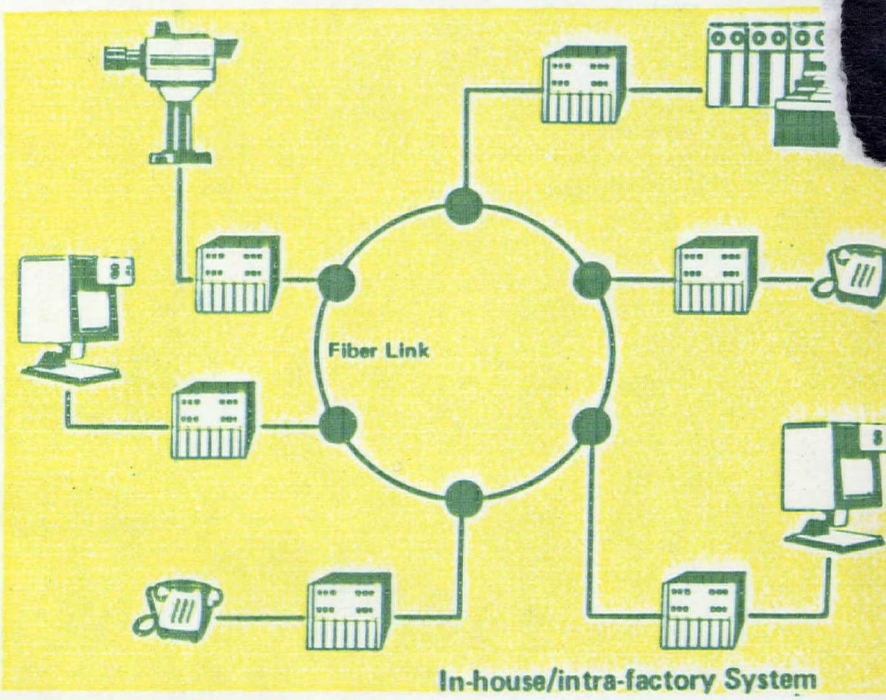
REPORT: FIBER OPTIC DEVELOPMENT
NEEDS OF LOCAL AREA NETWORKS

- TASK 3. EXECUTIVE SUMMARY



DSS CONTRACT NO. OST82-00134

FOR: DEPARTMENT OF COMMUNICATIONS

FROM: ANDREW T. SCHINDLER & ASSOCIATES INC.

March 25, 1983

LETTER OF TRANSMITTAL

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March 25, 1983.

Department of Supply and Services
Department of Communications

ATTENTION: Mr. S. E. Cooper, Science Procurement Manager, D.S.S.
Dr. D. C. Johnson, Scientific Authority, D.O.C.

SUBJECT: Contract No. OST82-00134

ENTITLED: Fiber Optic Development Needs of Local Area Networks (LANs)

We are pleased to submit fifteen copies of the "Task 3" Executive Summary (Final Report) with certification of Canadian content and Disclosures.

We take this opportunity to thank Dr. D. C. Johnson, the Scientific Authority on this project for the valuable guidance provided to ATS on this project and also thank Mr. S. Cooper, Science Procurement Manager for the professional way he handled this project.

Yours truly,

ANDREW T. SCHINDLER & ASSOCIATES INC.

A. T. Schindler,
President.

ATS/ds
ENCLS.

TASK 3 - EXECUTIVE SUMMARY REPORT

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1. STUDY OBJECTIVE

The objective of this study was to answer the question "what developments in fiber optic technology are needed in order to promote the implementation of economical fiber optic local networks?"

2. DEFINITION OF LOCAL AREA NETWORKS (LANS)

A local area network is primarily a data communications system that interconnects dissimilar devices (computers, terminals, energy control, etc.) within a limited geographical area. The geographical area may be a section of a building, a whole building, a group of buildings such as a campus or a factory complex. The LAN is privately owned. The transmission data rates may range from hundreds of Kilobits/sec. to over 200 Megabits/sec. The number of devices on a network may be dozens or hundreds. The local area network in addition to being a transmission media also has the capability of correcting for incompatibilities of various types of data processing machines and other devices. Most of the

traffic is confined to the LAN although gateways are provided in most systems to allow for connection via a satellite or public communication system to other LANs.

