September 17, 1991

A PROPOSAL

FROM

ERNST & YOUNG

Department of Communications

Telecommunications R&D Study

Technical & Price Proposal

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September 17, 1991

Mr. Marcel Ricard
Department of Communications
Journal Tower North
Materiel Management and
Contracting Services
Room 1738,
300 Slater Street
Ottawa, Ontario
K1A 0C8

Dear Mr. Marcel Richard:

Request for Proposals: Telecommunications R&D Study
No.36100-1-1795

We are pleased to submit three (3) copies our of proposal to conduct a Telecommunications R&D Study for the Department of Communications. We believe that Ernst & Young is ideally suited to conduct this study for Department of Communications. We have conducted numerous consulting assignments with the Department and are experienced in conducting assignments in the telecommunications industry. We have summarized the highlights of our proposal as follows:

1. **Our Experience in Telecommunications Management Consulting.** Ernst & Young has completed numerous consulting assignments and advised senior management at the corporate level on R&D related issues. We contribute to and are aware of current issues and emerging trends. As part of our responsibilities as a major consulting firm, we stay in tune with new developments in technology. We also monitor major industry-wide issues and their potential implications to our clients. We take pride in our contributions to the telecommunications industry.

2. **Client Relations.** Working to develop effective relationships with clients has become a hallmark of our approach to consulting. We take time to understand your needs, environment, and the many factors that can influence the study process and its value to you. Further, we keep you fully informed of progress through regular consultation, specific decision points built into the detailed workplan, and other opportunities for input.

3. **Our thorough methodology.** We believe that our extensive experience in conducting similar assignments ensures the appropriate method is applied and provides you with *credible and useful* results. Our method is effective and will provide you with value-added information.

4. **Strong National and International Representation.** Ernst & Young has 3,400 professionals in 33 cities across Canada and is represented in over 100 countries around the

globe. With our bilingual capabilities we have the unique ability to conduct studies in *any region* in either official language.

Thank you for the opportunity to respond to your Request for Proposal. If you have any questions regarding this proposal, please do not hesitate to call Jay Smith or Adrian Foster in Ottawa at (613) 232-1511.

Yours sincerely,

Ernst & Young

Jay Smith/Adrian Foster

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1.0 Introduction

Ernst & Young is pleased to submit this proposal to undertake the *Telecommunications Research and Development Study* (the Study). Ernst & Young provides extensive knowledge of and background in the telecommunications research and development sector at both the national and international levels as well as core expertise in the areas of finance and economics. Ernst & Young also provides focused expertise on existing and developing technologies in the telecommunications products and services sector as well as extensive experience with the federal regulatory environment.

1.1 Study Objectives

The telecommunications industry plays a significant role in the Canadian economy. It is also critical to many other sectors in terms of the availability and supply of efficient and competitively priced products and services.

The Canadian telecommunications service sector, including both manufacturers and service providers, is currently undergoing significant change due to recent modifications in the jurisdiction of the CRTC, increased pressure for competitive Message Toll Switch (MTS) and a relaxation of international trade barriers.

The Canadian telecommunications manufacturing sector has traditionally been viewed as a major component of the Canadian manufacturing industry but this dominance is rapidly being eroded. With the exception of Northern Telecom, most of the companies are mid-sized to small and are vulnerable in the global market as larger competitors have access to larger markets, larger financial resources and greater support from their respective governments. In addition, the growing popularity of industrial regional consortiums have generally excluded Canadian participants.

Our service providers are also threatened by the incursion of global competitors as the MTS market opens and trade barriers fall. Even our largest service provider is relatively small when compared to other operating companies on the world stage.

Within this context of the potential opening of the Canadian MTS market, the reduced trade barriers and increased technological change within the industry, there are questions concerning the infrastructure supporting research and development (R&D) infrastructure in Canada and the methods by which R&D is defined,(e.g.market research is excluded as an R&D expenditure.

The stated objective of this Study is to "develop a thorough understanding of telecommunications R&D in Canada, the competitive environment faced by Canadian companies and the role R&D plays within the environment, the regulatory, financial, policy and institutional factors effecting telecommunications R&D and the constraints to undertaking R&D."

We believe that the Study objectives will be met through an assessment of four specific areas:

The competitive environment faced by Canadian companies and the role and process of R&D in this environment. This includes knowledge of the current Canadian situation in terms of levels of telecommunications R&D expenditures and the makeup of telecommunications R&D activity. It also includes an understanding of the form and content of the R&D process for service providers and manufacturers alike (both large and small) and an identification of R&D discriminants between players within the sector. An understanding of telecommunications markets and the role R&D plays in the telecommunications sector today will be necessary.

Emerging technology and service trends in telecommunications. What technology and service trends are expected to emerge throughout the decade and what is the forecast for the beginning of the next century? Understanding the likely telecommunications technology mix and related R&D activity and the relative position of Canadian R&D vis a vis this mix will be important.

The factors which may affect the type and level of R&D in terms of financial, regulatory, institutional and policy issues. What are the financial, regulatory institutional and policy incentives and impediments to doing telecommunications R&D in Canada today? How are they impact telecommunications R&D? A comprehensive and thorough understanding of external R&D incentives and impediments is essential?

The international telecommunications R&D environment. What international comparisons are valid and to which countries (or regional alliances) should Canada be compared for purposes of comparison? The study requires capability for developing a rationale supporting an optimal and sustainable level of R&D expenditures in Canada in an increasingly globally competitive telecommunications market.

Models available to encourage telecommunications R&D coupled with an understanding of the implications of increased telecommunications R&D. This requirement includes an examination of the validity of the notion that R&D is directly related to the competitiveness of the communications sector and an examination of the linkages between R&D and firm and sector performance.

The proposed Study must put sufficient weight on each of these five areas if it is to succeed. Ernst & Young's proposed approach meets these requirements. The remainder of the section briefly touches upon some of the key issues which we would anticipate addressing in the proposed Study.

1.2 Technological Innovation

The basic function of innovation at the level of the firm is to increase or maintain profitability. This is generally accomplished through (1) a reduction or containment of costs and/or (2) an increase or maintenance of revenues. Cost reduction and containment enables the firm to maintain competitive prices and to improve the productivity of its capital and labour. Innovation of this type are often driven by technology opportunity. The aim in increasing or maintaining revenues is to develop

new markets and/or expand or maintain existing markets through innovation in products and services. In this category, innovation is often a market driven opportunity which depends upon requisite technology being available.

The main focus of the Study is on technological innovation in the telecommunications sector as driven by market opportunity. The Study will nonetheless address the important relationships between the telecommunications industry and the performance of Canadian firms in domestic and international markets as those firms innovate to improve the productivity of their capital and labour through telecommunications technology opportunity.

1.3 Innovation in the Telecommunications Industry

Technological innovation in the telecommunications industry impacts the development telecommunications products (including services) ranging from network facilities (e.g. digital switching machines, fibre optic transmission systems, SONET radio...), to products associated with network services (Inet, Call Management Services, Bulletin Boards...) and products intimately linked with end users (fax machines, PC Communications software...).

Some of the key factors which may influence the level and type of technological innovation in the industry include:

- Factors such as the technology base of the industry and the perceived technological risk associated with the innovation;
- Institutional factors such as the the availability of financial and human resources, the firm's corporate culture, and the firm's attitude towards risk;
- Market Factors such as the perceived costs and risks of developing, marketing and implementing the innovation and the perceived rewards of innovation; and

- External factors such as the regulatory and tax environments.

Research and Development activity is one of the main instruments associated with the process of innovation. Although research and development activity does not ensure successful innovation, it is one of the major inputs to the innovation process.

The Study will review Telecommunications Research and Development within the broad context of the process of technological innovation and will clarify and update the current situation in Canada.

1.4 Technology Trends

Technology trends in the telecommunications industry impact both the manufacturer and the service provider. From the service provider's perspective, the introduction of new technologies and services is closely related to both technological opportunity (in terms of improving the network) as well as market opportunity (in terms of the development of new services). From the perspective of the equipment manufacturer, market opportunity is the dominant requirement. The manufacturer's market includes the public service provider as well as private systems.

It is important to understand the technological underpinning of telecommunication R&D programs. This understanding permits a more thorough assessment and evaluation of the basis for and objectives of specific R&D programs undertaken by manufacturers or service providers alike. It also permits a more thorough coupling of R&D activity to the innovative process since the risks and rewards of specific programs are more clearly understood. The remainder of this section briefly reflects our views on some of the key emerging telecommunications technologies.

Specific technologies which are expected to impact the research and development of service providers and manufacturers in the next decade include: Fibre Optic Technology, Networking Technologies (including LAN/MAN/WAN and satellite), Voice/Image/Data integration and related

technologies (e.g. compression), Convergence (both technical and service), Network Intelligence (CCS7), the Personal Communications Network (PCN), and the Integrated Services Digital Network (ISDN).

Fibre Optic Technology

Fibre Optic Transmission Systems (FOTS) are being used extensively in the telcos and CATV local distribution networks. It can support broadband distribution and therefore will promote the development of telecommunications based information technologies as well as future digital broadcasting services.

Fibre cable in the telephone local distribution plant is today generally limited to interexchange and high capacity local inter-office systems or to providing large business customers with high capacity services. Its future deployment will depend upon the success of ISDN and related technologies.

Fibre is being introduced into CATV networks, first through the replacement of high capacity feeder plant. Primary driving forces relate to the preservation of market share, and the enhancement of revenues from existing market share, through the provision of higher capacity and quality services (e.g. more channels, lower noise, video-on-demand, High Definition Television, data and voice services). Attendant technologies and standards are pivotal to the development of future income sources necessary to exploit future CATV based opportunities. Fibre Optic Technology is closely linked to large bandwidth applications as well as convergence. R&D activity in this sector must be fully canvassed as part of the Study's mandate.

Personal Communications Network Technologies

A demand for personal, portable telephone service has given rise to the concept of the personal communications network (PCN). Technologies are being developed world-wide to meet this developing market. The

British digital cordless telephone (CT-2) and the Digital European Cordless Telecommunications (DECT) are examples of early PCN developments. True PCN with two-way calling capability, automatic roaming and broad geographic access has yet to be deployed, and represents a major future telecommunications market opportunity for both service and product industries.

Based on the success of cellular mobile communications, there is much industry interest in PCN's. In residential areas, PCN base stations could be established on buildings or utility poles. Connection to a local network could be achieved though either telco or cable distribution facilities, and the expected opening of the MTS market will also have a significant effect. VISION 2000 , the consortium of telecoms, computer, software and user organization was formed because industry leaders identified PCN's as a major market opportunity for Canada.

A large amount of research in PCN technologies are underway throughout the world. Research in digital spread spectrum techniques and Time Division Multiple Access Methods (TDMA) is on going. The Study will consider the strategic importance of this technology.

Data Networking Technologies

The telecommunications industry must now accommodate two major views towards the supply of data networking services and products. The first arose from the traditional telephone company perspective. The second arose from local area networking/mainframe processing applications when they were extended to address wide area networking. ISDN was primarily developed based on a traditional telephone view towards networking which was consistent with existing telco distribution architectures. Packet switching was developed directly based on local data communications requirements and represents a major force in all telecommunications areas.

Traditionally, industrial players develop products solely within groups dominated with these views (e.g. Northern developed ISDN switches but not LAN/WAN Routers). Also the "closed shop" of telco suppliers has opened up as more users implement networks utilizing products with both views (e.g. Newbridge, Stratacom, Net, compete with Northern Telelcom).

The convergence of data communications and telecommunications (i.e. telco methods) can be attributed to the increasing acceptance by the telco community of the new generation packet switching approaches over circuit switching. The telcos have yet to provide packet switching services in the popular connectionless form, and this provides an opportunity for alternate carriers such as cable carriers to supply such services. The deployment of broadband media in the public networks enhances the opportunity to supply high speed LAN interconnections with methods which are more closely aligned to traditional LAN methods. Data networking technologies have a strong international standardisation flavour and thus represent a major component of international R&D activity. The study will be sensitive to this issue.

Network Intelligence

The deployment of CCS7 capable switches is affecting the services available to both residential and business subscribers. Call Management Services (CMS) and Enhanced 800 Service are two examples. CMS is a set of services which permit the information already being transferred between network switches using CCS7 to be additionally transmitted to the subscriber who can then identify both the calling and called line numbers. Enhanced 800 capitalizes on the availability of CCS7 signalling to access centralized network databases to dynamically configure the 800 service. The deployment of CCS7 technology is the cornerstone of these new service developments. The increasing deployment of fibre-ready hosts and remotes equipped with CCS7 provide telcos with a further capability to

generate extra revenues from both the business and residential subscriber. This in turn fuels the penetration of the technology into the telco network. New common carriers service offerings in the 90's will be extensively supported by CCS7 technology, especially in the development of new enhanced local services such as CMS (in addition to enhanced 800 type services currently available). R&D at the service application level must be an important Study consideration.

Integrated Services Digital Network

The Integrated Services Digital Network (ISDN) represents an enabling technology sponsored by common carriers which promises to integrate a user's communications requirements (voice, data, video) over a high speed digital network with access provided through one simple universal interface. In the 1970's, ISDN was a vision of the Public Switched Telephone Network (PSTN) of the future. The vision anticipated the inefficiency and costs associated with building separate voice and data networks given the emerging benefits of digitization. At that time, ISDN grew from the benefits which the telecommunications carriers foresaw from the management and design of their own networks.

