        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 Convenction 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 pwer 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/BBN,
        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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