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A Note on Network Entry Using Subchannelization

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Introduction

Network entry in subchannelization, is necessary to exploit the full benefits of this mode. By supporting network entry in the subchannelization mode, distant SSs can utilize the additional power gain of up 6dB.
In draft D6alpha2 the use of network entry in subchannelization is specifically prohibited. In our view, this restriction is artificial and does rely on technical justifications.

This document addresses some concerns regarding subchannelized network entry.

Power measurements on a subchannelized burst.

One of the concerns regards power measurements on a subchannelized network entry. The argument goes as follows:
" Suppose that a network entry burst is received on subchannel 1. Suppose that the channel is highly frequency selective, and the power measured on subchannel 1 is not indicative of the power on other subchannels.
If subchannel 1 has faded, the BS will instruct the SSs to increase the transmit power significantly. The same transmit power will be use for other subchannels, which are not faded. In these case the transmit power will be excessively high and the transmission will interfere with other subchannels"

First, let us recall that in the subchannelization scheme, the active subcarriers are divided into clusters, which are spread across the entire band. Thus there is a high degree of frequency diversity. The likelihood that a single subchannel has faded while other subchannels have not, is very small.
To illustrate, we have looked at the statistics of the power received on a single subchannel (say subchannel 1), to power on all subchannels.
Let P_s and P_f, denote the power density of a single subchannel and the full bandwidth respectively. Figure 1 shows the probability of P_s/P_f being smaller than some value, for various SUI channel models. 2000 realizations were used for each channel model. Omni-directional antennas were assumed.

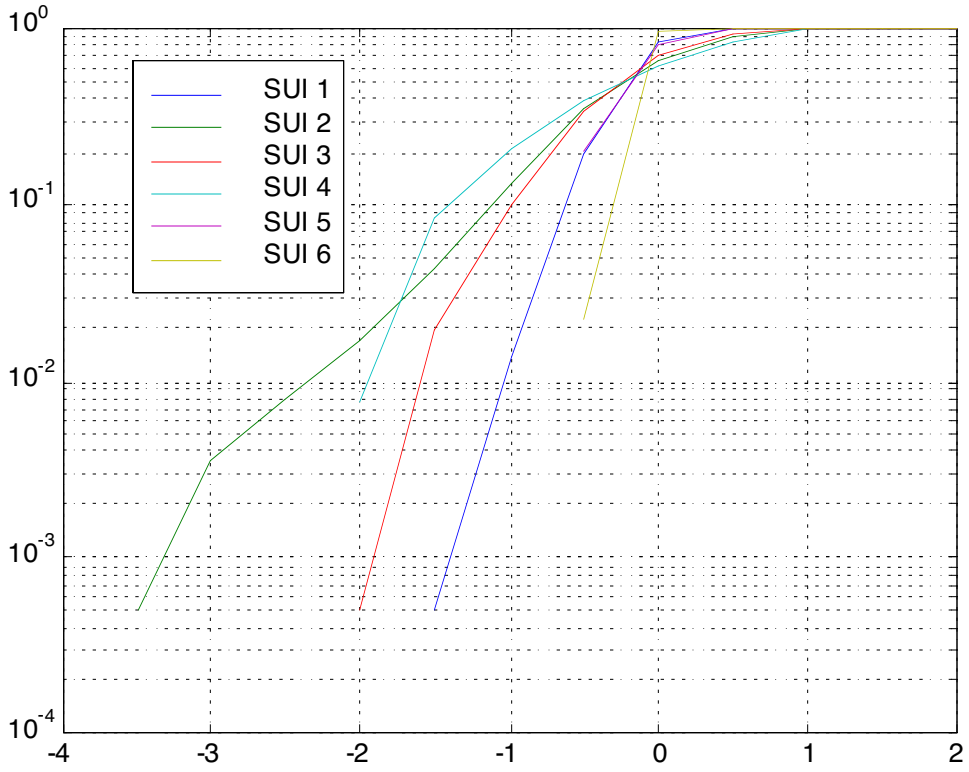

Figure 1 Probability of $P_s/P_f <$ Threshold

It can be seen the probability of –4dB outage is much smaller then 10^{-3}. Next we consider the P.D.F of the P_s/P_f for the same simulation experiment. The results are shown in Figure 2. It can be seen that for >99% of the cases the power is centered within +/- 2dB.