In the 80's, the technology began to be deployed. Field and market trials, as well as custom, though mainly private, implementations developed throughout the decade. The decade also saw the development of a new view of the evolution of the technology. The earlier vision, which could be termed narrowband ISDN, foresaw speeds up to approximately 1.5 Mbps. The new vision foresaw the development of a Broadband ISDN (BISDN) with access speeds in the 100's of Mbps range. This newer vision was closely linked with the development of fibre based technologies as well as the perceived limited bandwidth capability of the narrowband version for certain applications.

The need for higher bit rates led to the development of BISDN. BISDN is still under discussion within standards bodies, but it is expected to be

closely aligned to the emerging Synchronous Optical NETwork (SONET) standards and will rely on new high speed switching technologies such as Asynchronous Transfer Mode (ATM) being available in carrier networks. BISDN access speeds currently being discussed are in the 150 Mbps range. The Study will address ISDN within the context of high bandwidth services and BISDN products.

Convergence

Although the the telco local distribution network is currently optimized for voice communications and cannot support the high bandwidths required for uncompressed video, it is evolving towards higher bandwidth capabilities through the deployment of standardised fibre based architectures. SONET based standards are being used as basic building blocks for next generation systems capable of handling very much higher bandwidth signals in the telco environment. In addition, the newer generation of telco switching equipment is providing remote access interfaces for broadband signal distribution. Access to increased network intelligence using CCS7 signalling is permitting the continued expansion of traditional narrowband offerings, thus providing the financial support for the introduction of these new technologies.

New switching technology is combining with fibre to permit the offering of a wider range of switched wideband services to augment the traditional portfolio of narrowband services such as POTS and Centrex. In the short term (the next three to four years) revenue opportunities include dialable DS-1/fractional DS-1/DS-3 for video conferencing, and other wideband services such as high speed MAN services for LAN interconnection. The on-demand feature of these services is a significant departure from the traditional offerings available from the telco carriers and provide a significant cost savings to the end user who will pay on an as required basis.

The economical deployment of fibre to the home for new construction is not currently anticipated until the end of the decade and is considered to be contingent on the delivery of revenue producing broadband services. It is anticipated that Asynchronous Transfer Mode (ATM) switching technology will become available in the 1995 timeframe and that this technology will be the basis of future switched video applications should they develop in the post 2000 timeframe.

The technology of choice for CATV networks is also rapidly becoming fibre optics. CATV hybrid fibre/coaxial architectures are becoming attractive for both the replacement of old copper based distribution plant to reduce maintenance costs, and for the modernisation of networks to provide increased capacity, service quality and functionality. Advances in packet switching technology also offer certain large cable carriers with the opportunity to offer MAN type services on their fibre networks for the interconnection of LANs and computing facilities.

Convergence is a technology and service issue of prime importance to carriers today. The Study must link the R&D issues under study to the convergence trend in the industry.

1.5 The Stakeholders

The telecommunications industry in Canada is readily partitioned into four distinct but interrelated groups: Manufacturers, carriers and potentially cable operators, governmental policy and regulatory bodies, and users. Each of these groups may significantly influence the development and eventual deployment of new technology in telecommunications.

Manufacturers and their related research organizations develop new technologies in line with their perception of carrier and user needs. Carriers introduce technologies into their networks in support of their

own operational needs as well as their perception of user needs which can be met with a profitable service offering.

Government policy bodies tend to view technology development in terms of industrial competitiveness within the global market. Recent initiatives by Communications Canada in forming the Vision 2000 industrial consortium, as well as initiatives by Industry Science and Technology Canada (ISTC) in the implementation of a National High-Speed Network for Research and Development are examples of this latter focus.

Regulatory bodies are mainly concerned with the implementation of regulatory objectives, which for the telecommunications sector, are the control of monopoly power and the prevention of unjust discrimination in services and prices to customers. Technology is viewed in terms of these objectives.

Users may be viewed as the market. They will adopt and reject services and products based on the degree to which theses services and products meet their needs.

A Telecommunications R&D study must consider carriers, manufacturers, government bodies as well as users Our proposed approach to this Study addresses this requirement.

1.6 Telecommunications R&D and the Regulatory Environment

The effects of regulation on technological innovation by telecommunications manufacturers are likely to be mainly indirect and to depend upon the extent to which such regulation influences innovation by service providers. The only area in which regulation might exert a direct influence on innovation by equipment manufacturers is possibly the regulatory attitude to vertical integration. Regulatory programs and mechanisms such as structural separation requirements, the sustaining of monopoly service markets, rate of return mechanisms, tariff regulation

and the regulatory process itself are area which are expected to generate indirect effects on telecommunications R&D. The regulatory support for vertical integration may provide for more direct effects.

Vertical integration may facilitate the development of new technology though, for example, he promotion of the flow of information from the service provider to the manufacturer with respect to market opportunities and the overall telecommunications service environment as well as the provision of a reasonably assured market for the manufacturer's products. Vertical integration may inhibit the development of new technology by discouraging outside manufacturers from competing with the vertically integrated supplier, especially smaller firms.

Structural separation requirements on service providers may increase the risks and costs of innovation for the firm by inhibiting information transfer and otherwise precluding the realization of economies of scope. On the other hand indirect benefits to innovation may occur in that structural separation may assist innovation by facilitating fair competition (especially for smaller firms) and removing regulatory constraints on financial rewards.

A service monopoly tends to reduce market forecasting uncertainties and may reduce the amount of effort required to market many innovations. These factors may diminish the risk and cost of introducing innovations and provide greater ease of access to capital since the risks are lower that in open competition. However, monopoly network elements may tend to stifle innovation brought on by competition in the market.

Ceilings on the rate of return on investment may reduce the potential rewards from innovation and may restrict the financial resources available for R&D. On the other hand, a guaranteed rate of return may stimulate the development of long term development programs as long as they are deemed reasonable expenses for regulatory purposes.

Artificially high tariffs in a service market may stimulate by-pass innovation as well as encourage market entry but will usually discourage innovation in the resale market. Artificially low tariffs may discourage or delay innovation (due to the lack of financial contribution by the service in question) yet may stimulate innovation in the resale market.

The costs and delays imposed upon service providers by the regulatory process in order to gain approval for service innovations and the uncertainties associated with the outcome of the processtend to increase innovation cost and risk. The public nature of the regulatory process may also result in the disclosure of information on pending innovations to potential competitors.

1.7 International Telecommunications R&D Strategies and Effectiveness

A striking feature of the 1980's has been the rapid growth of research collaboration. The main driving force for this has been the steep rise in the cost and complexity of technology which means that few, if any, organizations can now be entirely self-sufficient regarding their technical needs. This trend has been encouraged by government R&D funding policies, particularly in the EEC, the U.S. and Japan. However the strategies of each of these governments also reflect the industrial infrastructure within which they can manifest their influence.

In each of these three jurisdictions information technologies and communications technologies have been selected as strategic technologies which are critical to economic well-being and wealth generation in the future.

United States. Major long-term research programs have been established in the United States in networked Centres of Excellence based on university capabilities in collaboration with industry. These research

programs, funded through the National Science Foundations (NSF) cover many of the technologies which are critical to all aspects of communications. Examples are seen in the Super Computer Network, where the goal of the hardware and software research is to maintain the perceived U.S. technology lead over its major global competitor, Japan. Applications research is also at the forefront of this network. Similarity, but perhaps more ambitious, is the program for R&D on next generation gigabit networks. Five research projects have been recently funded, and if these projects reach a successful conclusion, it has been estimated that up to $1 billion U.S. will be earmarked to accelerate this research towards a prototype system.

The projects mentioned above are focused in academic research institutions with cooperation and co-funding by industry. Other major cooperative initiatives have been established which are primarily undertaken by industry, for example Sematech. Sematech is a consortium of firms involved in integrated circuit (IC) design/manufacture. Of particular interest that in its agreement to provide funds for semitech, the U.S. government stipulated that only U.S. manufacturers could be used to research/develop the new equipment required. This is a strategy to force U.S. suppliers to become more competitive, i.e. a vertical integration implication in implied.

Other changes within the U.S. strategy for supporting R&D in high-tech areas are right now in the process of formulation. This is evident in the changing policy of the U.S. Department of Defence. Defence projects will now be funded only when significant spin-off into the commercial arena can be specified. Many of the U.S. defence industry firms have considerable communications capabilities, for example Hughes, Martin-Marietta etc. The implications of these firms developing strong commercial communications products in the future is a significant threat to Canadian manufacturers.

Europe. In Europe, it has been recognized for many years that national R&D programs are necessary but not sufficient for their firms to maintain a competitive position in global markets. Thus in the U.K. the government has backed National programs such as AIREY and BRITE, as well as EEC based programs such as RACE, ESPRIT, and EUREKA. These major cooperative programs established under the sponsorship of the EEC, (such as RACE and EUREKA) indicate the European strategy of fostering cooperative R&D between firms and between industry/academic. These joint research/development activities cover all of the major technology areas critical to advanced communications, stretching from optoelectronics, broad band switching, dedicated communications software and components for high bitrate long haul links, and open distributed processing. International standards are also reflected in major collaborative communications projects, for example COSINE, funded under the EUREKA project. COSINE is essentially an infrastructure and enabling project with the following strategic objectives.

a) to create a common operational OSI interworking infrastructure;

b) to establish and integrate on the required scale, all functions and support services necessary to allow users to take full advantage of the infrastructure; and

c) to ensure the infrastructure remains in place and at the leading edge of OSI communications technology.

More than 19 European countries participate in the COSINE project.

The implications of this project to Canadian firms are considerable, for example COSINE includes conformance testing for all vendor products to be used in this communications infrastructure. When considered in conjunction with the European, U.S. and Canadian governments commitment to OSI compatibility for all future communications procurements, it is easily seen that Canadian firms must meet these international conformance requirements to gain global market entry.

Japan. The Japanese strategy for R&D is currently based on the TECHNOPOLIS concept. The TECHNOPOLIS concept provides a physical environment in which the critical mass of R&D workers from government labs, universities and corporate labs can synergistically work together, a TECHNOPOLIS Zone. This "TECHNOPOLIS Zone" is linked to mother city which then can provide the necessary infrastructure such as airports, housing ect. Current projects include: "New Media Community", Teletoipia, Intelligent City/Marinnovation among others The TECHNOPOLIS Zones are linked together through NTT's INS network. However, a new communications network plan involving domestic and international satellites as well as fibre-options is now in the process of implementation.

The Ministry of International Trade and Industry (MITI) generates the basic guidelines for any new R&D program which is then further developed by the private sector. Following authorization by MITI infrastructure is created, including, local tax incentives. Financing is through the Japan Development Bank which encourages the cooperation of private companies to participate in the project. New consortia under consideration include R&D in such areas as Telecomputing, Home Electronics, Electronic Banking, Factory Automation, Optical Computers.

In comparison to the U.S. there are significant differences in the Japanese approach to R&D consortia. Consortia are normally small in Japan (<300 researchers) with small core teams (<100 researchers). SEMITECH (U.S.) has more than 1000 researchers associated with it. Also the Japanese consortia always contain several leveraged corporate labs which provide intra company transfers to the project, a practice seldom seen in the U.S.

It is obvious without detailing individual R&D projects, that the Japanese strategy has worked well in Japan. The strong technical capabilities which have resulted from previous MITI cooperative projects are constantly being evolved and new programs built upon the strengths gained. As an

example of this evoluation, the Japanese 5th generation computer project is just coming to its final phase, and a new project, the 6th generation computer project will draw heavily on the earlier projects research into artificial intelligence. Similar technology transfers are occurring for the new communications based projects such as the Intelligent City.

It is therefore apparent that cooperative R&D in National or International consortia is a growing trend which is being fostered by many governments. Each government has taken slightly different approaches to synergise this cooperation from the Canadian perspective, the following considerations should be considered:

a) Accepting the concept that R&D consortia are a necessary part of the future R&D infrastructure, what would be the most effective mechanism in Canada to catalyse their formation, recognizing the size and demographics of potential industry participants:

b) How can Canadians firms be encouraged to participate in international consortia?

c) How can the Canadian Government develop the mechanisms by which Canadian firms are invited to join international consortia?

d) Fundamental to consortia is the concept of technology transfer. How effective are the current methods for stimulating technology transfer in the R&D stage, and in particular for exploiting the results of technology development and transfer.

2.0 Approach and Scope

We propose that the Study initially focus on the competitive environment faced by Canadian telecommunications companies today and the role and process of R&D in this environment. Flowing from this initial focus.will be the analysis of the impact of external incentives and impediments to Telecommunications R&D, the assessment of the international situation, the development of models of R&D effectiveness and a determination of policy implications.

There is the requirement to thoroughly document the current Canadian situation in terms of levels of telecommunications R&D expenditures and the makeup of telecommunications R&D activity. This requirement includes an assessment of the form and content of the R&D process for service providers and manufacturers alike (both large and small) and an identification of R&D discriminants between players within the sector. This also includes an exposure of developing technology and service trends in telecommunications with a view of assessing the current position of Canadian telecommunications activity R&D in relation to these trends. We shall call this the Base R&D Review.

There is also a need to analyse of tax, trade, regulatory, and institutional incentives and impediments to doing telecommunications R&D in Canada today and their impact on telecommunications R&D. We shall call this the Financial, Regulatory and Institutional Review.

