

Navy Terminal Interoperable  
with a Commercial Low Earth Orbit  
"NICL"

Phase I

R&D Status Report #1

28 April 1995

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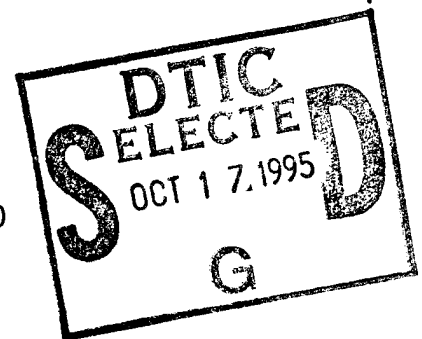
Office of Naval Research

Code 251A BSM

Ballston Tower One

800 North Quincy St., Arlington, VA 22217-5660

Contract # N00014-95-C-0102



Contractor:

Torrey Science & Technology Corp.  
10065 Barnes Canyon Road  
San Diego, CA 92121

Principal Investigator:

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Effective Date of Contract: 13 March 1995  
Contract Completion Date: 9 September 1995  
Reporting Period: As of Month Ending 28 April 1995

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May 2, 1995

Program Officer  
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Ballston Tower One  
800 North Quincy Street  
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Attn: Sherman Gee, ONR 313

Subject: Contract N00014-95-C-0102  
Progress Report, 0001AA

Dear Mr. Gee:

Enclosed please find one copy of the first Progress Report due under subject contract. This report covers the period from March 13, 1995 thru April 28, 1995.

Also enclosed is our invoice, DD Form 250, original plus four copies. Please sign blocks 21B and 22 indicating receipt and acceptance of this deliverable and forward to the paying office for payment. Please forward a signed copy of the DD 250 to us in the envelope provided.

Should you have any questions, please contact the undersigned at (619) 552-1052.

Sincerely,

Laurin Pause  
CFO

cc: Administrative Contracting Officer w/enc.  
Director, Naval Research Laboratory, w/enc.  
✓ DTIC, w/2 copies of enc.

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1. This R&D Status Report ("Progress Report") describes activity and progress on Contract N00014-95-C-0102, Navy Terminal Interoperable with a Commercial Low Earth Orbit "NICL", for the period 13 March 1995 through 28 April 1995. The following paragraphs are cross referenced to the contract Statement of Work ("SOW") Tasks. This is the 1st Progress Report for contract No. N00014-95-C-0102.
2. The following was accomplished under SOW Task 1: System Design.
  - a. A review of current and emerging Low Earth Orbit (LEO) satellite communication systems has started. This review is to quickly verify the ORBCOMM system as the leading candidate system. The considerations include such factors as acquisition cost, network charges, reliability, ease of installation and use, power consumption, coverage area, risk of system availability.

On April 3, 1995, Orbital Sciences Corporation successfully placed the first two ORBCOMM communications satellites, along with a third Microab-1 scientific spacecraft, into their targeted orbits approximately 450 miles over the Earth using the Pegasus air-launched rocket. The launch was carried out from Vandenberg Air Force base, California at 9:49 a.m. EDT. Pegasus was carried to its launch altitude of 40,000 feet approximately 50 miles off the California coast by the Company's modified L-1011 aircraft.

Having completed preliminary on-orbit test and check-out, ORBCOMM is currently conducting a set of comprehensive tests to validate the health and performance of the ORBCOMM satellites. Telemetry received by the Gateway Earth Stations (GESs) and relayed to ORBCOMM's Spacecraft Control Center (SCC) in Dulles, Virginia confirms that, following separation from the Pegasus launch vehicle, each satellite successfully deployed its solar panels and antennas, and signals from both spacecraft have been received by each of the three GESs. The telemetry confirms excellent signal strength, temperatures, attitude control and power levels. Initial tests also indicate that the ORBCOMM communications system software is operating as expected, including the critical function of selecting open communications channels to the satellites.

