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Title: A Proposed Approach to Defining an Interoperable MAC/PHY Layer Scheduler for 802.16

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Base Document:

802.16mc-99/11 URL <http://grouper.ieee.org/groups/802/16/mac/contrib/80216mc-99_11.pdf>

Purpose:

The purpose of this presentation is to acquaint members of the 802.16 Study Group with the underlying principles and approach considered in preparing the referenced document.

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What BWA Networks Need:

A ~~new~~ different

scheduling paradigm

My Mission

- **To get knowledgeable members of 802.16 working group involved in developing a new protocol for submission by May 2000**
- **Needed expertise**
 - **DOCSIS**
 - **ATM**
 - **IP**
 - **802.x MACs**
 - **STM**
 - **Other**

Key BWA Standard Mission

- To make Broadband Wireless Access systems “best of breed” of broadband distribution networks
 - Least delay
 - Smallest jitter
 - Most bandwidth efficient
 - Most protocol agnostic
 - Most manageable
 - Highest Reliability
 - Best QoS Support
 - Simplest

BWA System Needs

- **Bandwidth-on-demand scheduling for any rate**
- **Separate channel connectivity from interface protocols**
- **Support variable persistence flows**
- **Minimize delay and jitter**
- **Support multiple QoS levels**

Proposed Approach

- **Divide transmissions into fixed size headerless cell slots**
- **Minimize cell slot size**
- **Frames can be of any size**
- **Set frame rate to support all rates**
- **Channel defined by integer number of cell slots per frame**
- **Common signaling channel for control**