The Study also contains an important international dimension. It is also required to expose the the international telecommunications R&D environment with a view of being capable of developing a rationale for determining the level of Canada's R&D expenditures in an increasingly global telecommunications market. We shall call this the International Review.

Finally there is a requirement to examine a variety of models to encourage telecommunications R&D and to analyze the implications of increase telecommunications R&D. This requirement includes an examination of

the validity of the notion that R&D is directly related to the competitiveness of the communications sector an examination of the linkages between R&D and firm performance. We shall call this the Policy Review.

2.1 The Base R&D Review

The focus of the Base R&D Review will be on the the current Canadian situation in terms of levels of telecommunications R&D expenditures and the makeup of telecommunications R&D activity. The form and content of the R&D process for service providers and manufacturers, both large and small will be reviewed and R&D discriminants between players within the sector will be identified. Developing technology and service trends in telecommunications will be exposed and related to the current position of Canadian telecommunications R&D activity.

Specific issues which will be addressed include:

- The development of an R&D database for carriers, equipment manufacturers, universities and governments as identified in the RFP.
- The development of mechanisms for the Department to support the on-going monitoring of Telecommunications R&D.
- The revision and improvement, as appropriate, of currently available R&D data.
- A matrix of emerging and forecast technologies in telecommunications (an extension of the R&D database) related to R&D database line items.
- A description of the telecommunications R&D process in Canada among the small and large players including the development of R&D discriminants.

2.2 The Financial, Regulatory and Institutional Review

The focus of the Financial, Regulatory and Institutional Review will be on the analysis of tax, trade, regulatory, and institutional incentives and impediments to doing telecommunications R&D in Canada and their impact on telecommunications R&D.

Specific issues to be addressed include:

- R&D Definition: the currently accepted definitions of R&D for tax purposes, for policy purposes, for economic purposes and for regulatory purposes.
- Tax issues: An assessment of the degree to which Canadian firms take advantage of tax provisions.
- Other Fiscal Issues: The perceived impediments in current fiscal legislation to R&D activities.
- Regulatory issues: Regulatory programs and policies which impact R&D programs of regulated companies in terms of curtailment and stimulation as well as suggested approaches. The effects on R&D of competitive telecommunications service provision
- Institutional Issues: The effects of vertical integration and other institutional and organisational relationships.

2.3 The International Review

The focus of the International review is to expose the international telecommunications R&D environment with a view of being capable of developing a rationale for determining the level of Canada's R&D expenditures in an increasingly global telecommunications market.

It is proposed that specific comparisons between Canada, the U.S., Germany and Japan will be made in relation. The actual countries chosen for comparison will be conferment during the planning stage. The factors

to be compared in and related to this portion of the overall study are as follows include:

- The trade environments, regulatory and institutional environments.
- The sharing of R&D costs between government, carriers and manufacturers.
- The rate of investment by regulated carriers
- R&D models used to maximize R&D effectiveness

2.4 The Policy Review

The focus of the Policy Review is an examination of a variety of models to encourage telecommunications R&D and an analysis of the implications of increased telecommunications R&D on firm and sector performance. This activity will include an examination of the validity of the notion that R&D is directly related to the competitiveness of the communications sector an examination of the linkages between R&D and firm performance. Options to encourage appropriate levels of R&D expenditures by the major stakeholders will be developed.

Specific issues to be addressed include the following:

- Policies aimed at creating a better R&D environment.
- Funding support to industry.
- Government procurement policies.
- Collaborative R&D programs and alliance building.
- Organisational models which maximize R&D effectiveness
- Trade constraints to Canadian R&D treatment
- The relationship between R&D policy instruments and sector competitiveness

- Linkages between firm and sector performance and R&D
- The implications of increased R&D expenditures: rate increases, user benefits, industry benefits, benefits to the Canadian economy.

3.0 Methodology

The methodology to be adopted for the Study recognises the March 31, 1992 deadline for the final report as well as the importance of involving the client and key stakeholders in the Study process. The methodology and workplan proposed reflect the need to identify and canvass key stakeholders, to analyze the information obtained in a multidisciplinary team environment, to subsequently review the information with the client and make adjustments to the Study design as appropriate.

Only a well coordinated and managed team can attempt to address the issues which will be raised in this type of Study. Technological, economic, and regulatory issues are closely linked and must be canvassed and analyzed with a tight knit team of experts led by a strong manager comfortable with all the dimensions of the Study. The methodology being proposed recognises the importance of a well managed and all informed team environment. Strategy sessions will gather the project manager and team members on a bi-weekly basis to review progress and to discuss team findings and strategies with the client. Specific milestones have been planned for client briefing and feedback and are detailed below.

The main information gathering instruments will be used as part of the Study: Literature Searches, Interviews and the CANTECH(tm) Database which contains detailed profiles of over 3700 Canadian manufacturers of high technology products and providers of high technology services. CANTECH(tm) is profiled in Appendix B. Each is used in the proposed Study during that phase where its use has been judged to be most appropriate.

The five main Study Tasks have been summarized and are shown on the overleaf.

TABLE 1: TASK SUMMARY	
TASK 1: *Project Decision Review*	Review the Study methodology with the client, providing an initial opportunity to ensure that client goals will be met. Make adjustments as required.
TASK 2: *Base R&D Review*	Review the current Canadian situation in terms of levels of telecommunications R&D expenditures and the makeup of telecommunications R&D activity. Define the form and content of the R&D process for service providers and manufacturers, both large and small and identify R&D discriminants between players within the sector. Expose technology and service trends in telecommunications and relate to the current position of Canadian telecommunications R&D activity.
TASK 3: *Financial, Regulatory and Institutional Review*	Review and analyse the tax, trade, regulatory, and institutional incentives and impediments to doing telecommunications R&D in Canada and their impact on telecommunications R&D.
TASK 4: *International Review*	Expose the international telecommunications R&D environment with a view of being capable of developing a rationale for determining the level of Canada's R&D expenditures in an increasingly global telecommunications market.
TASK 5: *Policy Review*	Examine a variety of models to encourage telecommunications R&D and analyse the implications of increased telecommunications R&D on firm and sector performance. Include an examination of the validity of the notion that R&D is directly related to the competitiveness of the communications sector and an examination of the linkages between R&D and firm performance. Develope options to encourage appropriate levels of R&D expenditures by the major stakeholders.
TASK 6: *Results and Presentations*	Final reports and pesentations.

3.1 Task 1 - Project Design Review

Review the Study methodology with the client, providing an initial opportunity to ensure that client goals will be met. Make adjustments as required.

The output of this task will be an agreed to Study methodology a well as an agreed to set of operating procedures for the Study Team.

3.2 Task 2 - Base R&D Review

Review the current Canadian situation in terms of levels of telecommunications R&D expenditures and the makeup of telecommunications R&D activity. Define the form and content of the R&D process for service providers and manufacturers, both large and small and identify R&D discriminants between players within the sector. Expose technology and service trends in telecommunications and relate to the current position of Canadian telecommunications R&D activity.

Task 2a: Literature Review

Undertake a literature review in support of the task objectives. The review will include the following: Carrier Annual Reports, Selected CRTC and Statistics Canada Reports, Selected Technology Reports and periodicals.

Task 2b: Base R&D Interviews

Interview industry personnel in support of the task objectives. The interviews are proposed to include the following: BNR, the Telecommunications Research Institute of Ontario (TRIO), Bell Canada, MPR, BC Tel, Unitel, Telesat Canada, Newbridge, Mitel, IBM, DEC, Videotron, Rogers Cable, Northern Telecom, and selected resellers.

Contacts at all of these organizations have already been established through previous work.

Task 2c: Data Assembly Consultation

Select data parameters, assemble and compile data from CANTECH(tm) database. Consult the client upon data assembly completion.

Task 2d: Base R&D Analysis & Report

Prepare the Base R&D report in draft form for review by the client and, subsequently, complete and deliver the report in final form.

3.3 Task 3-Financial, Regulatory and Institutional Review

Review and analyse the tax, trade, regulatory, and institutional incentives and impediments to doing telecommunications R&D in Canada and their impact on telecommunications R&D.

Task 3a: Literature Review

Undertake a literature review in support of the task objectives. The review is proposed to include the following: Selected CRTC and Revenue Canada Reports....

Task 3b: Financial, Regulatory and Institutional Interviews

Interview selected personnel in support of the task objectives. The interviews are proposed to include the following: CRTC, Revenue Canada, Bell Canada, MPR, BC Tel, Unitel, Telesat Canada, Newbridge, Mitel, IBM, DEC, Vidéotron, Rogers Cable, Northern Telecom

Contacts at all of these organizations have already been established through previous work.

Task 3d: Data Assembly Consultation

Consult the client upon data assembly completion.

Task 3e: Financial, Regulatory and Institutional Report

Prepare the Financial, Regulatory and Institutional Report in draft form for review by the client and, subsequently, complete and deliver the report in final form.

3.4 Task 4-International Review

Expose the international telecommunications R&D environment with a view of being capable of developing a rationale for determining the level of Canada's R&D expenditures in an increasingly global telecommunications market.

Task 4a: Literature Review

Review the relevant documentation in support of task objectives.

Task 4b: Regulatory Interviews

Interview members of the international telecommunications R&D community; U.S Dept of Commerce,etc.

Task 4c: Data Assembly Consultation

Consult the client upon data assembly completion.

Task 4d: International Report

Prepare the report in draft form for review by the client and, subsequently, complete and deliver report in final form.

3.5 Task 5-Policy Review

Examine a variety of models to encourage telecommunications R&D and analyse the implications of increased telecommunications R&D on firm and sector performance. Include an examination of the validity of the notion that R&D is directly related to the competitiveness of the communications sector and an examination of the linkages between R&D and firm performance. Develop options to encourage appropriate levels of R&D expenditures by the major stakeholders.

Task 5a: Literature Review

Review the relevant documentation in support of task objectives.

Task 5b: Data Assembly Consultation

Consult the client upon data assembly completion.

Task 5c: Policy Report

Prepare the report in draft form for review by the client and, subsequently, complete and deliver report in final form.

3.6 Task 6-Results and Presentations

Task 6a: Preliminary Results Presentation

Present the Study's preliminary results.

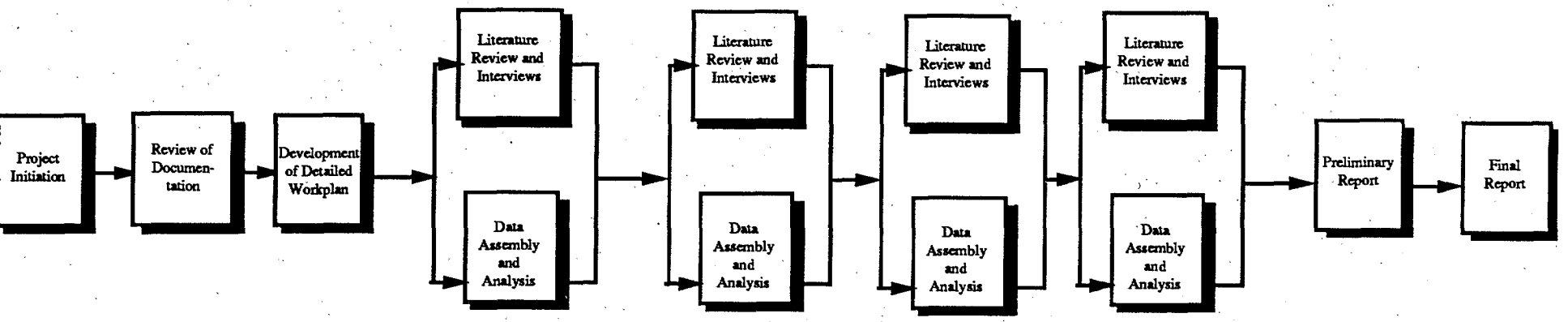
Task 6b: Final Report

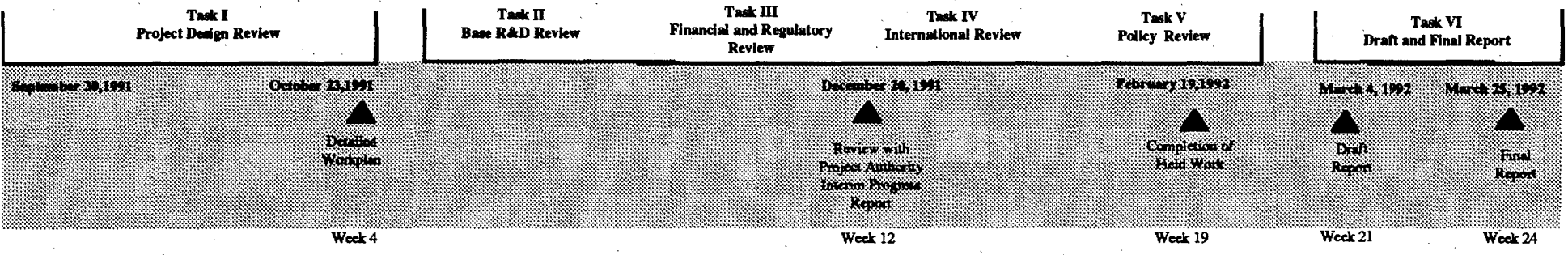
Prepare the report in draft form for review by the client and, subsequently, complete and deliver report in final form.

Task 6c: Final Presentation

EXHIBIT I

Workplan





Present the findings of the Final Report to the client.