At San Diego, we have monitored the downlink information from the satellite and decoded the information segments with our terminals. This marks a significant milestone in our progress. We have demonstrated the ability along with ORBCOMM to receive real data from the satellite using production terminal hardware and software. During multiple passes of the satellites, the downlink was acquired

when expected and the performance was analyzed. Current indications show that the terminal performed exceptionally and is meeting all expectations.

Telemetry indicates that the major spacecraft support systems on the satellites, including electrical power, flight computers, attitude control and thermal control, are operating as expected. Since ORBCOMM engineers established communications with both satellites on launch day, one satellite is currently experiencing a problem in its gateway uplink receiver, preventing the commanding of the vehicle through normal channels. This anomaly was first identified after five successful passes, and Orbital engineers continue to work on the problem. The engineers also discovered a problem in the subscriber communications subsystem on the other ORBCOMM spacecraft. This subsystem is responsible for communications with subscriber terminals. Potential corrective actions are being pursued, some of which will be attempted following completion of maneuvers to separate further the satellites in their orbit plane.

Despite current problems with the satellites, the ORBCOMM system is still the preferred system for NICL communications.







- b. An investigation into the EMC requirements of the terminal for ship topside operation has been conducted. This information was obtained from meetings and discussions with the Applied Electromagnetics Branch Code 822 of NRaD. The information obtained included the various transmitters and receivers which operate in the frequencies of the ORBCOMM system. Relative transmitter power and receive interference requirements of these systems were summarized.
  - c. Closely associated with the EMC requirements study, an investigation into the link requirements has also been started. This study will evaluate the requirements of the ORBCOMM terminal for reliable link performance within the EMC shipboard environment.
  - d. Antenna selection, installation and use for the planned terminal was also investigated. Antenna selection continues with emphasis on size, interference requirements and ease of installation and operation.
  - e. An investigation into the baseband interface requirements has also been started.
3. The following was accomplished under SOW Task 2: Terminal Design

