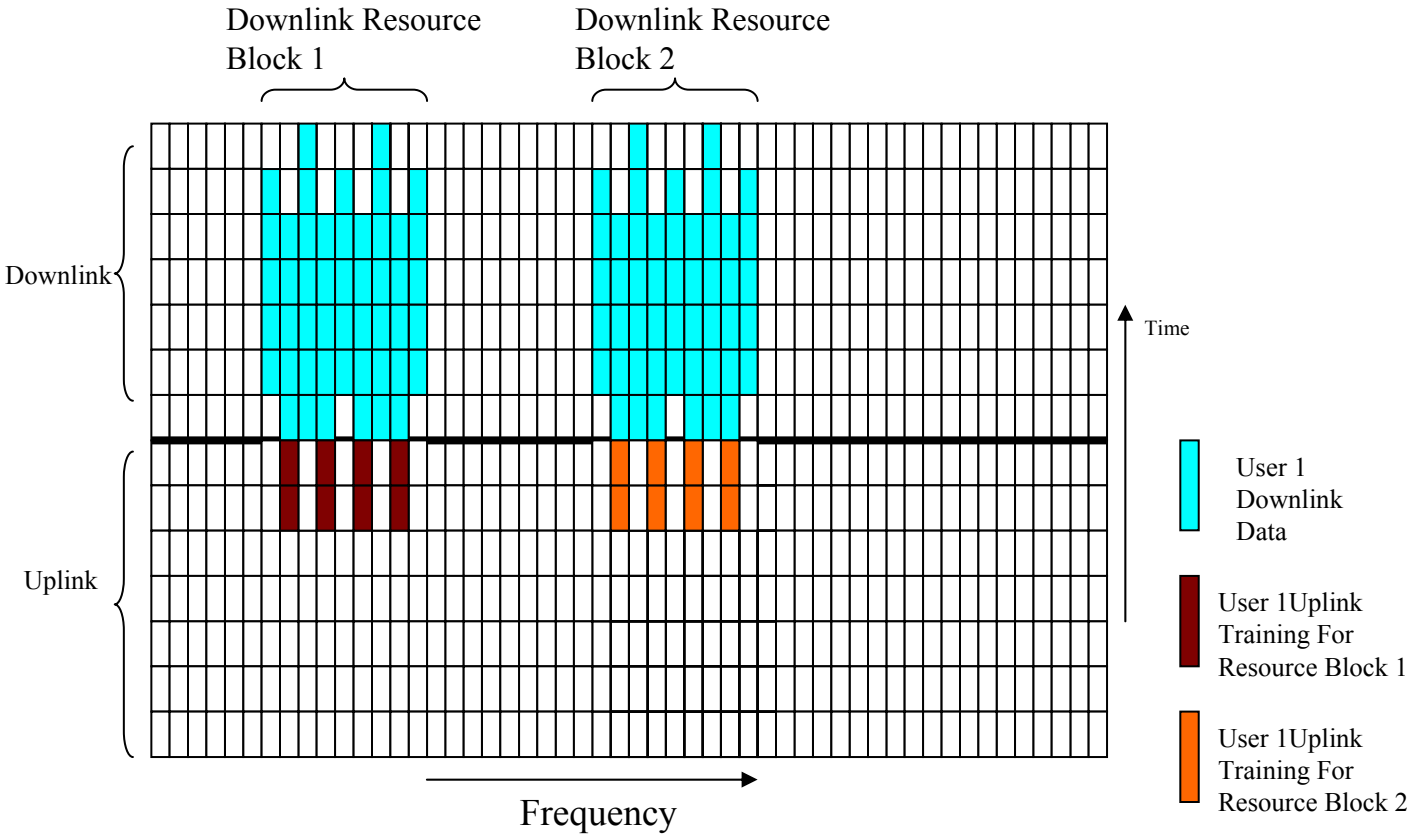
Uplink Training For Downlink



Uplink Training For Downlink

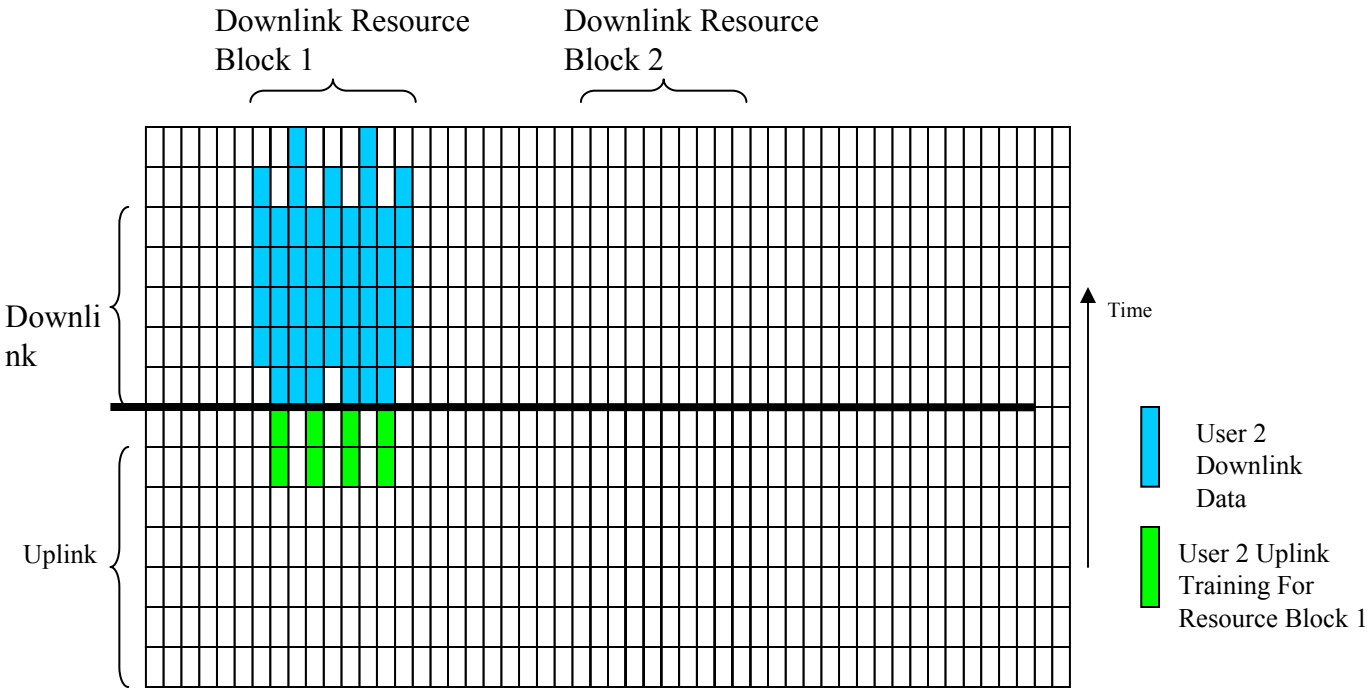
- Uplink training enables estimation of channel state information on the *downlink* for future transmission of data
  - Enables spatially selective transmission of information