3.7 Workplan & Schedule

The work plan and schedule for the completion of the Study tasks is described in Table 2. Month 1 has been assumed to be October 1991. Work must be completed by March 31, 1992. Project milestones are also identified in Exhibit A. These milestones represent the submissions to the client for review and feedback.

3.8 Deliverables

One presentation will be made concurrent with the delivery of the Final Report or shortly thereafter. The Final Report will contain an Executive Summary and Recommendations in both English and French with a roll-up of previous reports in the form of Appendices (English only). Three other reports will be provided, first in draft then final form. The Base R&D Report, the Financial, Regulatory and Institutional Report, the International Report and the Policy Report. Final Reports will be provided within 14 days of the receipt of client comments on the Draft Reports. The client will be expected to review Draft Reports within 14 days of receipt of the report. Five copies of draft reports will be provided. Thirty hard copies of the Final Report will be provided.

4.0 Our Study Team

4.1 Our Approach to Staffing

We recognize that proper staffing is important for the successful conduct of the study requested by the Department of Communications. Our approach to staffing reflects this emphasis in two ways:

a) We propose to have a senior Partner, as Project Director, responsible for overall conduct and delivery of the study and be readily accessible to the Department when required. This approach will maximize our understanding of departmental requirements, optimize coordination of activities, and ensure fully integrated and consistent results from all tasks undertaken. Jerry Jana will be the Partner responsible for the study.

b) We have identified core project teams using senior members primarily from our Ottawa and Toronto Offices. Additional outside expertise has been identified and they will be associated with Ernst & Young for this project. All of these project members have the specialized analytical skills and experience required by DOC. The core team can also be supplemented, as required, with professionals with relevant industrial expertise. This approach allows for flexibility and enables us to assemble the best possible team using a variety of functional and sectoral skills to successfully meet your needs.

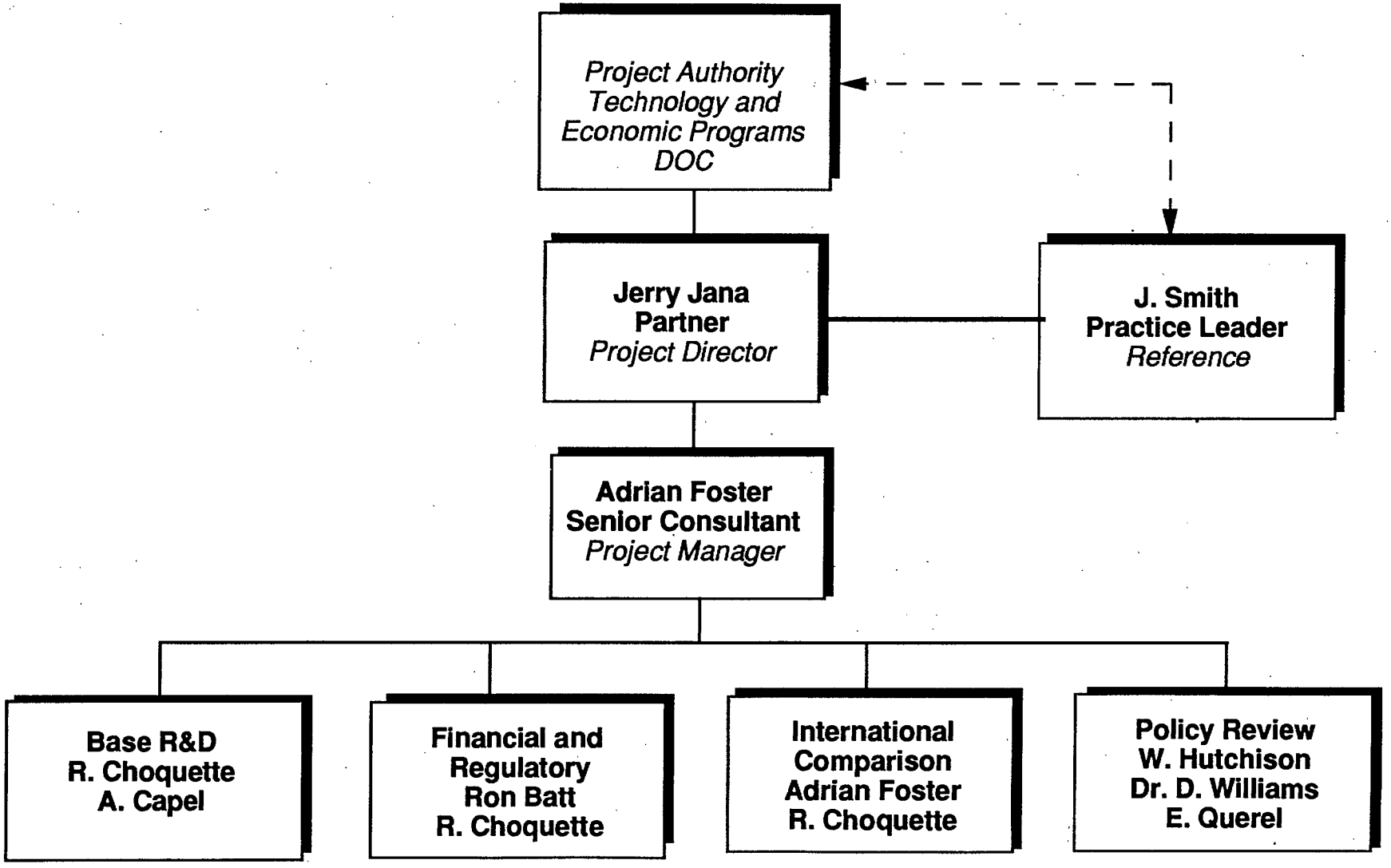
The remainder of this section provides the details of the qualifications and experience of personnel from our Ottawa and Toronto offices. Equally qualified personnel are located in these other offices, and are available if required. The study team members are identified on Exhibit II.

4.2 Staff Experience and Qualifications

The proposed study team is composed of a core group of senior professionals assisted by company support resources. This will provide an appropriate balance of professional disciplines and experience to meet the

EXHIBIT II

Proposed Study Team



needs of the statement of work. Exhibit III demonstrates the experience and knowledge of the study in areas relevant to this study.

Project Director

Jerry Jana is a senior partner in firm and is responsible for the Eastern Region Information Technology Practice of Ernst & Young. He has over twenty years of data processing experience, specializing in operations in government, utilities and financial service-related companies. Jerry has controlled and coordinated projects in these industries involving long-range business and systems planning, hardware and software evaluation and selection, profit improvement studies, organizational reviews, system designs and installations and operations and productivity work. Jerry will act as overall Project Director and coordinate all team activities.

Project Manager

Mr. Adrian Foster, M.B.A., C.M.C. (Prospective) is a Senior Consultant with our Government Services Group. Adrian has over 10 years of experience in the Telecommunications and Consulting industries in sales, marketing operations, finance and in financial and systems consulting. The following examples provide reference to his recent work:

- Project Manager for the review of the Human Resource Management Information Systems of Employment and Immigration Canada (currently underway);
- Project Manager for the EDP systems review of a National Newspaper and Magazine distributing company (currently underway);
- Team Leader for the cost and productivity improvement review of National Defence Headquarters - Communications Electronics Engineering Group (last summer/fall);
- Project Manager for the organization review of Emergency Preparedness Canada (last winter); and
- Manager, Information Systems, Data Networks Division Northern

Proposed Personnel
Key Knowledge/Experience Requirements

EXHIBIT III

Areas of Knowledge/Experience	*Partner Level*				*Manager Level*		*Associates*	
	W.Hutchison	*J.Jana*	*E. Querel*	*R. Batt*	*A. Foster*	*Dr.D.Williams*	*R. Choquette*	*A. Capel*
1. Canadian and Global Telecommunications Industry: Markets, Products and Services, and Suppliers.	XX	XX	XX	XX	XX	XX	XX	XX
2. Government R&D policies, guidelines, and processes, at the corporate level.	XX	XX	XX	XX	X	XX	XX	XX
3. Fiscal Policy and Tax incentive systems related to R&D.	X	X	X	XX	X	X	X	X
4. Regulatory Enviroment.	XX	X	X	XX	X	X	XX	XX
5. Innovation and Technology issues related to the Telecommunications Industry.	XX	X	XX	X	X	XX	XX	XX
6. Departmant of Communications.	XX	XX	X	XX	XX	XX	X	X
7. Project management.	XX	X	XX	X	XX	XX	X	X

XX - Detailed knowledge and extensive practical experience.
X - General knowledge and some practical experience.

Telecom. Responsible for customer service operation and network support.

- National Account Manager, Data Networks Division, Northern Telecom. Responsible for sales and marketing of DataCom Products to major account customers.
- Senior Financial Analyst-Strategic R&D, Northern Telecom. Responsible for financial component of Division Strategic Investment Plan.

Adrian also worked for 5 years with an international firm of accountants and consultants, and has acquired a very solid financial management base.

Adrian Foster will lead the Base R&D Review. Adrian Foster is cleared at the Secret Level.

Project Team Members

Policy Review

William G. Hutchison is a senior partner and National Practice Director for the Information Technology practice in Canada for Ernst & Young and has 30 years of experience in computer and telecommunications systems. Bill has planned and directed more than 600 man years of software development for major domestic and international users and suppliers of computer and telecommunications systems. Some of the largest information technology contracts ever consummated in Canada were negotiated by Mr. Hutchison. Contracts included $30 million with a European organization and $10 million for systems sold to a leading Japanese computer company.

For the past fourteen years, Mr. Hutchison has been a prominent information technology advisor to government and business executives. his professional advice has focussed on two areas; strategies and organization structures to achieve maximum productivity and competitive benefits from computers, software and telecommunications and strategies

for building competitive advanced technology companies. Mr. Hutchison is a member and past Vice Chairman of the Prime Minister's National Advisory Board for Science and Technology. He is also a member and past Chairman of the National Advisory Council of the Canadian Advanced Technology Association.

As a Chief Executive Officer, Mr., Hutchison has directed a variety of advanced technology firms in fields as diverse as computer hardware manufacturing, electronic publishing, software development and systems integration. Much of this activity has involved pioneering efforts that have helped to establish Canada's advanced technology infrastructure. For these efforts the Canadian Advanced Technology Association gave Mr. Hutchison its 1988 Award of Distinction for Private Sector Leadership in Advanced Technology. "In recognition of the outstanding contribution he has made to the creation and development of the advanced technology industry in Canada.". Mr. Hutchison has also been awarded the CIPS 25 year pin in recognition of his 25 years of service.

William Hutchison will lead the Policy Review supported by Emile Querel. Mr. Hutchison's extensive Telecoms and IT industry experience will be combined with his industry leadership and policy experience (Vision 2000 founding chair, CANET facillitator, CANARCE chair and NABST Vice-Chairman) to provide strategic policy input and options.

Emile Querel, is a senior Partner, and is responsible for leading the telecommunications practice in Toronto. He will assist Mr. Hutchison.

Financial and Regulatory Review

Ron Batt is a senior Tax Partner in our Ottawa Office and is a recognized leading practitioner in the area of R&D Tax Credits. In recent years, Mr Batt's professional duties have been focused in the high technology sector. Mr. Batt is presently a member of Ernst & Young's National High Technology Industry Specialization Committee and he also directs the Ottawa office practice in high technology industry, in terms of industry

segments, is the largest practice area in that office. Over the years, Mr. Batt has contributed his time to community service, particularly in the high technology sector. He has been a member of the Finance and Tax Policy Committee of the Canadian Advanced Technology Association ("CATA") since 1984 and in 1990, became a member of the Ottawa chapter of the Canadian Association of Data Processing Organizations ("CADAPSO"). CATA is a national organization in Ottawa which is the largest association of high technology companies in Canada with over 300 members and whose mission includes promoting the growth, competitiveness and global market position of Canadian based high technology companies. As a member of the CATA committee he has actively worked over the years in assisting that organization in formulating income tax and related policy measures for the Canadian high technology industry and has advised and assisted CATA in making tax policy representations to the federal government including presentations made to Revenue Canada and the Department of Finance. He played a key role in CATA's successful efforts which resulted in amendments to Revenues Canada's policies for high technology companies. In 1986 he was called to represent CATA as witness at a meeting of the Standing Committee on research , Science and Technology of the House of Commons. This meeting dealt with Revenue Canada's guidelines for scientific research and development tax incentives. He has spoken at several of CATA and CADAPSO seminars and conferences on income tax and other issues affecting the High Technology industry. He also organized and acted as Chairman at two CATA seminars held in 1988 and 1990. The first seminar dealt with major trends affecting the Canadian software industry and the second covered the trends affecting Canada's technology industries in the 1990's.. Ron Batt F.C.A. will lead the Financial, Regulatory and Institutional Review. He will be supported by Mr. Roger Choquette of Comgate.

International Review

Messrs, Roger Choquette and Anthony Capel will lead the International Review. They will be supported by Dr. Digby Williams.

Mr. Roger Choquette, P. Eng., received his undergraduate engineering degree from the Royal Military College in 1972, a post-graduate degree in Systems Engineering from the National School of Aeronautics and Space (Toulouse, France) and an Masters in Business Administration from the University of Ottawa in 1986. He was a senior Communications and Electronics officer in the Canadian Armed Forces, a senior engineer at the Canadian Radio-television and Telecommunications Commission, and Manager of Data Communications at Intellitech Canada Limited. Mr. Choquette has developed significant expertise in the development of requirement specifications, the application of structured design methodologies, the specification of systems based on OSI approaches and the application of security procedures in operational environments. In addition, Mr. Choquette has extensive experience with and knowledge of technologies, services and regulatory requirements in the Canadian telecommunications environment. He has also presented a variety of courses in technical and regulatory communications topics across Canada.