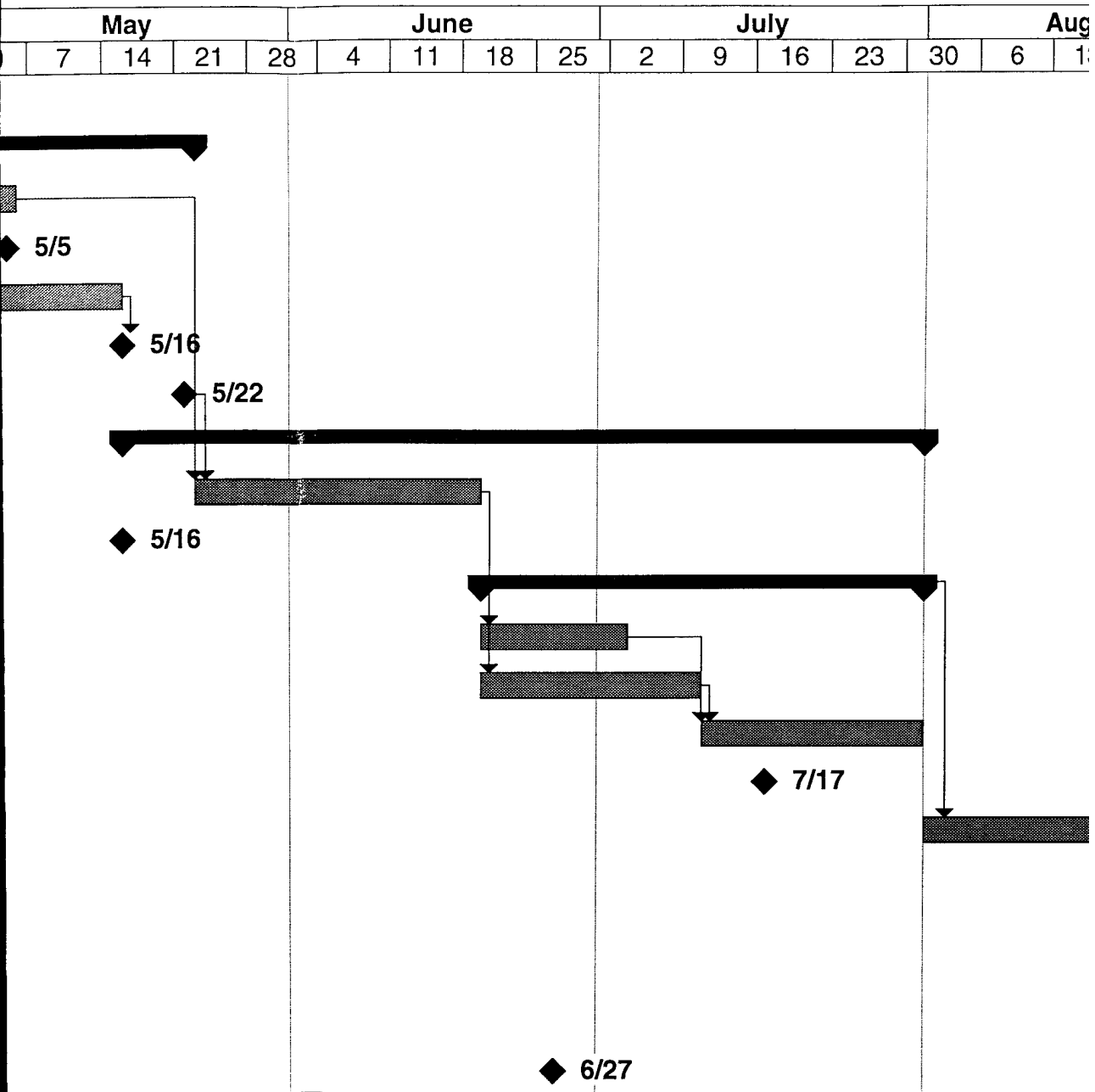
- a. A preliminary terminal architecture has been established and the high level design continues with partial low level designs being completed.
  - b. As part of the terminal design resulting from the EMC study and link analysis, a SAW filter was selected and placed on order as part of the low level design.
  - c. Initial design of high dynamic range preamplifier indicated two candidate approaches: NEC 46134 bipolar & Motorola MRF137 FET.
4. The following was accomplished under SOW Task 5: Meetings, Documentation and Reports
- a. A kick off meeting was conducted on 2 February 1995. During this meeting, additional contacts relevant to the project were identified. Clarification and definition of the goals along with planning and scheduling of the project were performed. Attendees were Sherman Gee (Office of Naval Research); Gunter Brunhart (Space & Naval warfare Systems Command); Roy Axford (NRaD); Chin-Hwa Lee (Naval Postgraduate School).
  - b. A meeting was held at NRaD with Peter Li and Daniel Tam of the Applied Electromagnetics Branch. Discussions covered the shipboard EMC environment, modeling assumptions an antenna usage.
  - c. As part of the design process, the EMC requirements have been summarized and is being incorporated into design documentation.
5. A project schedule chart was generated for internal project coordination. A copy is attached for the convenience of the Navy.

**Planned Activity for Next Two Months:**

1. Complete Baseband Interface Requirements study
2. Complete terminal architecture design
3. Perform low level design and analysis
4. Begin proto-typing of critical modules
5. Begin performance analysis
6. Continue discussions with NRaD on the fiber-optic link and complete the design

ID	Task Name	April					May					
		26	2	9	16	23	30	7	14	21	28	
1	Award of Contract		◆ 4/3									
2	<b>Preliminary Architecture</b>		▶									
3	RF Environment Study		▨									
4	RF HLD Review						◆ 5/5					
5	Interface Environment Study		▨									
6	Interface Environment HLD Review								◆ 5/16			
7	LLD Review									◆ 5/22		
8	<b>Breadboard Assembled and Tested</b>								▶			
9	Terminal Architecture Design										▨	
10	Front End Design Review											◆ 5/16
11	<b>Protoype Critical Parts</b>											
12	Schematics											
13	Simulations											
14	Prototyping											
15	Internal Progress Review											
16	Performance Analysis											
17	Final Meeting/Briefing											
18	Final Report											
19	Phase I Complete											
20	Report #1											◆ 4/27
21	Report #2											