Uplink Training For Downlink User 1



Note: Downlink training Not Shown

Uplink Training For Downlink User 2



Note: Downlink training Not Shown

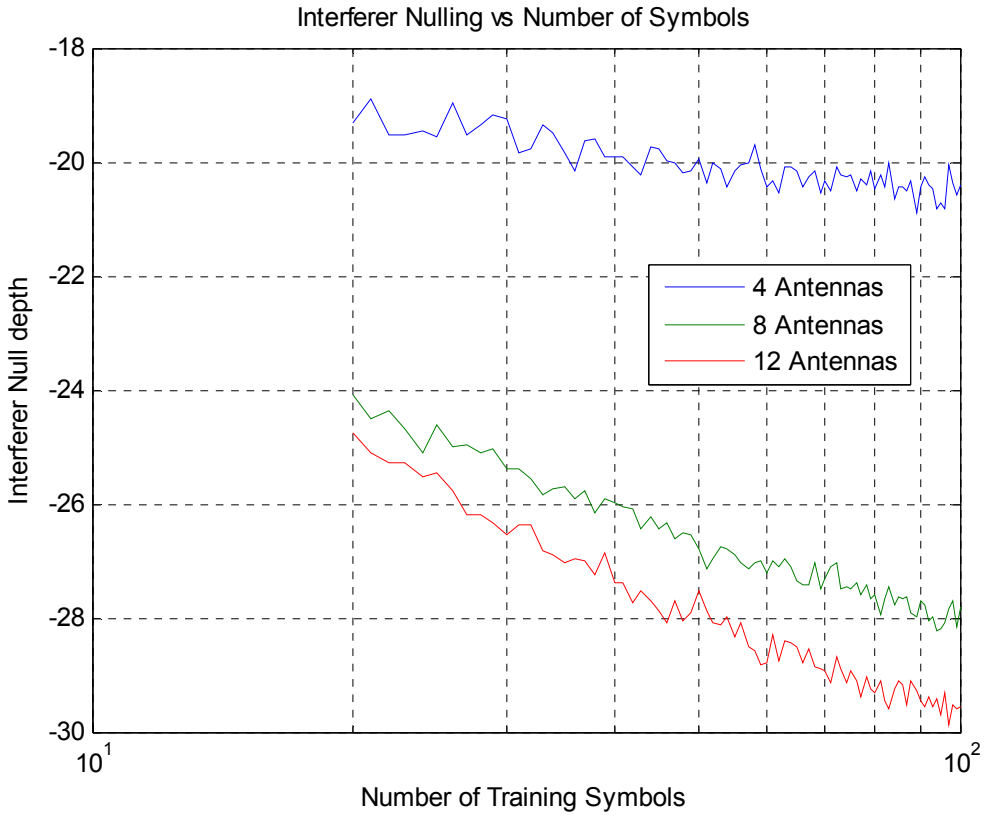
Uplink Training
Temporal and Spectral Proximity

- Uplink training should be in close temporal proximity to the uplink or downlink transmission to which it corresponds.