Mr. Tony Capel, P.Eng., has Bachelor and Master's degrees in electrical engineering from the University of Waterloo. He worked for Atomic Energy of Canada Ltd. in Chalk River for 14 years prior to joining Intellitech Canada Ltd. in Ottawa in 1986.1 While at AECL he developed significant communications expertise, directed several hardware development projects, became responsible for R&D strategic planning in the Reactor Instrumentation, Control and Electronics fields, and also participated in a range of AECL business development activities. While at Intellitech, Mr. Capel was responsible for the development of the CryptoNet communications security product and provided extensive

communications and system engineering services to clients. He has published over a dozen papers on communications and information security topics and is an active participant in international standards activities. Mr. Capel has in depth and extensive background in OSI matters.

Detailed resumes of the proposed personnel are included at Annex A and the detailed resource assignments are itemised in Section 8. A sufficient number of staff are proposed to account for unforeseen contingencies, at least one person within the team is capable of backing up another.

4.3 Replacement of Personnel

While we endeavor to insure continuity on all assignments, replacement of personnel is sometimes unavoidable. We have included resumes of any personnel we may utilize in the execution of any tasks assigned to our firm under any standing offer agreement, and are typical of the staff available

Any change of personnel would be undertaken by Ernst & Young only for reasons beyond our control. If it should become necessary to replace any personnel, we will give five (5) working days notice to the Project Authority. It is understood that any replacement of personnel and any impact that replacement might have on the project schedule must be authorized in writing by the Project Authority.

4.4 Certification of Education and Experience

We hereby certify that all statements made with regard to the education and the experience of the individuals proposed for completing the subject work are accurate and factual, and we are aware that the Department reserves the right to verify any information provided in this regard and that untrue statements may result in the proposal being declared non-responsive or in the taking of other action which the Department may consider appropriate.

5.0 Our Firm

5.1 Ernst and Young

Ernst & Young, for 126 years Clarkson Gordon in Canada, is one of the largest accounting and management consulting firms in Canada. Since its founding in 1864, the firm has remained 100% Canadian-owned and has provided a wide range of services to business, non-profit and charitable organizations, and government and government-related enterprises. The firm employs over 3,400 professionals in 33 cities across Canada.

Many of the world's leading companies, both Canadian and foreign-based, depend on our firm for audit and advisory services. In addition, we are senior advisors to both the federal and provincial levels of government on many important matters. With over 400 professional staff, Ernst & Young Consulting is one of Canada's largest management consulting firms. We also provide services to our clients on a world-wide basis through our membership in Ernst & Young International, a federation of national public accounting and consulting firms in over 100 countries. And we can provide specialized expertise to our clients in a wide range of areas.

Linguistic Capabilities

Ernst & Young has a very strong bilingual capability in that over 30% of our professional staff are able to work with equal ability in either official language. Our primary working language is English, however we can provide qualified professionals to meet the linguistic requirements of any assignment. We have provided our services in French and English to numerous clients, in both the public and private sector. In the province of Quebec, the working language of personnel is French, yet the majority are equally as proficient in English. Our in-house translation service at our Montreal office enables us to produce documents in either official language.

Support Capabilities

Our firm has the full range of support staff and equipment to assist in the conduct of assignments and preparation of reports and documents. These include word processing, computing, telecommunications, facsimile and printing. Any document can be produced in hard-copy format, as well as any computer readable format specified by the project authority.

5.2 Relevant Experience In Telecommunications

Among our projects, we have conducted major studies for the Canadian telecommunications industry including Bell Canada, Trans Canada Telephone System, the British Columbia Telephone Company, Canadian Radio-Television and Telecommunications Commission, Manitoba System and Edmonton Telephone System.

We have listed below a two examples of related telecommunications projects which we have conducted around the world. More examples appear in Appendix C.

Bell Canada

Ernst & Young assisted Bell Canada in understanding, evaluating the responding to a variety of regulatory issues and concerns. Among the areas addressed by Ernst & Young for Bell Canada are costing methodologies and systems development, terminal equipment deregulation, rate design, competitive provision of telecommunications services and regulatory strategy. Our activities focused on the manner in which these issues unfolded in the United States; identifying the positions of interested parties, the types of arguments employed and data used, key decision variables, and the practically of the ultimate decision.

British Columbia Telephone Company

In preparation of anticipated CRTC hearings on whether MTS/WATS should be permitted in Canada, Ernst & Young was engaged by BC Tel to prepare two "white papers". The first addressed how the "contributing" component of MTS/WATS rates had been treated in the U.S. in light of the development of interchange competition and divestiture, focusing on the implications of U.S. developments for the Canadian environment. The second addressed the development of interchange resale in the U.S. and its role in facilitating the overall development of competitive markets.

5.3 Comgate Engineering Ltd.

1. General Corporate Information

Comgate is a privately held company that provides senior systems engineering and consulting services to industry and government. Its focus is on telecommunications and distributed information systems, with a strong emphasis on international standards.

Comgate was established in Ottawa in March of 1989 by senior professionals who left Intellitech Canad Ltd. after this company was sold to another firm. Comgate occupies its own 1800 square foot leased facility at 331 Cooper Street, maintains a corporate security clearance with DSS Security Branch and standing offer arrangements with a number of federal government and private sector clients.

A corporate brochure is included as an attachment to the proposal.

2. Experience Related to Telecommunications and R&D Issues

a) The Canadian Radio-Television and Telecommunications Commission (CRTC), the Effect of Changing Technology on

Telecommunications and Cable Networks and the Impact Upon Services in the Nineties.

This study examined the regulatory issues which may arise due to the introduction of new technologies in telecommunications and cable networks in Canada. Issues examined in detail were: the base technologies which are expected to influence in future development of these networks, the services which may be offered by these networks as a result of this technology, and the policy, legislative and regulatory context which will influence the deployment of the new technologies on the one hand, and be affected by such deployment on the other.

b) Industry Science and Technology Canada (ISTC), Feasibility Study for a High Speed Network for Research and Development.

In association with James F. Hickling Management Consultants, Comgate led this Feasibility Study in the Areas of network architecture, standards, costs and regulatory matters. This Study has resulted in the development of a Business Plan in support of a Memorandum to Cabinet for project funding.

c) Treasury Board of Canada, Canadian Government OSI Profiles

Comgate prepared the OSI based Canadian government profile specification documents (COSAC documents) for Local Area Networking, LAN/WAN Interworking and Testing.

d) Transport Canada, Telecommunications Networks Integration Feasibility Study

Comgate undertook a highly successful feasibility study on the integration of all departmental networks at Transport Canada, including those in the Air, Marine and informatics Groups. The study included the analysis of both technical and organizational feasibility with the recommended alternative generating significant cost significant cost saving and benefit to the department. Migration and implementation issues were also addressed.

6.0 Fees and Timing

6.1. Timing

We understand that the work on this study can begin as soon as conveniently possible. We are prepared to complete the field work prior to February 28,1992 provided we can begin the assignment by no later than October 25, 1991 and complete the assignment by March 31, 1992.

If such an early start-up to the study is not possible, we are prepared to conduct the study starting in early November. We undertake to complete the study within an elapsed time of 24 weeks as outlined on the workplan in Exhibit I.

6.2 Fees

Our fees are based on time spent and on the experience and qualifications of the staff assigned to the project. Based on our experience with similar assignments and our review of the documentation provided by the Department of Communications we commit ourselves to a firm price fee of $97,500 expenses of $2,500 and travel of $3,500 to complete this assignment in accordance with the understanding of the objectives, scope and deliverables as described in this proposal. The total firm price is $97,500 exclusive of GST.

Ernst and Young and Associate Per Diem Rates are detailed in Table 2 for the team personnel. The Per Diem Rate quoted is inclusive of profit and all applicable Overhead Rates, which include word processing, photocopying, courier services, local travel expenses, administrative support etc.

Support staff are not included in the overhead component of the quoted Per Diem rates. They are therefore separately priced and included in the report preparation costs of $2,500 which includes translation. Out of town travel expenses and translation costs are not included in the daily rate and a budget for this is included separately in our price proposal. All

travel and living expenses will be charged according to Treasury Board guidelines. Estimates are based on two team members travelling to out of town locations for interviews. We understand the total travel budget is estimated at $3,500.

Personnel Categories	% Participation	Per Diems	Total Days
Partner Level			
W. Hutchison	8%	$2,250	7
J.Jana	4%	$2,250	4
E. Querel	5%	$2,100	5
R.Batt	5%	$1,913	5
Manager Level			
A. Foster	26%	$1,200	28
Dr. D. Williams	13%	$1,200	14
Associates			
R.Choquette/A.Capel	39%	$750	42
Project	100%	$870	105

Gross Fees	$127,191
Report Preparation	2,500
Travel	3,500
Less: Discount	133,191
Firm Price	35,691
	$97,500

6.3 Subcontracts

Subcontracts will be executed with Comgate Engineering Ltd.

6.4 Method of Payment

Ten percent (10%) will paid out after acceptance of the workplan. Twenty five percent (25%) will be paid upon receipt and acceptance of the interim report. Thirty five (35%) will be paid upon receipt of the draft report. Thirty percent (30%) will be paid upon receipt and acceptance of the final report.

Appendix A
Resumés of Ernst & Young's Team

Partners Level
William Hutchison
Jerry Jana
Emile P. Querel
Ron Batt

Manager Level
Adrian Foster
Dr. Digby Williams

Associates
Roger Choquette
Antony Capel

William G. Hutchison

Senior Partner, Practice Director, Information Technology Group, Ernst & Young, Toronto

Education

- Bachelor of Engineering (Electrical,) McGill University

William G. Hutchison has a Bachelor of Engineering degree in Electrical Engineering combined with 30 years of experience in computer and telecommunications systems. He has planned and directed more than 600 man years of software development for major domestic and international users and suppliers of computer and telecommunications systems. Some of the largest information technology contracts ever consummated in Canada were negotiated by Mr. Hutchison. Contracts included $30 million with a European organization and $10 million for systems sold to a leading Japanese computer company.

For the past fourteen years, Mr. Hutchison has been a prominent information technology advisor to government and business executives. his professional advice has focussed on two areas; strategies and organization structures to achieve maximum productivity and competitive benefits from computers, software and telecommunications and strategies for building competitive advanced technology companies. Mr. Hutchison is a member and past Vice Chairman of the Prime Minister's National Advisory Board for Science and Technology. He is also a member and past Chairman of the National Advisory Council of the Canadian Advanced Technology Association.

As a Chief Executive Officer, Mr., Hutchison has directed a variety of advanced technology firms in fields as diverse as computer hardware manufacturing, electronic publishing, software development and systems integration. Much of this activity has involved pioneering efforts that have helped to establish Canada's advanced technology infrastructure. For these efforts the Canadian Advanced Technology Association gave Mr. Hutchison its 1988 Award of Distinction for Private Sector Leadership in Advanced Technology. "In recognition of the outstanding contribution he has made to the creation and development of the advanced technology

industry in Canada.". Mr. Hutchison has also been awarded the CIPS 25 year pin in recognition of his 25 years of service.

Experience

Mr. Hutchison is the National Director of the firm's IT practice with nationwide responsibility for information systems consulting, software development of clients and the application of CASE tools. He also serves as a science and technology policy advisor for the firm's clients.

Mr. Hutchison has established a company and designed its proprietary product, the CANTECH Database. The company provides a wide range of information services focussed on Canada's advanced technology industry. Included are National Directories, the Software Directory, Search Services and Database usage licences.

Mr. Hutchison was President and an active consultant to an independent consulting firm. He and his associates specialized in electronic business systems, factory automation systems and technology strategies for laboratories, government and equipment suppliers. He provided advice to senior management in the areas of technical strategies, organization structures and methodologies for planning, implementing and evaluation systems. Clients included a wide range of industrial and government organizations in Canada, U.S.A., Britain and Japan. During this period and in a consulting capacity, Mr. Hutchison also served as Chairman and Interim President of Infomart, a leading electronic publisher and as Interim Vice-President, Information Systems for Harlequin Enterprises Inc.

Mr. Hutchison was Chairman and Owner of a computer systems engineering firm specializing in the design, installation and support of mid range computer systems for business. The firm developed and supported a large base of more than 300 clients throughout Canada and the United States. Applications include accounting systems, management information systems using the latest database tools and office communication systems. client business activity was in manufacturing, distribution, association management, general insurance agencies, publishing and retail. Mr. Hutchison sold his interest in this company in 1988.

Mr. Hutchison was involved in the first Canadian manufacturer of minicomputers and computer terminals. It pioneered in Canadian systems design, hardware and software development, and development of computer manufacturing and international marketing organization. It was also a major contributor to the

foundation of human resource skills upon which Ottawa's high technology community is based.

During Mr. Hutchison's career here, the company designed, manufactured and sold more than $150 million of equipment comprised 25,000 Canadian designed terminals and 3,000 Canadian minicomputers. Products were installed in 28 countries throughout the world and much of its equipment is still in operation. This company was an important Canadian technology pioneer in which Mr. Hutchison served in capacities from Vice President, Canadian Marketing to President and Chief Executive Officer.