3. MAIN AREAS OF LAN APPLICATION

The big data processing equipment users may need several LANs each with a different characteristic: TDMA for real time synchronous process control, token passing for highway traffic management system or for factory automation or laboratory use, CSMA/CD for office automation or terminal networking, and TDMA for a campus wide local area network to connect the different smaller areas.

4. INDUSTRIAL ACTIVITY

In the U.S. there are some 60 to 100 companies actively pursuing this market opportunity. Some 100,000 systems are in place at present. In Canada there are two companies pursuing this business and it is estimated that there are no more than 10 installed systems.

5. MARKET FORECAST FOR LANS

The U.S. market is expected to reach $3.2 Billion by 1990. with the following technological segmentation:

1. Fiber optics $1.6 Billion
2. Baseband Coax $1.1 Billion
3. Broadband Coax $0.5 Billion

ATS extrapolates that the Canadian market by the end of the decade should reach the $300 Million level.

6. MARKET PUSH

The major contributers to the market creation is by data processing users and LAN provides technology drive. The reason for this is the inability of carriers to provide economical high throughput data transmission service.

7. IMPACT ON PBX AND DATA MODEM INDUSTRY

Most users are initially justifying the purchase of LANs for data transmission. Hence, the short term impact is

likely to be insignificant. However, in the next two to four year time frame it is expected that LANs will provide a significant share of in-building telephone services. Northern Telecom has reacted to this threat by announcing plans for the Open Network Architecture System.

8. CURRENT LANS TECHNOLOGY BASE

Ethernet baseband coaxial systems followed by broadband coaxial cable system.

9. WHY PRESENT DIFFERENCE BETWEEN U.S. AND CANADIAN MARKET PENETRATION?

It is ATS' opinion that Canada's high-tech industry has the potential technical capability to develop LAN systems. However, Canada lacks the marketing skill to sell to a very diverse user market. None of the U.S. LAN suppliers are in the business of supplying telephone carriers.

10. FIBER LANS

In early stages of development the main obstacles are high cost (at present twice that of coax) and the lack of flexibility of access to fiber network for in-building systems. For long systems such as the ATS designed MTC Highway 401 for traffic management system where fiber low loss and bandwidth is a strong advantage, fiber system proves to be economical. Canstar together with the University of Toronto are planning a fiber HUB-NET system.

11. CANADA'S TECHNOLOGY STRENGTH

Canadian industry has a very strong fiber technology base which should be further fostered to develop a LAN capability as the U.S. export potential opportunity is very substantial.

12. FIBER TECHNOLOGY CURRENT DEFICIENCIES

- Low power lasers
- High cost of fiber (large aperture fiber)

- Lack of flexibility to connect
- Lack of experience with fiber in typical LAN environment

13. FIBER TECHNOLOGY STRENGTHS

- No electrical groundloop or short circuit problems
- Small size, 10 fiber optic cables to 1 coaxial
- Electromagnetic interference and crosstalk immunity
- Light weight, 15 to 20 times lighter than wire
- Large bandwidth
- Immunity to lightning
- Safe in combustible areas
- Immunity to electrical discharges
- Flexibility
- Longer cable runs between repeaters
- High strength
- Nuclear radiation resistant
- Secure against signal leakage
- High temperature operation potential
- Secure against interference
- Multiplexing capability
- No electrical hazard when cut
- Low installation costs

In addition, Figure 1 shows the fiber bandwidth advantage in comparison to other media and Figure 2 compares various fiber topologies with important LAN characteristics such as connectivity cost, flexibility, expandability and data flow control for point-to-point systems, ring, star and bus topologies.