- The uplink training data should be in close spectral proximity to the data to which it corresponds.

Uplink Training Quantity

- The number of independent uplink training symbols shall be enough to maximize spatial selectivity without using excessive resources for the training



Uplink Training
Cross Correlation

- The uplink training data shall have low cross correlation
  - Across different users within RF reach (in-cell and out-of-cell)

Uplink Training – Multi antenna Terminal

- The uplink training data should allow a mode for low cross correlation training across different antennas at the same user terminal.
  - Allows spatial discrimination of signals out of each antenna

Downlink Training

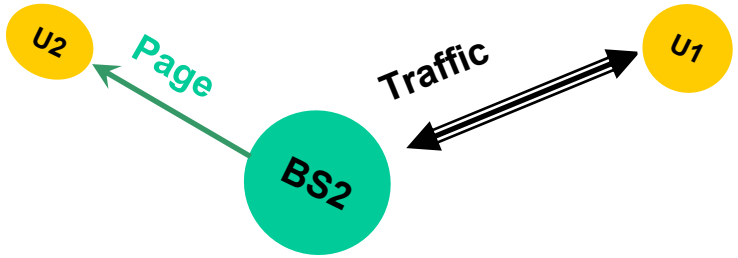
- **Similar to Uplink**

Broadcast

- Need balanced link when compared to channels that can inherently benefit from directivity
  - More robust coding rates
  - limited amount of information so as to restrict use of spectral resources
  - spatial/temporal diversity
- Should not share radio resources for the broadcast channel with those for directive channels such as traffic or paging across a network of base stations.

Paging

- Need balanced link when compared to channels that can inherently benefit from directivity
  - More robust coding rates
  - limited amount of information so as to restrict use of spectral resources
  - spatial/temporal diversity
- Should allow pages to be sent on bursts that may be shared with other traffic bursts.

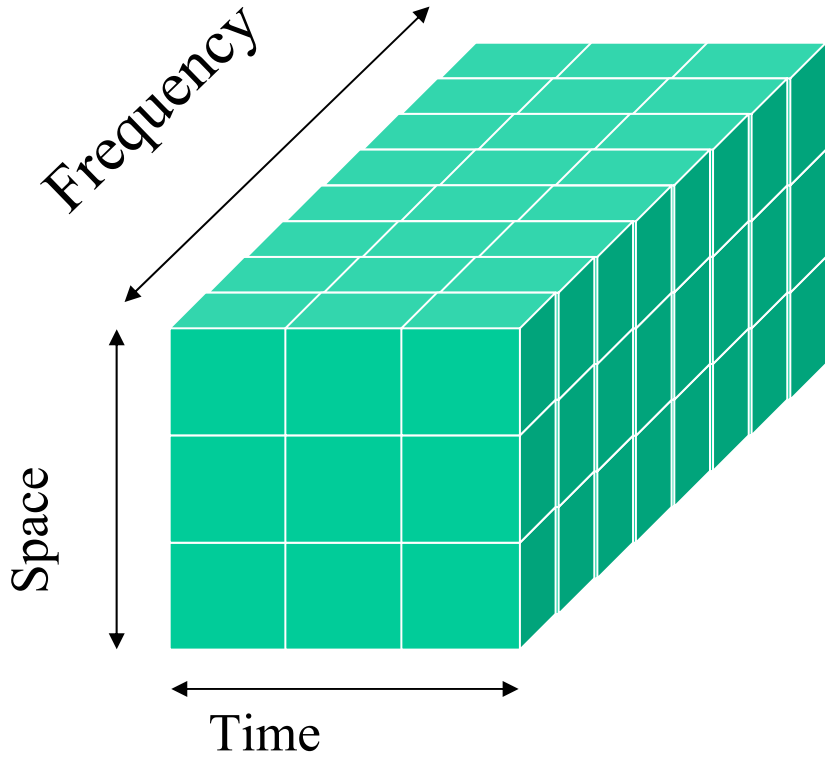


Link Quality Reporting

- Link quality reporting for directive and non-directive channels shall be supported.

Resource Allocation

1. The air interface shall utilize SDMA, shall utilize TDMA, and shall utilize FDMA or OFDM.



Random Access

- Allow random access bursts to be shared on the same resources as uplink traffic bursts.