Mr. Hutchison was one of the early group of pioneers who established an international company's Canadian business in computer information systems. His career here included systems engineering, marketing and senior management. When he left in 1969 he was Regional Director responsible for Central Canada and the company had become the second largest computer systems supplier in Canada.

Appointments

- Chairman/Exhibition, 1977 World Triennial Congress of the International Federation of Information Processing Societies, IFIP.
- Chairman 1982 - 1984; Director, 1981-1980, The Canadian Advanced Technology Association (CATA) Chairman, 1986-1990, CATA National Advisory Council
- Chairman, 1983; Director 1982 - 1984, Infomart
- Chairman, 1985, Seneca College, Friends of Seneca Association
- Chairman, 1978 - 1982, Advisory Board, Computer Data Magazine
- Director, 1984 - 1986, Canadian National Committee/International Electrotechnical Commission
- Member, 1984 - 1987, Associate Committee on Instructional Technology of the National Research Council of Canada
- Member, 1984 - 1988, Advisory board, Ryerson Polytechnical Institute's Electrical Engineering Department
- Member, 1984, Advisory Committee to Minister of Science and Technology, Government of Canada
- Governor, 1985, Computer Museum of Canada
- Chairman, 1985 - 1986, Ryerson Innovation Centre, Ryerson Polytechnical Institute

- Member, 1987 - 1988, Business Technology and Innovation Committee of the Board of Governors, Ryerson Polytechnical Institute
- Co-Vice Chairman, 1987; Member, 1988 - present, The Prime Minister's National Advisory Board for Science and Technology (NABST)
- Director, 1988 - 1990, Ontario Laser and Lightwave Institute
- director 1987 - 1990 Precarn Associates

Published Articles

Canadian Business
Infosystems (USA)
Financial Post
Canadian Datasystems
Computing (England)
Montreal Gazette
Electronic News (USA)
EIC Journal (Engineering Institute of Canada)
Computer World (USA)
DataMation (USA)
Globe & Mail
CA Magazine
Computer Data/Computing Canada
Financial Times (England)
Communications (USA)

Speeches

- Canadian Computer show, 1977, 1980
- International Data Entry Symposium, Rome, Italy - 1971
- Hanover Fair, Germany - 1972
- Data 78, 79, 80, 83, Conferences, Toronto
- Canadian Information Processing Society, Toronto, Ottawa, Calgary, Montreal, Hamilton, Edmonton, Regina, Halifax - various years.
- Data Processing Managers Association, Montreal, Toronto, Winnipeg - various years
- Canadian Office Machine Dealers Association (COMDA), Halifax, Toronto, Vancouver - various years
- Keynote Speaker at Fourteen National Technology and Productivity Conferences sponsored by the Canadian Government - 1983

- National Office of the Future Conference, Toronto - 9183
- Financial Economists Association - 1984
- Gulf Computer & Business Show, New Orleans - May 1986
- 1986 - 1990
  Various speeches to service organizations
- Strategic Partnering and Alliances (CATA) - 1988
- Financial Post R&D Conference - 1988 - University/Industry R&D Linkages
- Technology Transfer Issues - The Canadian Institute (1990)
- Wireless Communications - Wireless 90 Conference

Jerry L. Jana

Partner, Ernst & Young, Toronto

Education

- B. Sc. (Industrial Engineering) - Purdue University
- M. Sc. (Industrial Administration) - Purdue University

Responsibilities

Jerry is responsible for the Eastern Region Information Technology Practice. He has over twenty years of data processing experience, specializing in operations in government, utilities and financial service-related companies. Jerry has controlled and coordinated projects in these industries involving long-range business and systems planning, hardware and software evaluation and selection, profit improvement studies, organizational reviews, system designs and installations and operations and productivity work.

Experience

Jerry assists clients across a variety of industries to improve operational processes and systems in support of their business strategy and objectives. His recent experience has included:

- reviewing human resources and payroll alternatives for Canadian Depository For Securities

- as project leader, developed a Strategic Information Systems Plan considering data/application requirements, hardware and software strategy, management reporting and information resources organization for Gray Coach

- leading a team of ten in the development of an information plan for the corporate controllership function at Ontario Hydro, including reviewing payroll processing alternatives, and defining a front end processing concept for data entry

- directing the design and installation of an Investment Accounting and Tax Reporting System for a large life insurance company

- acting as project leader for the revision of financial reporting and controls required to monitor development of large projects for the real estate division of a life insurance company
- authoring The Technology Infrastructure Section of the Canadian Life Insurance Study, reviewed the use of technology to achieve competitive advantage
- as project leader, analyzing the administration of unemployment insurance and employment services, including the review of efficiency and effectiveness of unemployment operations, administration costs, organization structure and size and impact of changes to policy and procedures

Emile P. Querel

Partner, Ernst & Young

Education

- Bachelor of Commerce (Major in Management and Computer Science) Concordia University

Memberships

- Canadian Business Telecommunications Alliance
- Past Director of the CBTA 1984
- Past Director of the International Communications Association 1982 - 1984
- Past Director of the Communications and Signal Division
- Association of American Railroads, 1980 - 1983

Experience

1987 - Present, Ernst & Young Management Consultants

Ernst & Young Partner responsible for the telecommunications consulting practice.

1985 - 1987, Telecommunications Consulting Manager, DMR

Responsible for DMR's Toronto based telecommunications consulting.

1983 - 1985, Director of Communications, Canadian Pacific

Responsible for the planning, design and operations of the corporate voice systems and networks. Provided communications consulting to CP Limited subsidiaries. Managed 14 communication professionals and an annual budget in excess of $14 million.

1972 - 1983, Voice and data telecommunications responsibilities with CP Rail

Specific References

Strategic Telecommunication Technology Studies

Provided project management and senior consulting to a large crown corporation on the evaluation and planning for telecommunications

services and systems. Evaluated all voice, data and video services costing approximately $25 million annually. Provided a strategic plan and identified technology improvements and cost reduction opportunities in excess of $3,000,000 annually. Assisting in the implementation of high speed digital trunking, digital telephone switch upgrades and Meridan technologies.

Provided project management for a worldwide study of EDI requirements across industry associations for the feasibility of an International EDI institute.

Managed and directed a team of consultants on a major voice and data telecommunications study for a large insurance firm. Evaluated all services and systems, analyzed a number of alternatives including multiplexing, packet switching and integrated voice/data. Designed the corporate network and project managed the installation reducing corporate telecommunications costs by over $1 million annually.

Managed a telecommunications project for the specification and selection of voice and data communications systems for a major insurance firm establishing two new branch locations and relocating their Head Office. Assisted in the implementation planning.

Provided Project management and senior consulting to a large division of Northern Telecom for the migration of all data communications onto twisted pair technology. This involved business systems as well as factory LAN's and establishing network gateways. Designed the building distribution systems and implemented twisted pair solutions.

Provided senior consulting and project management to Northern Telecom Canada in the planning, design and implementation of voice mail technology for 900 head office personnel. Developed and directed a training program across the system.

Consolidated head office departments for a large property development company. Designed a building distribution system using twisted pair technology. Migrated all voice and data (Wang, 3270) onto a twisted pair solution. Significantly reduced annual communication costs. Provided PBX, project management and coordinated the installation of all voice and data communications.

Provided project management and senior consulting to develop a 5-year strategic plan for telecommunication services used by the Los Angeles Power and Water Commission. Reviewed all business services

communication systems, process control, private terrestrial and microwave systems and leased services to develop an overall integration strategy wherever feasible.

Provided senior management and technical consulting to Petro-Canada in Calgary during a transfer of network responsibilities. Developed a strategic plan in the area of voice telecommunications. During this assignment worked closely with senior management and developed a proposal to consolidate the current voice and data networks into an integrated digital network. Issued a detailed Request for Proposal to Telecom Canada, CNCP Tel and Telsat. Evaluated responses and recommended a network option which would substantially reduce their annual costs for network services.

Office Relocation Projects

Managed and directed a team of consultants on the upgrade and relocation of the head office for a large financial institution. Developed the technology plans including telephone system, voice messaging, network management, integrated building cabling for voice, data and text, and project managed through to installation.

Managed a major office relocation project for Ontario Hydro affecting 1200 personnel. Designed the building cabling system, issued RFQ and participated in the vendor selection for a voice switch, voice mail and Local Area Network.

Provided senior management and technical consulting to Northern Telecom Canada to plan and manage the installation of all communications in their new Toronto Headquarters building. During this assignment provided a master plan and detailed work plans for telephone, data, office automation, private packet switching and cabling directing both internal Northern and other contractors personnel.

Provided project management and senior consulting to a large Toronto based property development organization for the evaluation, selection and installation of a 400 line digital PBX. The project involved analyzing the user requirements, preparing a request for quotation, vendor evaluation and selection and the detailed installation planning. During the project we also evaluated the feasibility of multi-tenant services, voice mail and common cabling for all voice and data communications.

Cost Reduction Opportunity Studies

Conducted a Telecommunications Opportunity Study for a large insurance corporation to identify cost savings in the areas of voice and data communications services for head office and approximately 160 Branch locations. Identified current technologies and costs. Analyzed systems and services and evaluated a number of system and network alternatives. Provided a strategic telecommunications plan and reduced costs by approximately $1 million annually. Assisted in the implementation of packet switching and integrating voice/data digital networking.

Provided project management and senior consulting for a voice and data telecommunications study for a major financial corporation including two large insurance companies. The study involved an assessment of approximately $16 million annual expenditures in telecommunications; conducting an opportunity study to identify the potential savings from shared voice and data networking; conducted detailed design and costing for the various alternatives; preparation of implementation plans for recommendations. Total annual savings were estimated at about $1.8 million.

Provided project management and senior consulting to a major insurance company to design and plan a data network to connect 60 cities within the United States. Reviewed U.S. satellite carrier offerings, AT&T services and other value added carriers. The project involved developing usage statistics and a technical evaluation of IBM's New network concentrator products. Developed networking alternatives with associated response times, line utilizations and costs.

Provided telecommunications consulting for an insurance industry sponsored project to develop standard functional specifications for the cost-effective, electronic exchange of batches of insurance business transactions between automated agencies/brokers and companies. Defined the detailed functional specifications for the data communications interface between agency and company machines from which physical design and coding can be undertaken, identified the building blocks required (hardware and software) to support the communications method.

Managed a number of other telecommunication studies including opportunity studies for cost reductions for Magna International and LEP, voice mail evaluations for Ontario Hydro and PBX evaluations for Steelcase, Tory Tory, etc.

Ronald H. Batt, F.C.A.

Tax Partner, Ottawa Office, Ernst & Young

Education

- Carleton University - B. Comm. (Hons.) - 1973
- C.A. Ontario Institute 1975
- F.C.A. Ontario Institute 1991
- C.I.C.A. In-depth Tax Course - Parts A, B and C: 1976-1977, 1980

Membership

- Canadian Tax Foundation
- Ernst & Young's High-Technology Industry Specialization Committee.
- High-Tech Steering Committee of the Ottawa Board of Trade.
- Finance and Tax Policy Committee of the Canadian Advanced Technology Association.
- High-Tech Advisory Council of Ottawa-Carleton.
- Canadian Association of Data Processing Organizations

Business Experience

Income tax experience includes the development and implementation of all aspects of personal and corporate tax planning including new ventures, incorporations, reorganizations, liquidations, divestitures, purchases and sales, in both Canadian and international jurisdictions.

As coordinator of the Ottawa office's high technology practice, his client responsibilities include providing tax services for emerging high tech companies as well as large companies involved in international operations including Mitel Corporation, SHL Systemhouse Inc., Cognos Inc., Lumonics Inc., Lockheed Canada Inc., CAL Corporation. He has developed international tax structures to minimize tax for a number of high tech clients.

As a member of several high technology associations, he has assisted those associates in making representations to the federal government on various tax policy matters affecting the high technology industry.

Teaching Experience

University of Ottawa - lecturer in introductory and advanced courses in taxation.

Instructor at various in-house training courses and seminars on taxation.

Speaker at a number of meetings and seminars sponsored by various high technology associations on tax issues applicable to that industry.

Publications

Contributing author, "Income Taxation in Canada", published by Prentice-Hall.

Writer of a series of tax articles for "Ottawa Business News", a local business publication.

Other

Past President

- Ottawa Chartered Accountants' Association.

Past Chairman

- Accountants' section of the United Way Campaign of Ottawa-Carleton

Adrian M. Foster

Senior Consultant, Ernst & Young,
Government Services Group, Ottawa office

Education

- Honours B.A., Political Science and Economics, University of Western Ontario, 1978
- Masters of Business Administration, Finance and Policy, York University, Toronto, 1980

Associations

- Prospective CMC, Enrolled in program leading to Certified Management Consultant designation, Ontario 1991
- American Marketing Association
- Armed Forces Communications and Electronics Association
- Planning Forum
- Financial Management Institute

Clearance

Secret

Experience

March 1990 to Present, Ernst & Young

Areas of preferred practice are marketing, information technology and productivity improvement.

Project Manager - Revenue Canada Taxation, Productivity Study of the Ottawa Taxation Centre. In depth review of functions and activities and analysis of performance to determine areas of significant productivity improvement.

Team Member- Department of National Defence, NDHQ Functional Review, indepth review of management, functional activity, decision-making and analysis to determine ways to improve effectiveness and economy of operations.

Project Manager - Emergency Preparedness Canada, Management Review of Activites and Resources.

Project Manager - National Search and Rescue, Management Review of the Search and Rescue Information System.