Figure 1. Bandwidth for Local Area Network Media

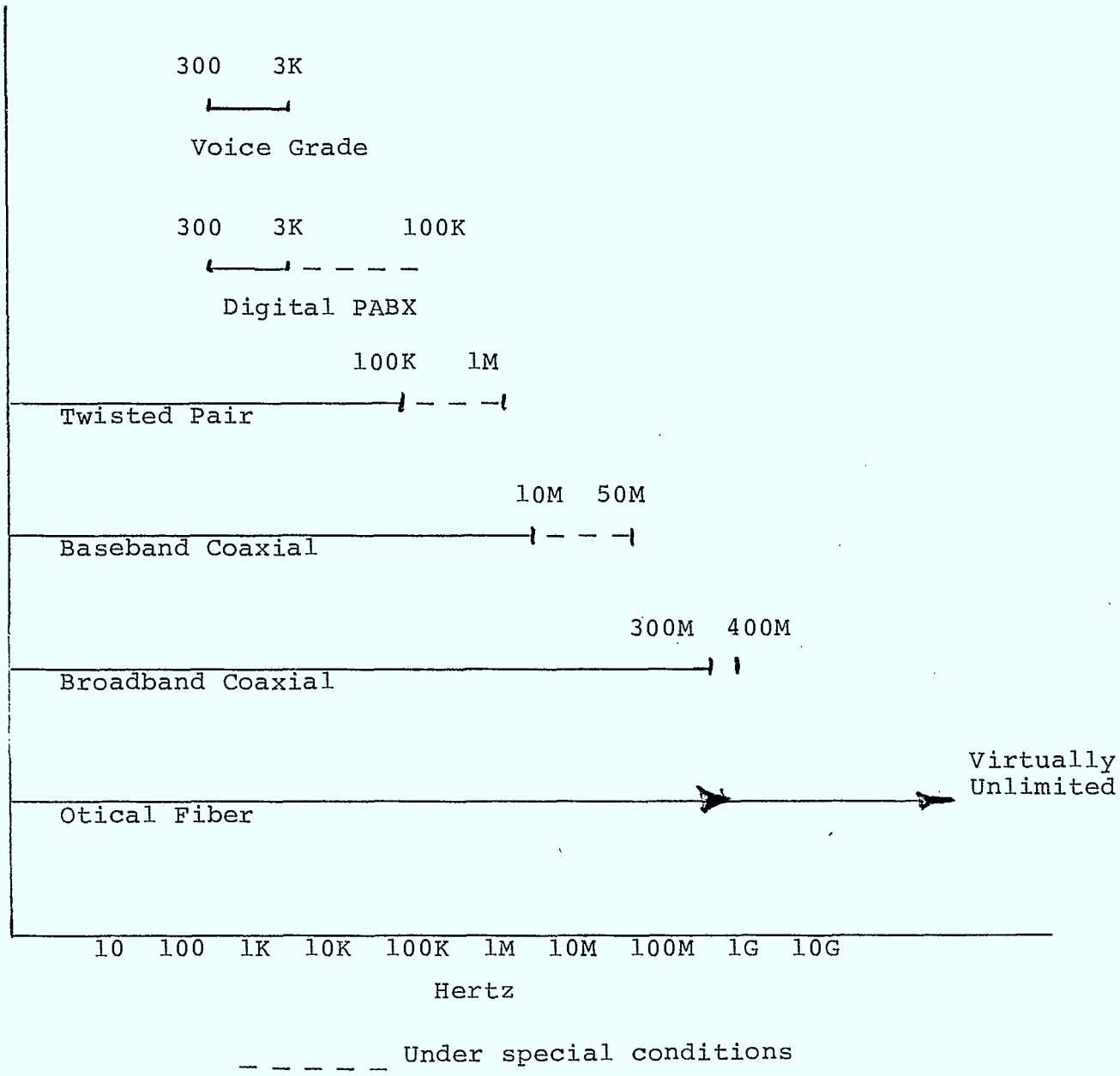
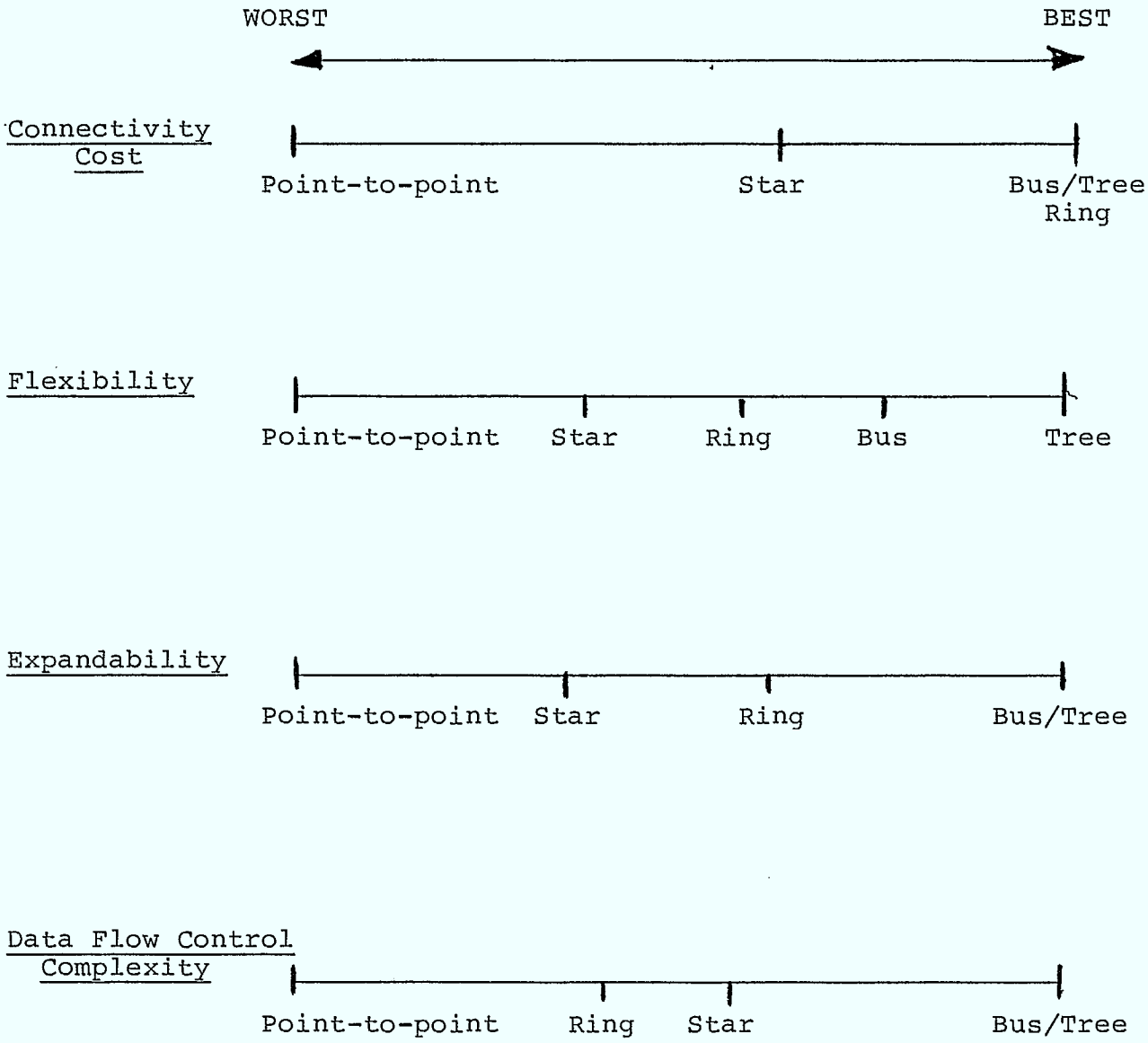


