MEMORANDUM

BARBER

To: IMP Guys

From: John McQuillan

Subject: Heuristics for Identifying Errors in Routing Messages with Bad Checksums

Date: March 15, 1973 IG# 19

This note serves as a supplement to IG# 18. I hope that information pertinent to the diagnostic messages can be made available by the software staff whenever possible.

The format of a routing update message is as follows, where L is as in IG# 18:

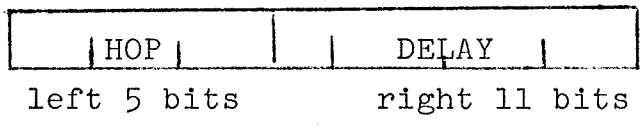
L		
L+1		
L+2		
L+3		
L+4		
L+5	IMP# | 01	Source IMP# in left 8 bits
L+6	GLOBAL TIME	in 25ms units
L+7	HOP | DELAY	IMP ØØ
.		# Hops in left 5 bits
.		Delay in right 11 bits
.		
L+106	HOP | DELAY	IMP 77
L+107	CHECKSUM	
L+110	UNUSED	
L+111	L+107	

The words L+7 through L+106 constitute an IMP Routing Table. The following conventions apply:

Entry = 0 this IMP is the source of the routing message

Entry = 177777 (= -1) this IMP is dead or non-existent.

Otherwise, the format is



Where the hop count equals the number of intermediate IMPs on the shortest path between the source of the routing message and the IMP to which the entry refers. The delay count is computed by adding four for each hop plus the number of packets on the output queue at each hop. Thus an entry = 004004 means the IMP for that entry is one hop away with a delay of 4, the minimum delay for that number of hops. Likewise 010010 means two hops, 014014 means three hops, etc. The delay for a hop can vary from the minimum of 4 to a maximum of 14 (octal). Thus it is possible to see an entry such as 014015 (slight extra delay), or 014040 (heavy delays).

Now for some heuristics to determine where the errors are in a routing update message with a detected bad software checksum.

1. L+111 should contain L+107.
2. L+7 should contain 177777, since there is no IMP ØØ.
3. L+55 through L+106 should contain 177777 since IMP numbers 46 through 77 octal do not exist.
4. Other IMP entries should be 177777, according to what IMPs were down at the time of the error.
5. If the source IMP of the routing message is IMP number N, then L+7+N should contain a zero.
6. The hop count to each IMP which is up should agree with the length of the shortest path from the source IMP, given the network topology at the time of the error.
7. The delay count should never be less than 4 times the hop count, and never greater than 14 (octal) times the hop count.
8. The delay count should <u>rarely</u> be very much greater than 4 times the hop count.
9. If the delay count to one IMP is much more than four times the hop count, then the delay counts to other IMPs should also be greater than the minimum.
10. It should be easy to check the IMPs that are claimed to be one hop away. Also, it is not likely that there will be a hop count more than 14 decimal, which is 070070 with minimum delay. That is, the high order bit should not be on usually, except when the entry is 177777.