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The Ability of PCS to Co-exist with Microwave is Better Served with Larger Spectrum Blocks

The success of PCS systems co-existing with incumbent microwave operators depends critically upon the outcome of many complex issues. Perhaps most prevalent among these is the spectral width of the microwave receive filters. In virtually all instances, the receive filter bandwidths are as wide as a designated 20 Mhz PCS channel block. Figure 1 shows the microwave radios that are used on approximately 90% of the microwave paths in the country along with the IF filter bandwidths.

Therefore, considering the proposed PCS allocations, a single microwave receiver could easily impact the use of PCS spectrum in more than just one PCS block. An example of this is that a single microwave receiver using one of these filters may obstruct the use of an entire 20 MHz PCS block throughout large portions of a market. Figure 2 shows the impact that one microwave receiver may have within a 20 MHz block in Denver. A large portion of the market is blocked due to interference. Although this is a somewhat pessimistic case, the important point is that there will not be any spectrum available in a 20 MHz block over a large within a market.

The best way to avoid interference into incumbent microwave

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systems is to relocate all of them. Of course, this is impractical; thus, the next best way to avoid interference is to frequency engineer around them. However, there needs to be sufficient spectral room to do so. PCS spectrum allocations that are as wide as the occupied microwave channel leave no options for frequency coordination. Instead, PCS operators with these allocations are faced with the predicament on day one of relocating a large percentage offending microwave paths. Larger PCS spectrum allocations provide at least some spectral space to permit deployment and allow for the PCS operator to become viable before being forced to contend with microwave relocation. Indeed, without immediate relocation of the microwave incumbents, a larger spectrum allocation will allow for interference avoidance, thus permitting less costly systems to be deployed.

Negotiations with Microwave Incumbents May Tend to be Protracted and Complicated

Comsearch has been involved in the technical realm of microwave and mobile engineering for over 17 years, and we feel well-qualified to offer comment on the technical aspects of this process. Our experience, especially with private microwave, indicates that the problems associated with negotiation and relocation are complicated, and could tend to

be exacerbated by the rules.

The 80 MHz bifurcated PCS frequency block allocations were conceived to be coincident with the 80 MHz transmit / receive separation of the existing microwave frequency plans.[1] Unfortunately, the problems born by this attempt to provide PCS operators "some flexibility in designing their systems" are many. To be sure, 80% of the licensed microwave paths in the 1.9 GHz band use the 80 MHz separation, as shown in figure 3. So, should a PCS operator pay to relocate an entire microwave path if only one receiver is in the operator's spectrum? How can the inequity of paying to make spectrum available in a potential competitor's spectrum block be mitigated.

In addition, due again to the wide-band nature of the microwave receive filters, adjacent channel interference will tend to play a substantial role in spectrum availability, and accordingly, in negotiations. Figure 4 shows the results of a recent study in Atlanta which indicates that adjacent channel paths constituted up to 50% of the paths required to be relocated to make spectrum available.

Adjacent channel problems may not be the only problems to

[1] See Notice of Proposed Rulemaking and Tentative Decision, FCC 92-333, GEN Docket No. 90-314, ET Docket No. 92-100, para. 39.

plague PCS operators. The FCC has mandated that PCS operators consider all microwave paths within a coordination distance of up to 305 km around their market. This means that is possible, and indeed likely to have to relocate paths that are neither in an operator's band nor in the operator's market.

Practically all industry segments face the potential to be inundated by the demand to relocate microwave paths. Within the band allocated to PCS, there are over 12,000 licensed microwave paths. To relocate this magnitude of microwave paths within a reasonable amount of time will tax the resources in practically every segment of the industry. By comparison, there were fewer than 350 new paths licensed in the 6.7 GHz OFS band during all of 1993, and this band will likely be the desired home to the majority of those 12,000 paths.