Responsible for leading Ottawa Practise in the areas of Cost Performance Improvement, Strategic Management, and Information Technology.

1988 to 1990
Information Services Manager, Data Networks Division, Northern Telecom

Data Networks Division is the leading provider of packet-switched and ISDI data networks worldwide.

Responsible, as Project Leader, for on time, on budget departmental acquisition and implementation of a state of the art management information system and tools involving networked work stations and applications.

Responsible for Global Customer Support Role - Marketing and Product Communications. Staff of 18 and expenditures in excess of $2.0 million. Introduced new products and services.

Mandate to review functions and activities to improve service and reduce cost. Implemented organization and process changes including state of the art, tools and systems. Achieved 25% productivity improvement and annualized savings in excess of $200,000. Introduced new services and

1987 to 1988 - National Account Manager, Data Networks Division, Northern Telecom Ltd.

Responsible for achieving sales of sophisticated datacom products in excess of $2.0M annually. Maintained key account status and relationships. Accounts included Canada Post Corporation, Teleglobe, Hydro Quebec and Telecom Canada.

1985 to 1986 - Associate Account Manager, Data Networks Division, Northern Telecom Ltd.

Sales and bid support for key wins including the Integrated Data Network - Dept. of National Defence.

Senior Financial Investment Analyst, Data Networks Division. Responsible for preparation and analysis of financials for Srtategic, Operating and Annual Budgets for a major Global business unit of NTL.

1980 to 1986 - Senior Staff Accountant, Arthur Andersen & Co.

Senior Accountant with responsibility for all major office audits including telecommunications,manufacturers, real estate, printing and consumer products.

Consulting activities including functional reviews of various government departments and agencies such as: Industry, Trade and Commerce, Communications, Indian and Northern Affairs, etc.

Other Activities

Prospective Member Kiwanis Club of Ottawa. American Marketing Association. The Planning Forum-The International Society for Planning and Strategic Management.

Digby F. Williams

Associate, Ernst & Young, Ottawa

Education

- Ph. D University of Manitoba, 1965
  M. Sc University of Manitoba, 1962
  B.Sc Nottingham University, 1957

Responsibilities

Strategy and Technology Advisor to Ernst & Young

Experience

Dr. Williams is the strategy and information technology advisor for Ernst & Young IT practice. He is President of Williams Consulting, providing liaison with government and corporate strategy advise to Canadian IT firms. As well as corporate consulting, Dr. Williams is often invited to give talks on next generation IT technologies/products and on technology exploitation. He has an excellent knowledge of industrial and academic research/development players and directions in Canada and abroad.

Dr. Williams has been senior technology advisor in the Information Technologies Branch, ISTC and thus was required to advise on IT based initiatives throughout the federal government. His responsibilities included proposal evaluation for IT related government programs, strategic technology evaluation, membership in Canadian and international IT discussion teams including defence technologies and communications technologies. He was also responsible for developing the National Communications initiative for R&D in telecommunications.

Dr. Williams has been responsible for the development and successful implementation of the federal government policy to enhance Canadian industrial and academic capabilities in microelectronics and information systems development. this work required an evaluation of current capabilities, delineation of critical IT technologies, and the development of a plan of action for government involving industry and academia which included focussed industrial and university research support programs and organizational infrastructure changes in government. Dr. Williams

Dr. Williams has headed a research team of up to 12 PH.D's studying new thin film semiconductors and deposition processes. During this research period he published more than 150 articles in refereed journals and was an invited speaker to many international conferences. His team provided the technology for a major NRC/PILP contract to Bell Northern Research ($14M). Dr. Williams was a member of many Interdepartmental Committees including those on Artificial Intelligence and High Speed Circuits. He was Chairman, Canadian Semiconductor Conference, in 1982-4-6.

Roger M. Choquette, P.Eng.

Education

Mr. Choquette holds a Master of Business Administration degree from the University of Ottawa (1986), a diploma in systems Engineering, from the National School of Aeronautics and space (ENSAE), Toulouse, France (1973), and a Bachelor of Engineering degree, from the Royal Military College of Canada (1972).

Responsibilities

Roger Choquette is President of Comgate Engineering Ltd, where he focuses on the definition of user requirements, system design, and project management and control. Mr. Choquette has an extensive background in telecommunications systems management including service and system costing, communications networks design and security methods and procedures. He has over fifteen years telecommunications engineering and management experience both as a user and consultant.

Experience

Mr. Choquette's major areas of professional involvement are as follows:

Engineering Economics

Mr. Choquette prepared detailed and extensive cost analysis of the service offerings of major Canadian common carriers. These service offerings included the 14/12GHz and 6/4GHz space segment services and ground station earth segment of Telesat Canada and the majority of monopoly and competitive services of Bell Canada and British Columbia Telephone Company. He has completed an extensive study for Telesat Mobile Inc. relating to satellite based mobile data services, as well as a detailed cost service and technology studies for the Canadian Radio-television and Telecommunications Commission (CRTC).

Strategic Technology Planning and CCITT Standards.

Mr. Choquette managed and participated in an extensive study of the impact of new telecommunications technologies on the Canadian regulatory environment. The study included the active participation of major organizations, in both the private and public sectors. From 1985 to 1988 he represented the Canadian Radio-television and Telecommunications Commission (CRTC) on the National Study Group XVIII (ISDN) and I (Services).

Communications Networks

Mr. Choquette has prepared detailed data flow specifications for communications networks using CASE tools, most recently for a secure packet radio network for the Department of National Defence. Recent activities include the evaluation of the security requirements of a national private packet switching network for Employment and Immigration Canada and a major study which analyzed the requirements of, and then optimized, the national voice and data network used by Transport Canada. Mr. Choquette has also worked with Industry Science and Technology Canada in the definition and specification of a national high speed network for research and development.

Secure Communications Systems.

While a member of the Canadian Armed Forces, Mr. Choquette directly supervised the operations and technical support of large communications and air defence facilities and participated in the specification and testing of national data networks. As a senior officer in Air Command, he supervised the technical evaluation and management of Canadian NORAD communication and surveillance facilities and acted as Chief of the Battle Staff support Centre at 22nd NORAD Region. As an officer in Communications Command, he supervised unit level security procedures as Crypto Custodian in addition to squadron operations and maintenance activities.

Requirements Definition and Specifications.

Mr. Choquette participated in the development of user operational requirements and subsequent proposal evaluation for the deployment of a secure national computerized message switching system. He recently participated in the design and implementation of a rapid prototyping facility for the definition of user interface and system requirements using state-of-the-art microcomputer and software prototyping technology. He subsequently translated user requirements into detailed specifications in accordance with the DOD-STD-2167A software development methodology and MIL-STD-490A specification practices standards.

Network Evaluation and Simulation

Mr. Choquette designed, developed and implemented user acceptance tests for a computer communications network and design a traffic simulation model for the analysis of traffic on a transportation network. He recently participated in the simulation and evaluation of a distributed computer network with varying interconnecting media, with his major areas of involvement being the development of transaction load profiles, the definition of the database data dictionary, the development of system processing models and the definition of system evaluation scenarios.

Project Management

Mr. Choquette has implemented project management systems relating to contract planning and project engineering in both the private and public sectors.

Educational

Mr. Choquette has designed and delivered a series of voice and data communications seminars across Canada to both private sector and government clients. These seminars were presented in both official languages.

ANTONY C. CAPEL P.Eng.

Mr. Capel is Vice President of *Comgate Engineering Ltd.* where he specializes in the areas of data networks and data communication protocols. Combining expertise in both hardware and software aspects, he has actively participated internationally in the development of the IEEE-802, ISA SP-72 and IEC-955 networking standards. He also has extensive background in analog and digital electronics design, including the management of several product development programs which have included the development and simulation of communication systems. He has also developed and implemented a line of data communications security equipment.

EDUCATION

Mr. Capel holds B.A.Sc. (1970) and M.A.Sc. (1973) degrees in Electrical Engineering from the University of Waterloo.

MEMBERSHIPS IN PROFESSIONAL ASSOCIATIONS

Mr. Capel is a registered member of the Association of Professional Engineers of Ontario (APEO), a member of the Institute of Electrical and Electronics Engineers (IEEE), and a senior member of the Instrument Society of America (ISA). He was a member of both IEEE-802.4 and secretary of ISA SP-72 during the development of the IEC-955 standard. Mr. Capel is chairman of the Canadian National Committee of the International Electrotechnical Commission (IEC) subcommittee for Industrial Process Measurement and Control (CNC/IEC SC-65C) sponsored by the Canadian Standards Council. He is the Canadian technical expert to international Working Group 6 which is developing the IEC Field Bus standard, and is chairman of its Link Layer sub-group.

RECENT PROFESSIONAL ACTIVITIES

International Communications Standards: For over ten years Mr. Capel has participated actively in the development of communications standards for process control and manufacturing automation applications. His work is acknowledged in the IEEE-802.2, IEEE-802.4, ISA SP-72.01, and IEC-955 standards. This work, initially supported by Atomic Energy of Canada Ltd. (AECL), included the laboratory verification of electronic transmission techniques and software implementation feasibility. He continues to be active in the development of an international industrial field bus standard. Mr. Capel has actively promoted the use of these standards in Canada and has published several papers on this topic in North America.

In support of the Canadian Treasury Board's commitment to OSI based standards, Mr. Capel developed draft sub-profile specification documents (COSAC documents) for Local Area Networking (LAN - based on IEEE 802, MAP/TOP and US and UK government profiles), Wide Area Networking (WAN), LAN/WAN Interworking and OSI Conformance Testing. These documents are forming the basis for government-wide standardization for LAN, WAN, network gateway and acceptance plans. He has provided presentations and other support to government departments incorporating OSI based communications and assisted in the integration of OSI into existing design methodologies.

Application of Networking Technologies: For Transport Canada, partipated in a major study to integrate the (voice, data and image) telecommunications systems for Aviation, Airport, Marine, Surface and Finance directorates to reduce costs and raise service levels for all systems across Canada. The study recommended specific optimizations and strategies for the next ten years which would result in reductions in telecommunications expenditures while maintaining the operational requirements of the department.

For Transport Canada (Aviation), continues to provide OSI model support for the Canadian Automated Air Traffic System (CAATS). Various work has included the definition of interface requirements between Canadian and United States air traffic control systems, the refinement of Remote Monitoring and Maintenance interface provisions and detailed studies relating to the distributed database component, including sizing, transaction load

and manpower predictions. This work is assisting the CAATS project office to impose OSI based standards and modern design methodologies to this new nation-wide flight data system.

For Industry Science and Technology Canada (ISTC), he was recently responsible for a large technical feasibility study for a high speed Research and Development wide area network proposed to interlink major R&D facilities and industries across Canada. This work developed user needs and examined the relevant emerging technologies for the transport of data, voice and image information at speeds in the 1.5 to 44 Mbps range with particular emphasis on the application of standardized (ISO and TCP/IP) communications protocols. This project was able to attain significant government and industrial support as a result of the study, and continues to be an important government initiative.

For the Department of National Defence, he provided OSI model and LAN technology support for the definition of a tactical communications and distributed database system for artillery forces. In addition to system concept definition, this included the application and simulation of modern LAN technologies applied to radio and land-line media, to provide secure and survivable communications. In addition to the technical studies, specifications were written according to DOD-STD-2167A and related military standards. Mr. Capel actively monitors the relevant standards applicable to these applications.

For the Canadian Government Telecommunications Agency, has assisted in the investigation of OSI based architectures within which the next generation of common government data telecommunications services might be provided.

For the Canadian Radio-television and Telecommunications Commission, participated in a study to examine the effects of changing technology on telecommunications and cable networks in the 1990-2000 time frame.

Product Development: Data Encryption Equipment. Mr. Capel was responsible for the team which developed this IntelliNet product which uses standard X.25 and DES encryption protocols and FS 1027 and X9 security criterion. This work required the development of trusted design methodologies and these were developed in conjunction with the Canadian government agencies responsible.

Research and Development: Reliable Distributed Processing Systems. For over twelve years Mr. Capel was responsible for the development of communications technologies in support of the distributed control of Canadian nuclear power systems. During this time he developed a proprietary token-passing local area network using wideband Cable Television (CATV) technology. The patented design provided terminal and X.25 protocol interconnections for a distributed data acquisition system. Later work concentrated on the development, adoption and use of the emerging international standards for process data networks.

Product Development: For AECL he led teams which designed and produced: (a) A radiation safety monitor for industrial use. Product was licensed to industry and is actively marketed. (b) A precision well-logging probe for geochemical and geophysical exploration.

PUBLICATIONS

A.C. Capel, *Implementation Considerations for a Network Security System*, Armed Forces Communications and Electronics Association Conference, Proceedings, April 4-5, 1990, Ottawa.

A.C. Capel, K.C. Toth, *Secure Communications in an X.25 Networking Environment*, Proceedings pp. 355-357, First Annual Canadian Computer Security Conference, Canadian Security Establishment, January 1989.

K.C. Toth, A.C. Capel, *Security Management in Data Networks*, Proceedings pp. 399-417, First Annual Canadian Computer Security Conference, Canadian Security Establishment, January 1989.

A.C. Capel, C. Laferriere, K.C. Toth, *X.25 Network Security*, pp. 123-139, Data Communications Magazine, November 1988.

A.C. Capel, *Field Bus: An Industrial Standard for Real-Time Monitoring and Control*, Armed Forces Communications and Electronics Association Conference, April 13-14, 1988, Ottawa.