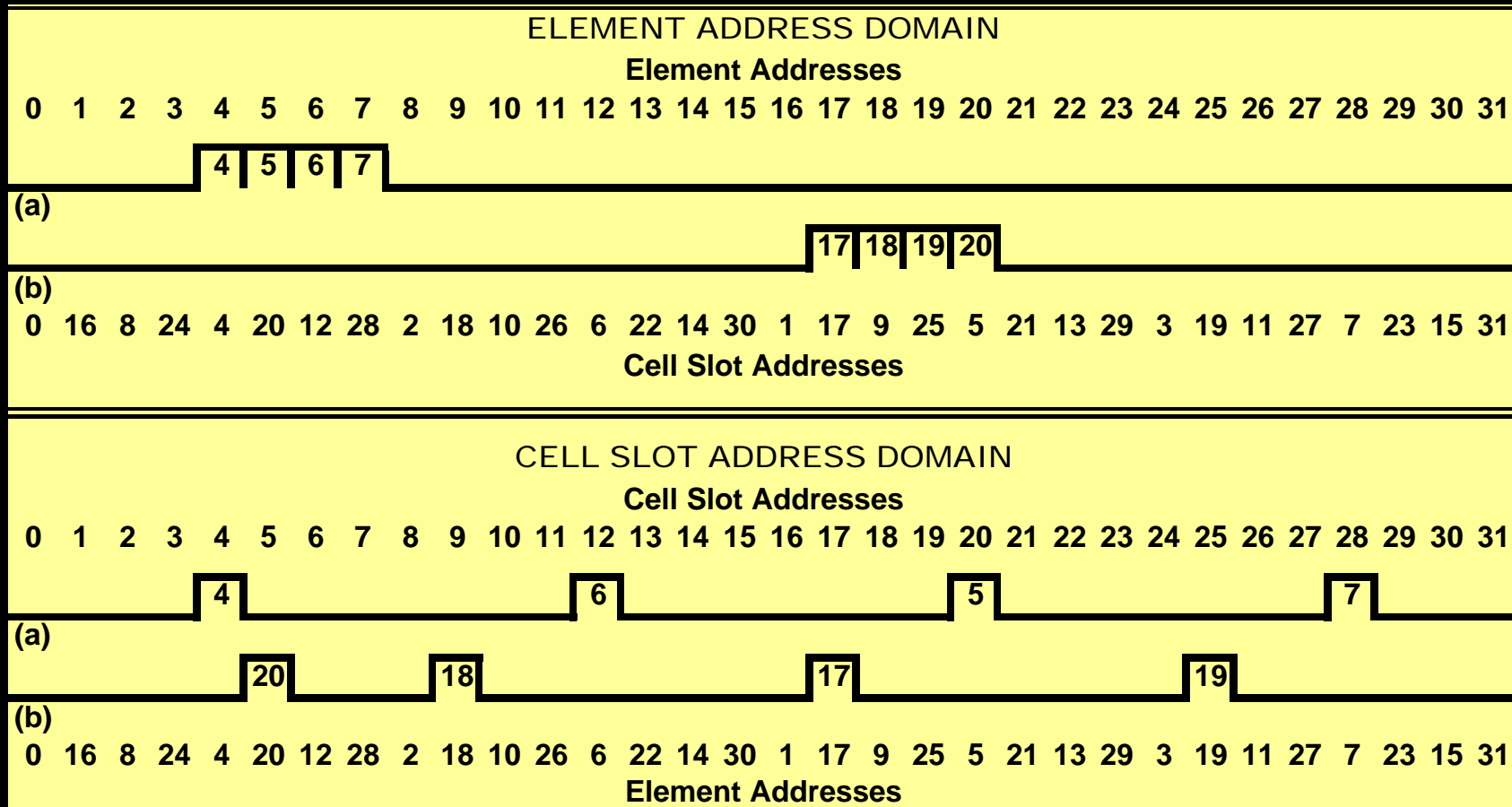
Ideal BWA Multiplexing

- **Assign channels as a contiguous number of cell slots per frame**
- **Spread cell slots uniformly throughout a frame to minimize delay**
- **Change channel bandwidth only when a source data rate changes**
- **Base station commands all channel changes (including their bandwidths)**

Basic Transform - I

| Element Address | | Cell Slot Address | | Element Address | | Cell Slot Address | |
|-----------------|-------|-------------------|----|-----------------|-------|-------------------|----|
| 0 | 00000 | 00000 | 0 | 16 | 10000 | 00001 | 1 |
| 1 | 00001 | 10000 | 16 | 17 | 10001 | 10001 | 17 |
| 2 | 00010 | 01000 | 8 | 18 | 10010 | 01001 | 9 |
| 3 | 00011 | 11000 | 24 | 19 | 10011 | 11001 | 25 |
| 4 | 00100 | 00100 | 4 | 20 | 10100 | 00101 | 5 |
| 5 | 00101 | 10100 | 20 | 21 | 10101 | 10101 | 21 |
| 6 | 00110 | 01100 | 12 | 22 | 10110 | 01101 | 13 |
| 7 | 00111 | 11100 | 28 | 23 | 10111 | 11101 | 29 |
| 8 | 01000 | 00010 | 2 | 24 | 11000 | 00011 | 3 |
| 9 | 01001 | 10010 | 18 | 25 | 11001 | 10011 | 19 |
| 10 | 01010 | 01010 | 10 | 26 | 11010 | 01011 | 11 |
| 11 | 01011 | 11010 | 26 | 27 | 11011 | 11011 | 27 |
| 12 | 01100 | 00110 | 6 | 28 | 11100 | 00111 | 7 |
| 13 | 01101 | 10110 | 22 | 29 | 11101 | 10111 | 23 |
| 14 | 01110 | 01110 | 14 | 30 | 11110 | 01111 | 15 |
| 15 | 01111 | 11110 | 30 | 31 | 11111 | 11111 | 31 |