While we are optimistic that the industry can meet the complicated negotiation challenge, the effort to develop strategies, create organizations, and marshall resources will be herculean. Those who must begin to prepare today for the negotiation and relocation effort include microwave vendors, negotiators, coordinators, microwave incumbents, engineering and installation companies, and the FCC. This can all be accomplished, but we anticipate protracted time frames, and more complicated negotiations to result. One key to help pave

the way to quick deployment is a regulatory framework that is considerate of these issues.

The Original Belief that PCS can Co-exist with Microwave is Being Replaced by Spectrum Sharing as a Stopgap Accommodation While Prioritizing Relocations

PCS requires a certain amount of spectrum in order just to deploy service. Naturally, this spectrum is required in the most populated regions of a market, where the occurrence of a single microwave path might easily pre-empt deployment. To achieve roll-out goals, PCS operators will likely have to relocate incumbent microwave paths well before the first base station turns on. How many paths need to be relocated depends upon a myriad of factors including the amount of spectrum allocated to the PCS operator.

In 1993, Comsearch produced a much-discussed study. The goal of the study was to examine the staging of relocations commensurate with spectrum requirements. The results of this study, as well as other proprietary studies all indicate the same conclusion: in most markets, before even the first cell is turned up, microwave paths will need to be relocated. In order to achieve FCC-mandated coverage requirements, many microwave paths need to be relocated. Thus, we have seen the

notion that PCS and microwave can share spectrum long-term practically being reduced to short-term relocations where the focus becomes frequency engineering and microwave relocation.

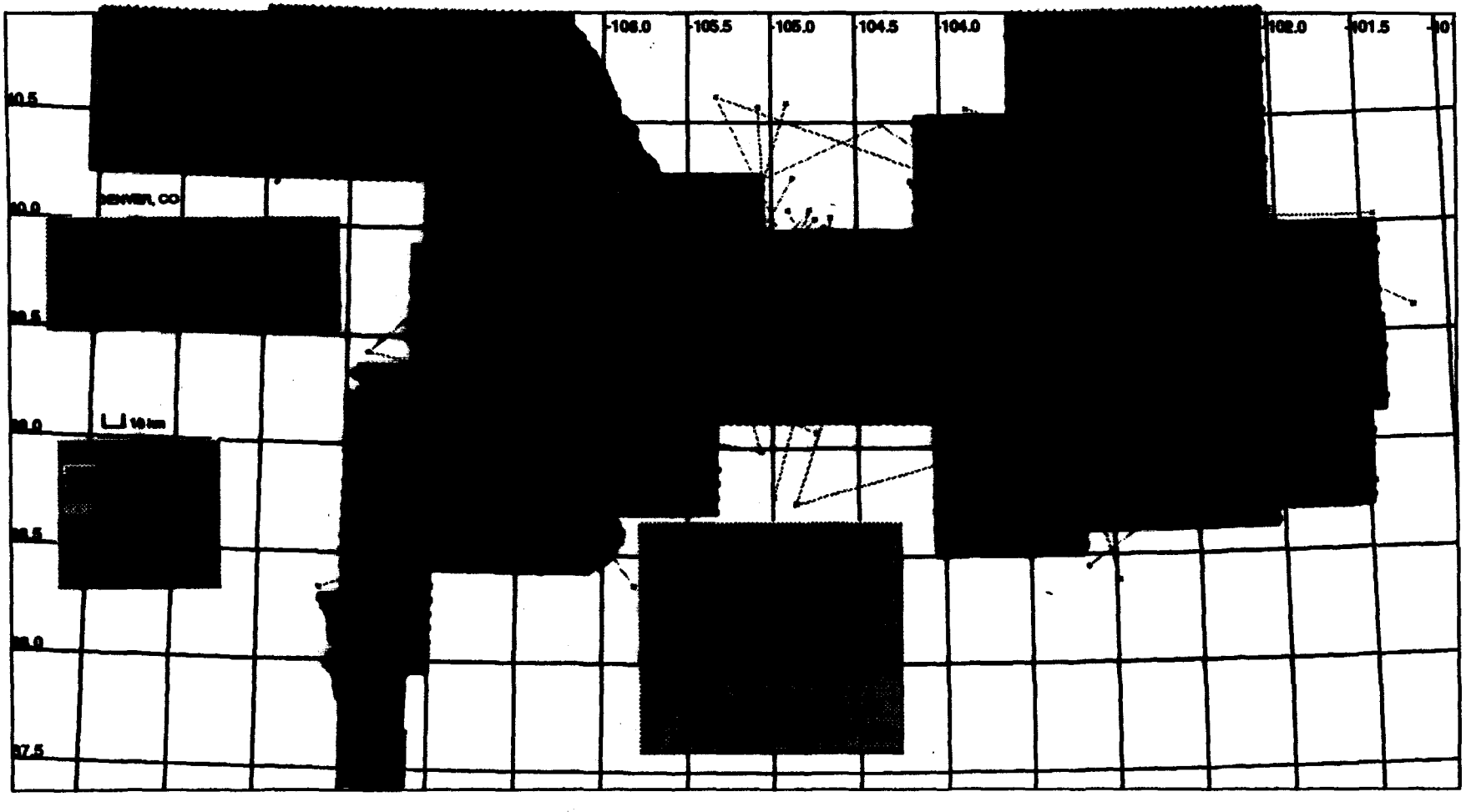
There will be Costs Associated with PCS and Microwave Trying to Share the Same Spectrum

