

CALIFORNIA INSTITUTE OF TECHNOLOGY
 Laser Interferometer Gravitational Wave Observatory (LIGO) Project

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 Refer to: LIGO-E95101-00-E
 Date: November 29, 1995

Subject: Telecommunications requirements for Hanford, WA Site.

In response to Otto's request for guidance in sizing the site telecommunications requirements, I met with Fred Raab and Rolf Bork, and then separately discussed the issue with Greg Hiscott.

1. Voice (analog) phone lines

The requirements in Table 1 were derived using several assumptions and references.

Table 1: Analog phone line requirements, Hanford WA

Station	Room	Basis of Estimate	# of Phone Lines
Corner	LVEA	1 per CDS rack cluster; 2 per wall	28
Corner	OSB	LIGO-E950098 where noted; 1 per office otherwise; 2 per lab/room; 4 per large room	62
Corner	Chiller Bldg. Maintenance Bldg.	1 in Chiller Bldg.; 3 in Maintenance Bldg.	4
Mid-Station (x2 per site)	VEA	1 per CDS rack cluster; 2 along each of long walls	8
Mid-Station (x2 per site)	Other rooms	1 per room (excepting janitor/toilet areas)	10
End-Station (x2 per site)	VEA	2 per CDS rack cluster; 2 along each of long walls	8
End-Station (x2 per site)	Other rooms	1 per room (excepting janitor/toilet areas)	10
Site Total [internal lines]			130
With 100% expansion capability			260
Site Total [external lines @ 5% usage]			13

The number of phone lines (voice, analog) for certain OSB rooms were provided by CDS and compiled in the document LIGO-E950098-00-F, Operations Support Building (OSB) Requirements. Additional estimates for remaining OSB rooms (offices, conference room, multi-use room, etc.) were derived using bases for the estimates noted in Table 1. Requirements other buildings (maintenance room, mid- and end-stations, etc.) were similarly estimated. Allowing for 100% expansion capability (rule-of-thumb recommended by CDS) the number required is 260. These are internal lines (i.e., unique telephone extension numbers).

REQUIREMENT:

The requirement for the number of incoming/outgoing calls which can be handled simultaneously is estimated to be 13. This was determined using a rate of 5% in use at any given time as a conservative number. Obviously, this is an estimate, and if there is a cost/technology break-point near this number, it can be varied accordingly.

2. Digital (data) lines

Discussions with Rolf and Fred concluded that we would require 2 ISDN (64 KBAUD) lines dedicated to video teleconferencing, 2 ISDN lines dedicated to servers accessing the Internet, and 3 ISDN lines dedicated to communications from Hanford to each of the other LIGO hubs: Livingston, MIT, and Caltech. We came up with a need for 7 ISDN lines immediately, plus allowing for 100% expansion, we would have a need for at least 12 (rounded down) ISDN lines, or one T1 line at Hanford.

I spoke afterwards to Greg Hiscott, who gave me a cost estimate of \$2500/month per T1 line. In addition, when I shared with him the numbers above, he recommended that two other factors should be considered in sizing the digital data communications requirements: need for large volume data transfers and redundancy. He pointed out that even though the LIGO baseline calls for tape-based data transfer from the sites, this approach will most likely prove inadequate. Greg recommends we go to all-T1 connections among the hubs. Considering the presently baselined data rate (including all house keeping) is, according to Rolf, 6Mbyte/sec + overhead = 64MBAUD = ~42 T1 lines per interferometer, it is not feasible shipping 100% of the data around the LIGO hubs. More conservatively, however, if we stream the main data channel from each IFO, about 2/3 of a T1 is in constant use. Adding possible remote display of CDS screens, etc. at the other LIGO site and Universities, this finishes off one T1. For additional services, a second T1 would probably be needed. The layout of T1 lines is probably dependent on how we plan to operate and analyze data. Figure 1 indicates two possible topologies of such a configuration. If WA and LA are to be closely linked, the second sketch would be the choice, with the eventual addition of a line directly between WA and LA (dotted connection).

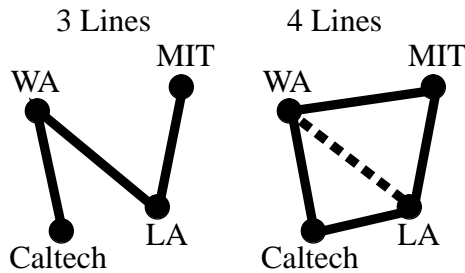


Figure 1: Two possible T1 connections among the LIGO hubs.

REQUIREMENT:

The 3-line system offers no redundancy, whereas the 4-line system provides at least two paths from any one hub to the other. Both configurations will require 2 T1 lines initially at Hanford.

3. Thoughts on other options

We originally had asked that the Civil Construction provide an all-digital phone system. When this proved too expensive, we opted for analog lines. However, now that the site requirement for analog lines approaches 260 (1. above), perhaps there are other options worth pursuing.

If we go to 2 T1 lines per site, it may be possible to do without the analog phone system by providing for the needed phone capacity ourselves, as part of the digital data communications infrastructure we are building with CDS. CDS plans to purchase and install its own switching (PBX) system as part of the computer system infrastructure. According to Rolf, the backbone at the sites will probably be ATM (Asynch Transfer Mode) switches with 155Mbit/sec (OC-3) capacity, upgradeable to 620Mbits/sec (OC-12). They presently plan to carry video, and they can check as well on voice connections, though it had not been planned (or costed by CDS). Additional funds for CDS could be provided from Facilities cost savings if we forego phones as part of the Civil Construction.

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| Barish | Shoemaker | Raab | Weiss |
| Asiri | Zucker | Weiss | Whitcomb |
| Vogt | Coles | Whitcomb | Althouse |
| Spero | Coyne | Althouse | Chronological File |
| Hiscott | Sanders | Raab | Document Control Center |
| Blackburn | | | |