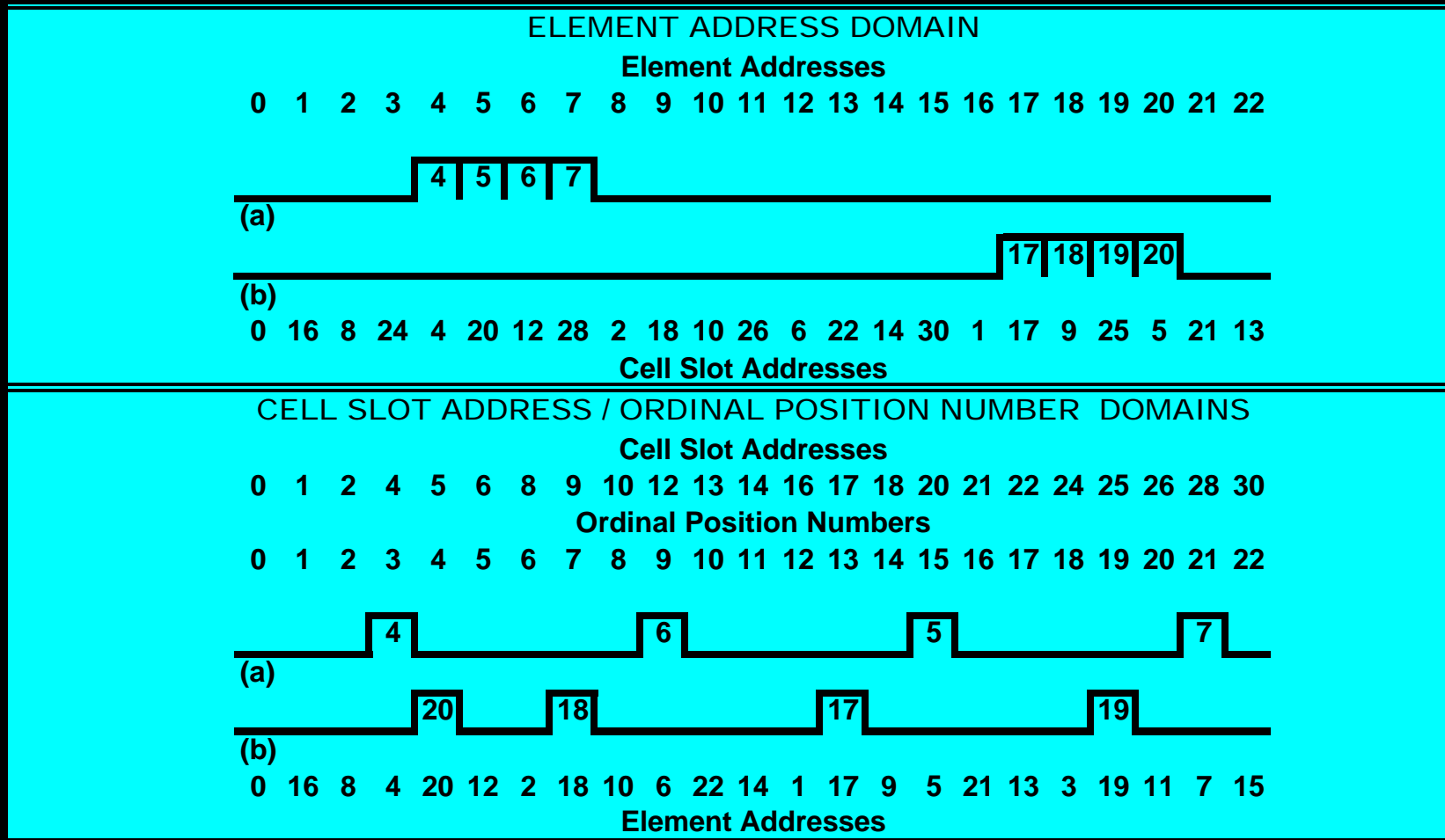
Basic Transform - I



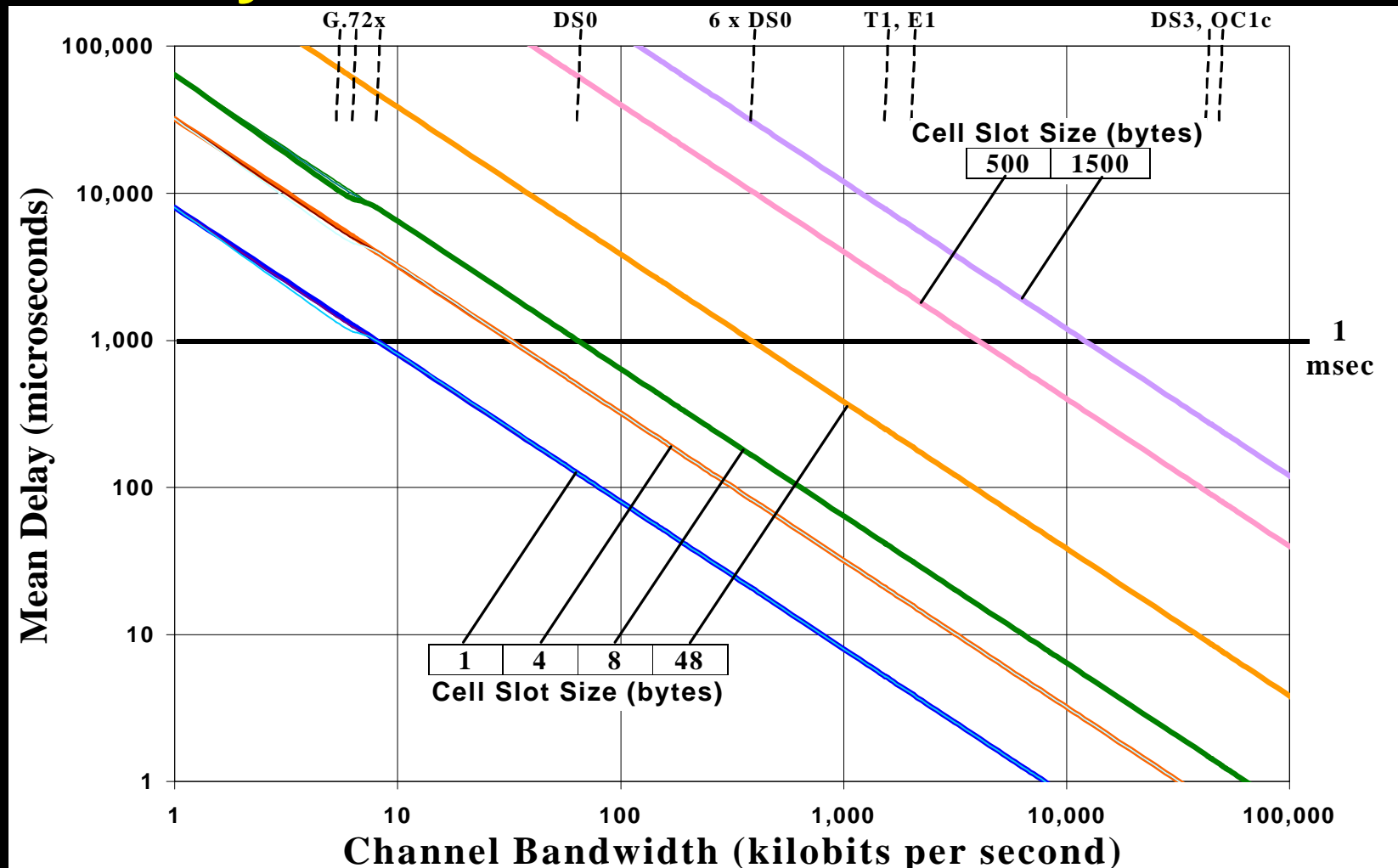
Basic Transform - II

| Element Address | | Cell Slot Address | | Element Address | | Cell Slot Address | |
|-----------------|-------|-------------------|----|-----------------|-------|-------------------|----|
| 0 | 00000 | 00000 | 0 | 16 | 10000 | 00001 | 1 |
| 1 | 00001 | 10000 | 16 | 17 | 10001 | 10001 | 17 |
| 2 | 00010 | 01000 | 8 | 18 | 10010 | 01001 | 9 |
| 3 | 00011 | 11000 | 24 | 19 | 10011 | 11001 | 25 |
| 4 | 00100 | 00100 | 4 | 20 | 10100 | 00101 | 5 |
| 5 | 00101 | 10100 | 20 | 21 | 10101 | 10101 | 21 |
| 6 | 00110 | 01100 | 12 | 22 | 10110 | 01101 | 13 |
| 7 | 00111 | 11100 | 28 | 23 | 10111 | 11101 | 29 |
| 8 | 01000 | 00010 | 2 | 24 | 11000 | 00011 | 3 |
| 9 | 01001 | 10010 | 18 | 25 | 11001 | 10011 | 19 |
| 10 | 01010 | 01010 | 10 | 26 | 11010 | 01011 | 11 |
| 11 | 01011 | 11010 | 26 | 27 | 11011 | 11011 | 27 |
| 12 | 01100 | 00110 | 6 | 28 | 11100 | 00111 | 7 |
| 13 | 01101 | 10110 | 22 | 29 | 11101 | 10111 | 23 |
| 14 | 01110 | 01110 | 14 | 30 | 11110 | 01111 | 15 |
| 15 | 01111 | 11110 | 30 | 31 | 11111 | 11111 | 31 |