Project:	Task		Milestone		Rolled Up Task	
	Progress		Summary		Rolled Up Milestone	



Rolled Up Task

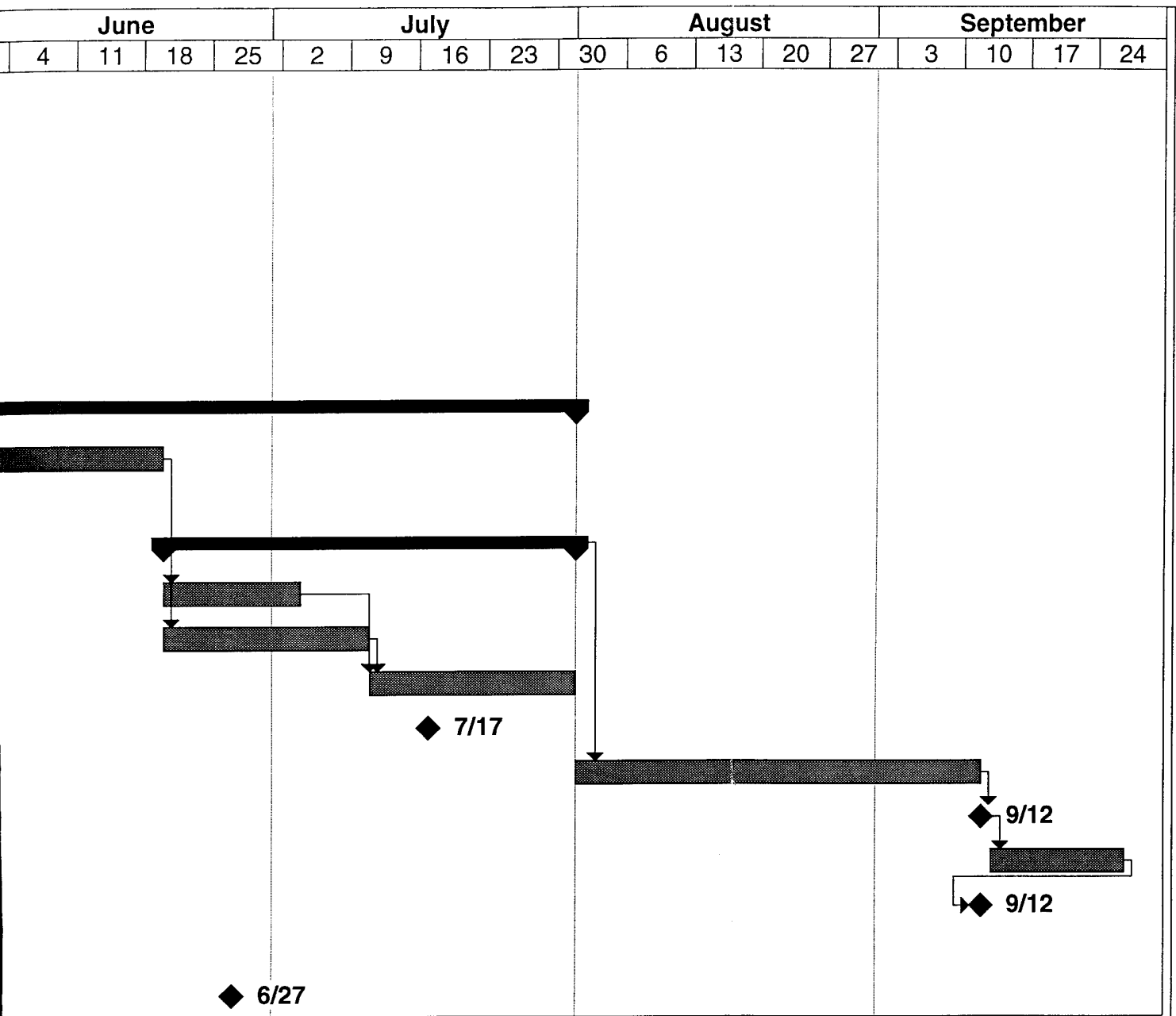


Rolled Up Progress



Rolled Up Milestone





Rolled Up Progress