The conclusion is that power ranging can be performed on subchannelized bursts, and the variability of received power in subchannelized burst relative to a full bandwidth burst is small. In fact the variability is smaller than any sensible power control margin. *Thus the concerns made above are not justified*.

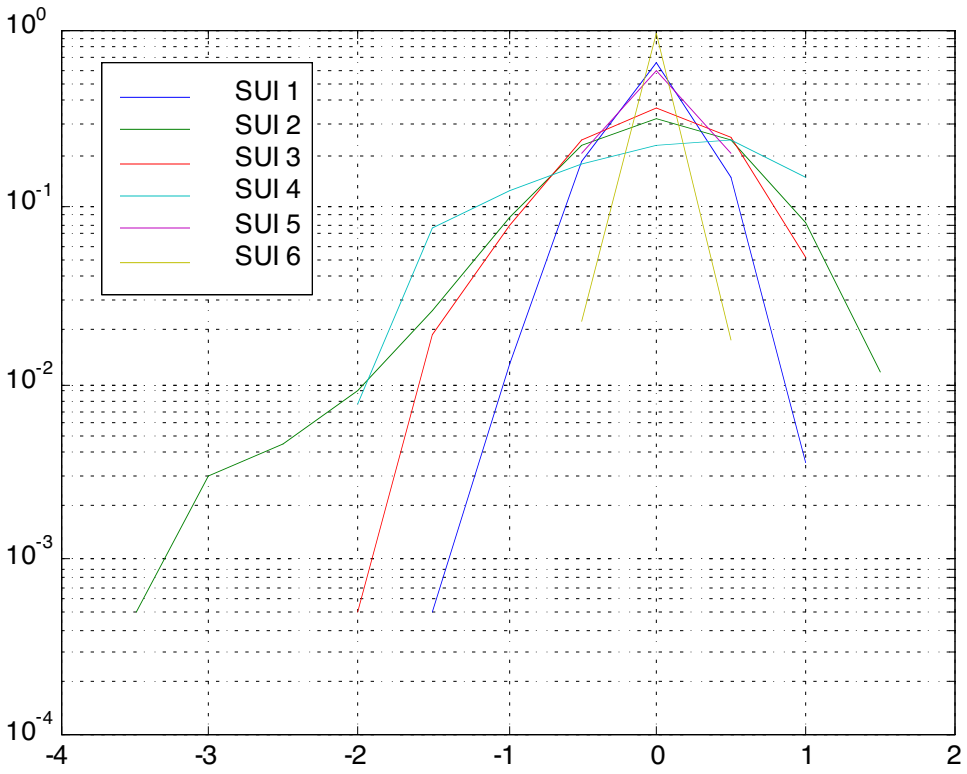

Figure 2 P.D.F of P_s/P_f

Proposed Network entry procedure.

In spite of the results of the previous section, we realize that one can device a channel for which an entire subcahhnel is deeply faded. In nature these channels will be extremely rare.[1] However due to Murphy, 'what might go wrong shall', and so we propose the following mechanism.

The BS allocates some entry opportunities which are on the entire band and some which subchannelized. This makes sense because:

a. We should allow non-subchannelized SSs to enter the network.

[1] In a previous version of subchannelization, the clusters were spread across the band in a regular manner. Channels of the form $1+z^{-n}$ could potentially erase a single subchannel. In current version the spreading is non-regular and simple two-ray channels cannot create such effect.

b. Network entry in full bandwidth is more efficient, since in subchannelization only one subchannel can be used at a time. Most of the SSs shall use the full bandwidth entry, and only the far away SSs shall use the subchannelized entry, and shall enjoy the 6dB gain.

At typical ratio may be 70% of the opportunities are full bandwidth, and 30% subchannelized.

To further increase the frequency diversity, the BS may occasionally alter the entry subchannel.

A SS shall first attempt to enter the network in a full bandwidth opportunity. Only when this process failed it can try to enter the network on a sub-channelized opportunity.
For the major part of the SSs, ranging shall performed on the full bandwidth. Only link-budget-challenged SSs shall use the subchannelized entry procedure. For those SSs there is no risk of using an excessive transmit power. Also rare cases of selective faded will alleviated by altering the entry subchannel.