Basic Transform - II

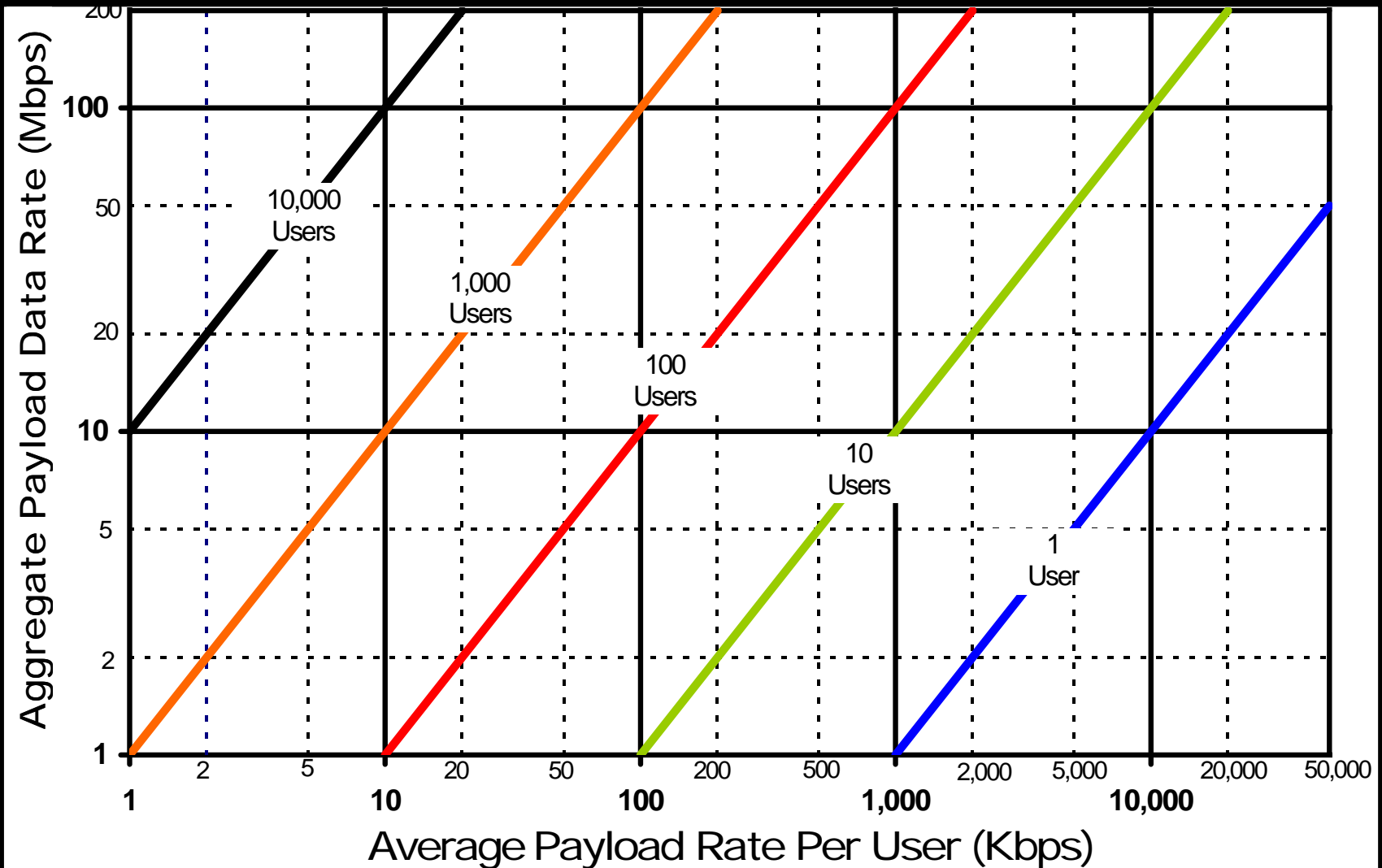


Delay vs Bandwidth & Cell Slot Size



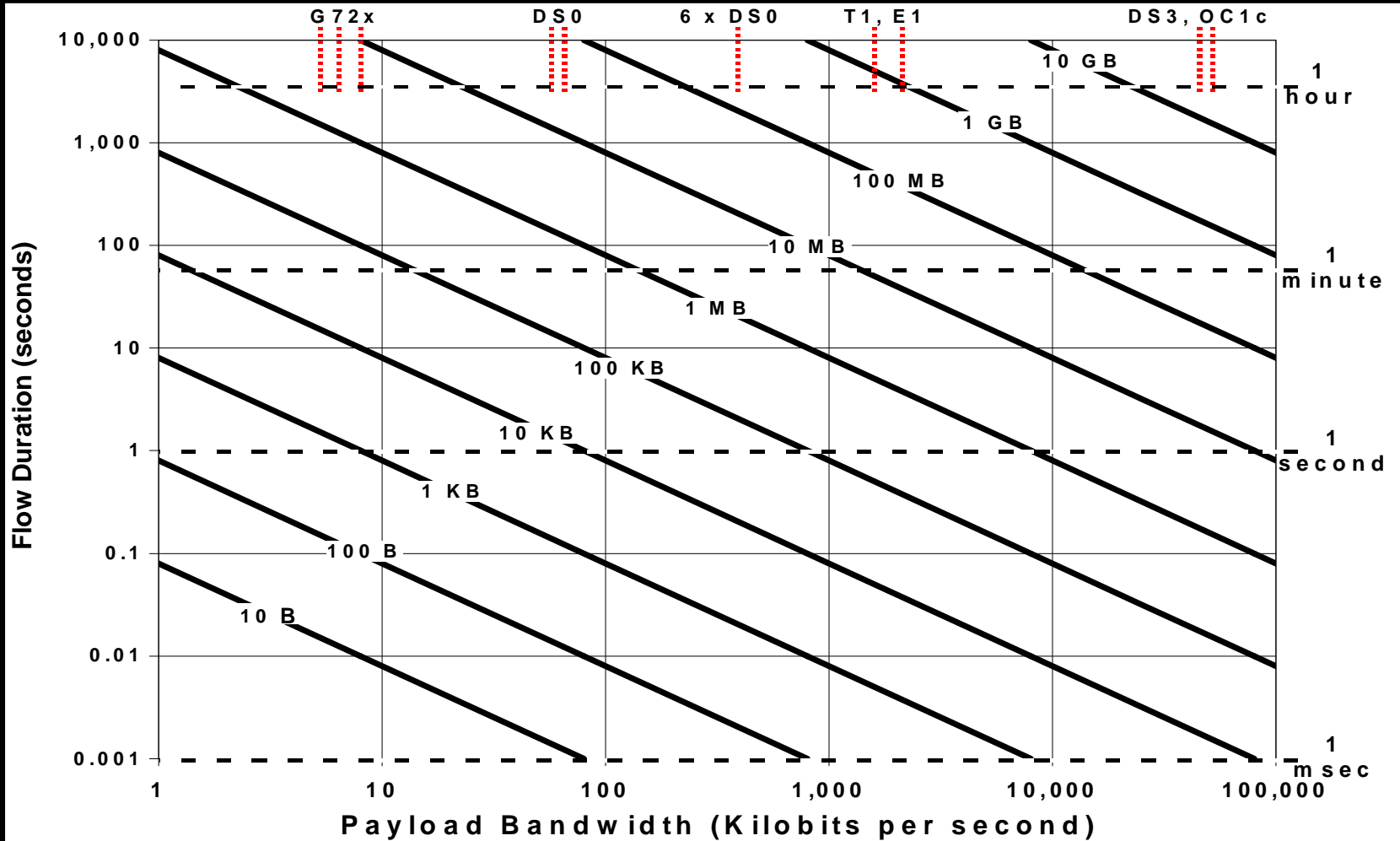
Ray W. Sanders, CircuitPath

Average Payload Rate Per User