Figure 2. Comparison of Local Area Network Topologies



14. DEVELOPMENTS IN FIBER OPTIC TECHNOLOGY NEEDED TO PROMOTE IMPLEMENTATION OF ECONOMICAL FIBER OPTICS LANS NETWORKS

LASERS

Present Status: Presently, the optical power of commercially available lasers suitable for passive star configuration LANs using fibers of large numerical aperture limits the number of nodes to about 15 stations. This limitation is a major drawback for most practical LANs systems which require a larger number of stations. Xerox has developed laboratory prototype lasers with high output power (3 watts), which may be commercially available in the near future. A high power laser source removes the present limitations on the number of stations and depending on the network configuration will permit service up to 200 stations.

Conclusion: CRC may wish to investigate the availability of high power lasers and evaluate their technical characteristics as well as their cost effectiveness in passive star LANs.

FIBER

Present Status: Fibers currently offered for LANs are of the large core diameter variety to allow low cost terminal connectivity to the LAN. These special fibers are at present costlier than the standard graded index fibers or coaxial cables for overall system applications. The greatest technical hinderance to the development of fiber-optic LANs is the unavailability of a low cost flexible means for accessing the fiber.

Conclusion: It is recommended that investigation into the inherent connectivity and coupling problems of optical fibers be conducted, based on the high level expertise already available within CRC. It is also desirable that the alternate approach proposed by ATS of infra-red through the air links to overcome connectivity and mobility problems inherent in the current fiber systems be investigated. The expected impact of this approach is a substantial reduction in cost per node of future fiber LANs systems and increased LAN flexibility.

SYSTEM INSTALLATION

Present Status: For most present LANs coaxial cable media is more cost effective than optical fibers primarily for the reasons previously outlined. The principal limitation is network flexibility which consists of the capability to add additional nodes easily and to rearrange access locations. However, coaxial systems fundamentally have other limitations, such as size, weight and flexibility which increase the installation cost relative to fiber.

Conclusion: Cost of initial installation of fiber LAN systems is lower than coaxial cable systems due to the fibers physical characteristics. In addition if innovative technology such as through the air infra-red links solve the problem of network flexibility the operational costs of the fiber LAN will be virtually eliminated.

ATS PROPOSED SYSTEM APPROACH

Proposal: ATS proposes investigating the application of infra-red through the air connection to the LAN to overcome the present limitations of fiber optic LAN technology. This alternative approach permits the use of low cost, standard graded index fibers in LAN construction and is likely to solve the problems of connectivity and network flexibility of the fiber LAN with the added advantage of user mobility. Any part of the installed system can be accessed without the necessity of modifications to the physical fiber cable.

The type of infra-red devices required for the through the air links are readily available and cost below $3. The proposed system could consist of graded index fibers terminating in nodes consisting of infra-red through the air transceivers which are installed in the ceilings and on the building walls. Thus no physical connection between LANs network and the individual user work stations is required.

Desired Action: It is proposed that CRC launch a detailed system study to configure an optimal system layout for various LANs applications such as office environment, factory

environment etc. and to determine the performance limitations and suitability of such proposed systems.

Anticipated Results: This type of infra-red through the air connections should permit the implementation of reliable, flexible and cost effective fiber optic based LANs utilizing all the advantages of fiber optic technology taking LANs systems into the next generation of such LAN applications.

Market Potential

Current Status: Activity on LANs in Canada is at present at a very low level due to a lack of user appreciation of the benefits that may be derived from this new technology. Potential providers of this new technology have also not focussed developmental activity in this area.

Conclusion: It is evident that there is a need to focus the attention of both users and suppliers on the benefits of this new method of networking. To crystallize activity in this area, a suitable market study is highly desirable. Such a market study is expected to show a sizeable demand for LANs and the necessity to develop a Canadian industrial capability

in this field which also has a potentially significant export market.

ATS RECOMMENDATIONS

- That CRC undertake a research program to investigate high powered lasers

- That CRC conduct research into the feasibility of using infra red devices for the interconnection of stations onto fiber LANs

- That CRC give serious consideration to sponsor a system design study of fiber LAN system for CRC application

- That the Department of Communications sponsor a comprehensive market study to determine the LAN potential in Canada

- That the Market Study be segmented into three major areas: Office Automation, Data Processing and Factory Automation LANs.

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