

Memo from the Consortium for Slow Commotion Research (CSCR)

Status of this Memo

This RFC is in response to RFC 1216, "Gigabit Network Economics and Paradigm Shifts". Distribution of this memo is unlimited.

To: Poorer Richard and Professor Kynikos

Subject: ULSNET BAA

From: Vint Cerf/CSCR

Date: 4/1/91

The Consortium for Slow Commotion Research (CSCR) [1] is pleased to respond to your research program announcement (RFC 1216) on Ultra Low-Speed Networking (ULSNET). CSCR proposes to carry out a major research and development program on low-speed, low-efficiency networks over a period of several eons. Several designs are suggested below for your consideration.

1. Introduction

Military requirements place a high premium on ultra-robust systems capable of supporting communication in extremely hostile environments. A major contributing factor in the survivability of systems is a high degree of redundancy. CSCR believes that the system designs offered below exhibit extraordinary redundancy features which should be of great interest to DARPA and the Department of Defense.

2. Jam-Resistant Land Mobile Communications

This system uses a highly redundant optical communication technique to achieve ultra-low, ultra-robust transmission. The basic unit is the M1A1 tank. Each tank is labelled with the number 0 or 1 painted four feet high on the tank turret in yellow, day-glo luminescent paint. Several detection methods are under consideration:

- (a) A tree or sand-dune mounted forward observer (FO) radios to a reach echelon main frame computer the binary values

of tanks moving in a serial column. The mainframe decodes the binary values and voice-synthesizes the alphameric ASCII-encoded messages which is then radioed back to the FO. The FO then dispatches a runner to his unit HQ with the message. The system design includes two redundant, emergency back-up forward observers in different trees with a third in reserve in a foxhole.

- (b) Wide-area communication by means of overhead reconnaissance satellites which detect the binary signals from the M1A1 mobile system and download this information for processing in special U.S. facilities in the Washington, D.C. area. A Convection Machine [2] system will be used to perform a codebook table look-up to decode the binary message. The decoded message will be relayed by morse-code over a packet meteor burst communications channel to the appropriate Division headquarters.
- (c) An important improvement in the sensitivity of this system can be obtained by means of a coherent detection strategy. Using long baseline interferometry, phase differences among the advancing tank column elements will be used to signal a secondary message to select among a set of codebooks in the Convection Machine. The phase analysis will be carried out using Landsat imagery enhanced by suitable processing at the Jet Propulsion Laboratory. The Landsat images (of the moving tanks) will be correlated with SPOT Image images to obtain the phase-encoded information. The resulting data will be faxed to Washington, D.C., for use in the Convection Machine decoding step. The remainder of this process is as for (b) above.
- (d) It is proposed to use SIMNET to simulate this system.

### 3. Low Speed Undersea Communication

Using the 16" guns of the Battleship Missouri, a pulse-code modulated message will be transmitted via the Pacific Ocean to the Ames Research Center in California. Using a combination of fixed and towed acoustic hydrophone arrays, the PCM signal will be detected, recorded, enhanced and analyzed both at fixed installations and aboard undersea vessels which have been suitably equipped. An alternative acoustic source is to use M1A1 main battle tanks firing 150 mm H.E. ordnance. It is proposed to conduct tests of this method in the Persian Gulf during the summer of 1991.

#### 4. Jam-Resistant Underwater Communication

The ULS system proposed in (2) above has the weakness that it is readily jammed by simple depth charge explosions or other sources of acoustic noise (e.g., Analog Equipment Corporation DUCK-TALK voice synthesizers linked with 3,000 AMP amplifiers). An alternative is to make use of the ultimate in jam resistance: neutrino transmission. For all practical purposes, almost nothing (including several light-years of lead) will stop a neutrino. There is, however, a slight cross-section which can be exploited provided that a cubic mile of sea water is available for observing occasional neutrino-chlorine interactions which produce a detectable photon burst. Thus, we have the basis for a highly effective, extremely low speed communication system for communicating with submarines.

There are a few details to be worked out:

- (a) the only accelerator available to us to generate neutrino bursts is located at Batavia National Laboratory (BNL).
- (b) the BNL facility can only send neutrino bursts in one direction (through the center of the Earth) to a site near Tierra del Fuego, Chile. Consequently, all submarines must be scheduled to pass near Tierra del Fuego on a regular basis to coincide with the PCM neutrino signalling from the BNL source.
- (c) the maximum rate of neutrino burst transmission is approximately once every 20 seconds. This high rate can be reduced considerably if the power source for the accelerator is limited to a rate sustainable by discharging a large capacitor which is trickle charged by a 2 square foot solar panel mounted to face north.

#### 5. Options for Further Reducing Effective Throughput

- (a) Anti-Huffman Coding. The most frequent symbol is assigned the longest code, with code lengths reducing with symbol probability.
- (b) Minimum likelihood decoding. The least likely interpretation of the detected symbol is selected to maximize the probability of decoding error.
- (c) Firefly cryptography. A random signal (mason jar full of fireflies) is used to encipher the transmitted signal by optical combining. At the receiving site, another jar of fireflies is used to decipher the message. Since the

correlation between the transmitting and receiving firefly jars is essentially nil, the probability of successful decipherment is quite low, yielding a very low effective transmission rate.

- (d) Recursive Self-encapsulation. Since it is self-evident that layered communication is a GOOD THING, more layers must be better. It is proposed to recursively encapsulate each of the 7 layers of OSI, yielding a 49 layer communications model. The redundancy and retransmission and flow control achieved by this means should produce an extremely low bandwidth system if, indeed, any information can be transmitted at all. It is proposed that the top level application layer utilize ASN.1 encoded in a 32 bit per character set.
- (e) Scaling. The initial M1A1 tank basis for the land mobile communication system can be improved. It is proposed to reduce the effective data rate further by replacing the tanks with shuttle launch vehicles. The only slower method of signalling might be the use of cars on any freeway in the Los Angeles area.
- (f) Network Management. It is proposed to adopt the Slow Network Management Protocol (SNMP) as a standard for ULSNET. All standard Management Information Base variables will be specified in Serbo-Croatian and all computations carried-out in reverse-Polish.
- (g) Routing. Two alternatives are proposed:
  - (1) Mashed Potato Routing
  - (2) Airline Baggage Routing [due to S. Cargo]

The former is a scheme whereby any incoming packets are stored for long periods of time before forwarding. If space for storage becomes a problem, packets are compressed by removing bits at random. Packets are then returned to the sender. In the latter scheme, packets are mislabelled at the initial switch and randomly labelled as they are moved through the network. A special check is made before forwarding to avoid routing to the actual intended destination.

CSCR looks forward to a protracted and fruitless discussion with you on this subject as soon as we can figure out how to transmit the proposal.

## NOTES

- [1] The Consortium was formed 3/27/91 and includes David Clark, John Wroclawski, and Karen Sollins/MIT, Debbie Deutsch/BEN, Bob Braden/ISI, Vint Cerf/CNRI and several others whose names have faded into an Alzheimerian oblivion...
- [2] Convection Machine is a trademark of Thoughtless Machines, Inc., a joint-venture of Hot-Air Associates and Air Heads International using vaporware from the Neural Network Corporation.

## Security Considerations

Security issues are not discussed in this memo.

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