The cost of avoiding interference may be more than the cost of relocating microwave paths. All spectrum avoidance techniques such as beacons and intelligent frequency avoidance systems, while perhaps adequate for permitting spectral co-existence, imply increased cost and complexity. In addition, to design around incumbent microwave paths will require additional cells, lower antenna heights, directional antennas, etc. The costs associated with relocation are generally one-time costs, while the cost associated with avoidance are recurring. PCS operators need to weigh the relocation costs against the frequency costs when deciding how to approach the sometimes intractable problem of spectrum sharing. Indeed, costs may well become prohibitive unless there is sufficient spectrum in addition to well-qualified rules.

FILTER INFORMATION FOR SOME OF THE MOST COMMON ANALOG MICROWAVE RADIOS

EQUIPMENT Make/Model	Channel Loadings	Threshold (dB)	IF Filter 3dB Bandwidth (MHz)
Motorola MA372	300/480	-82.0	16.0
Motorola MA372	600	-78.0	16.0
Motorola MA372	252	-85.0	10.0
Motorola MA372	132	-88.0	10.0
Motorola ABZ89FC6602	600	-82.4	18.0
Motorola ABZ89FC6602	480	-86.8	18.0
Motorola ABZ89FC6602	300	-92.8	10.0
Harris/Farinon FAS2000	600	-81.5	16.0
Harris/Farinon FAS2000	480	-86.5	14.0
Harris/Farinon FAS2000	300	-90.0	14.0
Harris/Farinon FL1-2	300	-88.0	12.0
Farinon FM2000	300	-87.5	12.0
Lenkurt 79F1	300/480	-84.0	22.0
Rockwell MIR-2	300	-95.5	15.0
Rockwell MIR-2	480/600	-87.9	28.0

Figure 1



[redacted]