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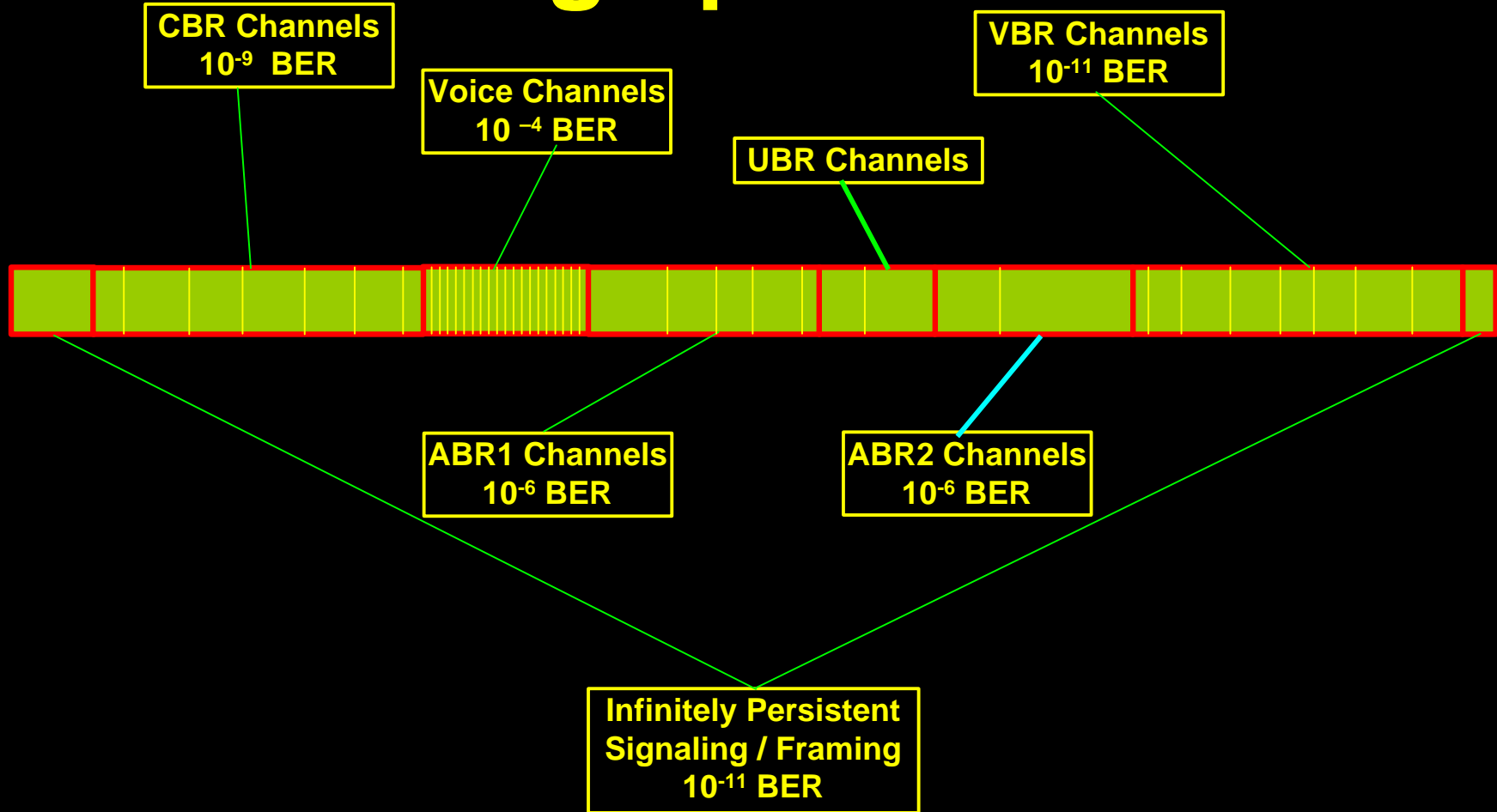
Dealing with Flows



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Note Attached

Setting up Channels



How Can We Assure Success with This Approach

- Get a group of 802.16 members to with complementary skills to *work* together to produce a best of breed protocol
- Individual incentive: it will be fun
- Corporate incentive: be among the first to field products with best of breed capabilities