Figure 2

Frequency Separation for Microwave Paths Between 1850-1990 MHz

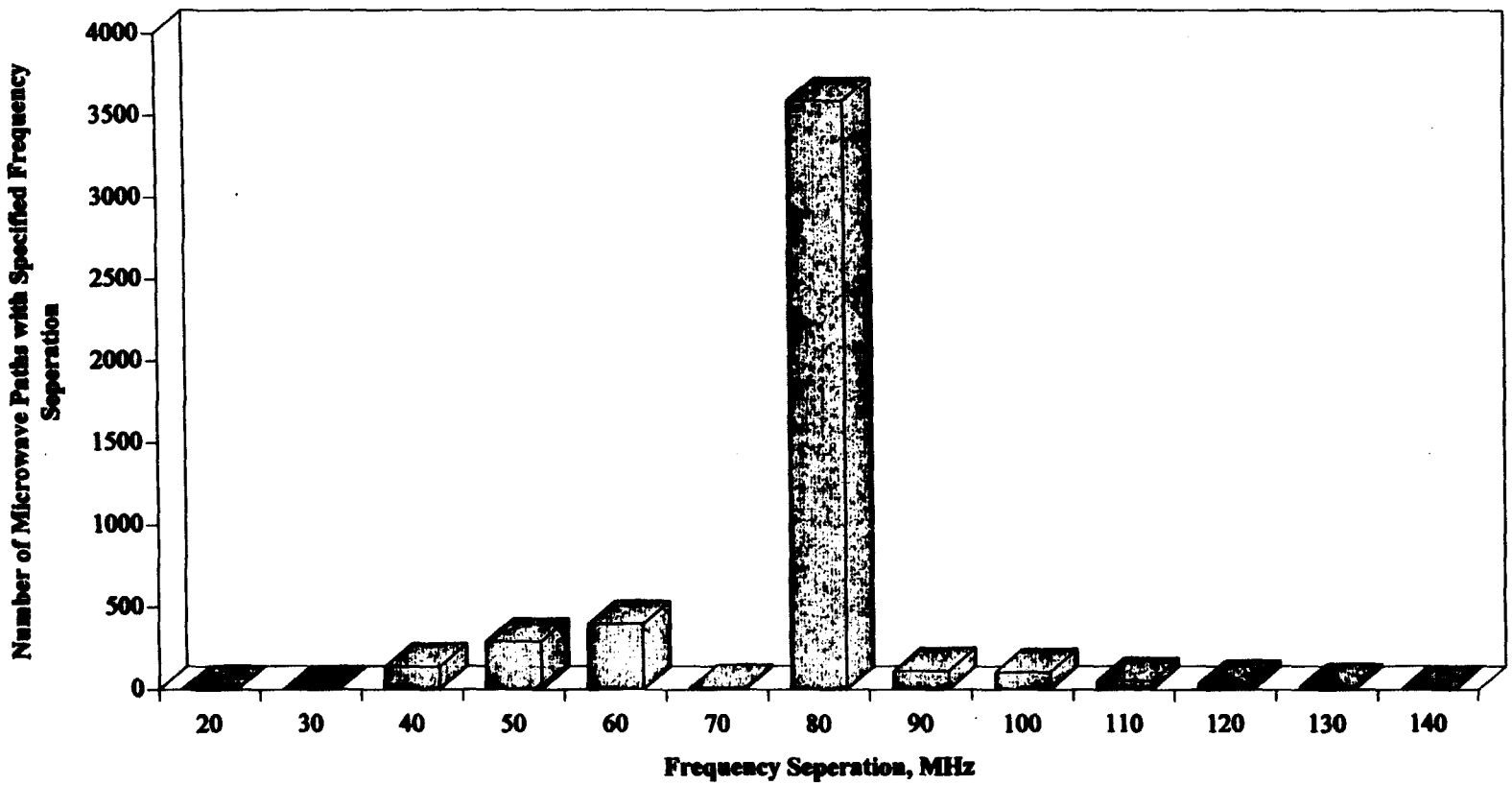


Figure 3

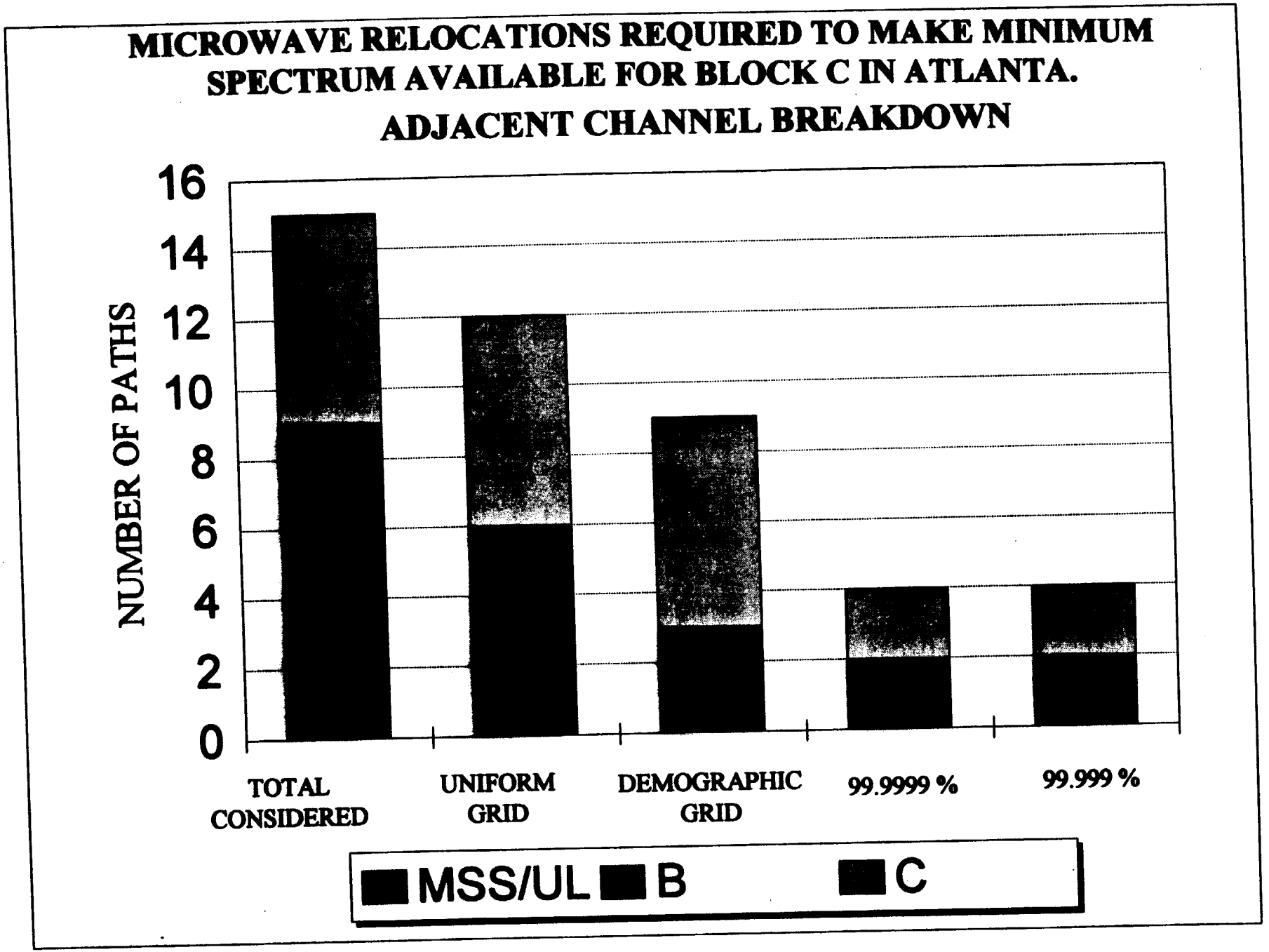

MICROWAVE RELOCATIONS REQUIRED TO MAKE MINIMUM SPECTRUM AVAILABLE FOR BLOCK C IN ATLANTA.
ADJACENT CHANNEL BREAKDOWN
NUMBER OF PATHS
16
14
12
10
8
6
4
2
0
TOTAL CONSIDERED
UNIFORM GRID
DEMOGRAPHIC GRID
99.9999 %
99.999 %
MSS/UL
B
C

Figure 4