A.C. Capel, G.F. Lynch, *Proway: the Evolving Standard for Process Control Data Highways*, ISA Intech Magazine, pp. 91-94, September 1983.

L.M. Watkins, A.C. Capel, R.R. Shah, C.E. Andison, *A Highly Reliable and Easily Expandable Time-of-Day Subsystem for Distributed Nuclear Power Plant Control and Instrumentation Systems*, IAEA International Symposium on Nuclear Power Plant Control and Instrumentation (NPPCI), Munich, Proceedings IAEA-SM-265, pp. 1-13, October 11-15, 1982.

A.C. Capel, G. Yan, G.E. Gilks, R.J. West, *Distributed Multi-Port Communications System*, U.S. Patent #4,340,961, July 20, 1982; Canadian Patent #1,138,553, December 28, 1982.

A.C. Capel, *Data Highways for Distributed Process Control*, 1982 Canadian Conference on Industrial Computer Systems, Hamilton, Proceedings, pp. 74.1 to 74.5, 3-5 May, 1982. Also invited presentation at Interface 82 Conference, Dallas, 22-25 March, 1982 (AECL-7678).

A.C. Capel, G.E. Gilks, R.A. Basso and G. Yan, *A Distributed Local Area Network Using Non-Contention Protocols*, NBS/IEEE Computer Networking Symposium, Washington, Proceedings, pp. 12-17. December 1981. (AECL-7436).

A.C. Capel, G. Yan, *Distributed System Design Using Separable Communications*, IAEA NPPCI Specialists' Meeting on Distributed Systems for Nuclear Power Plants, Chalk River, Proceedings, AECL-7056 pp. 141-155, 14-16 May 1980. Also published in 1980 Spring Regional Meeting Minutes, International Purdue Workshops, Purdue University, 21-24 April 1980.

R.R. Shah, A.C. Capel, C.F. Pensom, *Distributed Terminal Support in a Data Acquisition System for Nuclear Research Reactors*, IAEA NPPCI Specialists' Meeting on Distributed Systems for Nuclear Power Plants, Chalk River, Proceedings AECL-7056, pp. 226-238, 14-16 May 1980.

A.C. Capel, G. Yan, *An Experimental Distributed System Development Facility*, IEEE Transactions on Nuclear Science, NS-24, pp. 395-400, February 1977.

Appendix B

CANTECH Database Profile

Appendix B

Business Profile

The CANTECH(tm) Database profiles over 3,700 Canadian manufacturers of high tech products and providers of high tech services.
The database encompasses such industries as factory automation, biotechnology, computer hardware and software, pharmaceuticals, telecommunications, advanced materials, defence products and energy systems among others. A proprietary classification system, developed exclusively for advanced technology, ensures that all companies are properly classified and easily retrieved.

Each corporate profile contains information on the firm's name, address, and contact numbers. Company size is determined by number of employees, sales revenues and R&D activity. Business activities are outlined in a brief paragraph or two. Also, included in each profile is a list of executives responsible for key areas such as President, sales, advertising, finance, buying, manufacturing, R&D and personnel. Profiles are updated annually, and versions of the Database are produced quarterly.

Appendix C

Experience in Telecommunications

Appendix C

Experience in Telecommunications

Among our projects, we have conducted major studies for the Canadian telecommunications industry including Bell Canada, Trans Canada Telephone System, the British Columbia Telephone Company, Canadian Radio-Television and Telecommunications Commission, Manitoba System and Edmonton Telephone System.

We have listed below a sample of related telecommunications projects which we have conducted around the world.

Bell Canada

Ernst & Young assisted Bell Canada in understanding, evaluating the responding to a variety of regulatory issues and concerns. Among the areas addressed by Ernst & Young for Bell Canada are costing methodologies and systems development, terminal equipment deregulation, rate design, competitive provision of telecommunications services and regulatory strategy. Our activities focused on the manner in which these issues unfolded in the United States; identifying the positions of interested parties, the types of arguments employed and data used, key decision variables, and the practically of the ultimate decision.

British Columbia Telephone Company

In preparation of anticipated CRTC hearings on whether MTS/WATS should be permitted in Canada, Ernst & Young was engaged by BC Tel to prepare two "white papers". The first addressed how the "contributing" component of MTS/WATS rates had been treated in the U.S. in light of the development of interchange competition and divestiture, focusing on the implications of U.S. developments for the Canadian environment. The second addressed the development of interchange resale in the U.S. and its role in facilitating the overall development of competitive markets.

Direct Broadcast Satellite (DBS) System

We carried out studies to determine the potential market size for a DBS system and to determine the industrial impacts from implementing a DBS system in Canada.

In addition, we investigated the price that users would be prepared to pay for the improved level of service that the satellite could provide. This included development of cost formulate to enable the replacement cost of an existing terrestrial mobile radio system to be compared with projected satellite service costs.

U.K. Government Networks

Ernst & Young have been retained by the Central Computer and Telecommunications Agency (CCTA) of HM Treasury to assist in the evolution of the Government Data Network (GDN, being implemented by Racal, into the integrated value-added Government Telecommunications Service (GTS). Our assignment has covered defining market and service requirements, tariff structures, tariff modelling, financial considerations and service valuation.

European Telecommunication Commissions

Organized, directed and chaired a political forum bringing together 250 senior executives from telecom suppliers and operations around the world to debate the European Commission's follow-on steps on its Green Paper on Community Telecommunications policy.

European Standards Committees

Our consultants have had numerous papers on networking and telecommunications published in trade and national journals, and they are also in demand to speak at networking and telecommunications conferences. Our Networking Group is an active member of the Centre for European Policy Studies (CEPS) working party on "Harmonisation and Liberalisation", the International Chamber of Commerce (ICC) working party on "Networking Security", and we have members on various OSI standards committees.

Joint U.S.-Canadian Mobile Communications Satellite Planning Study

Study of user requirements for mobile communications in rural and remote areas of Canada which covered mobile telephone, mobile radio paging communications, as well as data transmission and other requirements such as automatic vehicle location and computer aided dispatch. As well, the study developed projections to the year 2001 for the size of the potential market for satellite mobile communications services and analyzed the U.S. involvement in satellite mobile communications.

Telehealth

An in-depth investigation of the potential for telehealth applications in Canada which encompassed application of any telecommunications medium in the support of a wide range of health care activities including medicine, dentistry, nursing and allied health professionals. The service delivery media investigated included terrestrial systems such as telephone, cable, data networks and radio teleconferencing, as well as systems encompassing satellite communications technology.

Telecommunications Industry Selected Clients

The following is a list of selected clients we have provided consulting services to:

Alberta Government Telephones
Andrew Antenna
Bell Canada
CTG
Canada Development Corporation
Canadian General Electric
Communications Research Centre
Department of Communications
Industry, Science and Technology Canada
INMARSAT
Microtel
Miller Communications
Mitel
Mobile Data International
Motorola
NCR
National Research Council
Nothern Telecom
Ontario Ministry of Transportation and Communications
Ontario Research Foundation
Spar Aerospace
Telecommunications Terminal Systems
Teleglobe Canada
Telemedia
Telesat Canada
Terra Nova Tel

Appendix D

Employment Equity Certification

Employment and Immigration Canada | Emploi et Immigration Canada

FEDERAL CONTRACTORS PROGRAM FOR EMPLOYMENT EQUITY

AN IMPORTANT NOTICE FOR BIDDERS

The Federal Contractors Program for Employment Equity requires that some organizations bidding for federal government contracts make a formal commitment to implement employment equity*, as a pre-condition to the validation of their bids. Your organization is one of those covered by this program when

1. you are bidding for a goods and /or services contract worth $200,000 or more; and

2. you have 100 or more permanent part-time and/or full-time employees.

In such a case, proof of your commitment to implement employment equity must accompany your bid. Specifically, you must enclose with your bid either a signed Certificate of Commitment or, if you had earlier submitted a signed Certificate, quote the official number assigned to that Certificate by the Canada Employment and Immigration Commission. **Please note that, in the absence of a signed Certificate of Commitment, or of a Certificate number, your bid is liable to be rejected.**

By completing the form below, you can make a quick check of whether you are meeting the bidding requirements of the Federal Contractors Program. In cases where the Federal Contractors Program requirements do not apply (see reasons for exemption in form below), please check the applicable box. **In all cases, the completed form must be returned with your bid.**

* The criteria and other information about the Federal Contractors Program for Employment Equity, if not enclosed, are available upon request.

PROGRAMME DE CONTRATS FÉDÉRAUX POUR L'ÉQUITÉ EN MATIÈRE D'EMPLOI

AVIS IMPORTANT AUX SOUMISSIONNAIRES

En vertu du Programme de contrats fédéraux (PCF) pour l'équité en matière d'emploi, certaines entreprises soumissionnant des marchés fédéraux doivent s'engager formellement à mettre en oeuvre un programme d'équité en matière d'emploi avant que leurs soumissions puissent être validées. Les organisations suivantes seront assujetties à cette condition:*

1. *Celles qui soumissionnent un marché de biens ou de services d'une valeur de 200 000 $ ou plus; et*

2. *Celles qui ont 100 employés permanents ou plus, à temps partiel ou à temps plein.*

Les entreprises devront ajouter à leur soumission la preuve de leur engagement à mettre en oeuvre l'équité en matière d'emploi. Plus précisément, elles devront inclure une Attestation d'engagement remplie ou, si elles en ont déjà soumis une, indiquer le numéro officiel de l'Attestation qui leur a été accordé par la CEIC. ***Veuillez noter que les soumissions non accompagnées d'une Attestation signée ou d'un numéro d'Attestation pourront faire l'objet d'un rejet.***

En remplissant le formulaire ci-dessous, vous saurez rapidement si vous respectez les conditions du Programme des contrats fédéraux. Dans les cas où le PCF ne s'applique pas (voir les motifs d'exemption ci-dessous), veuillez cocher la case appropriée. ***Tous les soumissionnaires doivent retourner le présent formulaire avec leur soumission.***

** Si les critères d'application du PCF et les renseignements généraux ne sont pas inclus, on pourra les obtenir sur demande.*

NOTE - *VEUILLEZ NOTER*

ALL BIDDERS MUST CHECK THE APPLICABLE BOX(ES) BELOW.
TOUS LES SOUMISSIONNAIRES DOIVENT COCHER LES CASES APPROPRIÉES CI-DESSOUS

FAILURE TO COMPLETE AND RETURN THIS FORM WILL RENDER BIDS LIABLE TO BE REJECTED.
À DÉFAUT DE REMPLIR ET DE RETOURNER CE FORMULAIRE, TOUTE SOUMISSION POURRA FAIRE L'OBJET D'UN REJET.

[X] COPY OF SIGNED CERTIFICATE OF COMMITMENT IS ENCLOSED
COPIE DE L'ATTESTATION D'ENGAGEMENT EST INCLUSE

OR - *OU*

[X] CERTIFICATE NUMBER IS
LE NUMÉRO OFFICIEL DE L'ATTESTATION EST 60188

OR - *OU*

PROGRAM REQUIREMENTS DO NOT APPLY FOR REASON CHECKED BELOW
LE PROGRAMME NE S'APPLIQUE PAS POUR LES RAISONS SUIVANTES

[ ] BID IS LESS THAN $200,000
LA VALEUR DE LA SOUMISSION EST INFÉRIEURE À 200 000 $

[ ] THIS ORGANIZATION HAS FEWER THAN 100 PERMANENT PART-TIME AND/OR FULL TIME EMPLOYEES
NOTRE ORGANISATION COMPTE MOINS DE 100 EMPLOYÉS PERMANENTS, À TEMPS PARTIEL OU À TEMPS PLEIN

[ ] THIS ORGANIZATION IS SUBJECT TO THE EMPLOYMENT EQUITY ACT
NOTRE ORGANISATION EST ASSUJETTIE À LA LOI SUR L'ÉQUITÉ EN MATIÈRE D'EMPLOI.

NAME AND ADDRESS OF ORGANIZATION
NOM ET ADRESSE DE L'ORGANISATION

Ernst & Young
55 Metcalfe Street, Suite 1600
Ottawa, Ontario KIP 6L5

Canada

FEDERAL CONTRACTORS PROGRAM
CERTIFICATE OF COMMITMENT
TO IMPLEMENT EMPLOYMENT EQUITY

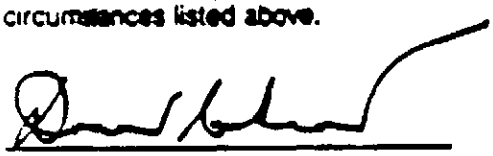
Clarkson Gordon (and related firms)

Name of Organization

The above-named organization hereby certifies its commitment to implement employment equity in the following circumstances:

1. the organization has a Government of Canada goods or services contract worth $200,000 or more; and
2. the organization has 100 or more permanent full-time and/or permanent part-time employees.

In such circumstances, the organization undertakes to implement employment equity in keeping with the Criteria for Implementation. This document, duly signed by the chief executive officer, constitutes a Certificate of Commitment which, under the Federal Contractors Program for Employment Equity, is a prerequisite for the validation of bids submitted in the circumstances listed above.



Signature of the Chief Executive Officer

October 16, 1986

Date

Donald C. Scott

Please Print Name

Public Accounting, Management Consulting

Industrial Sector

Clarkson Gordon (and related firms)

Organization

3,152

Number of Employees

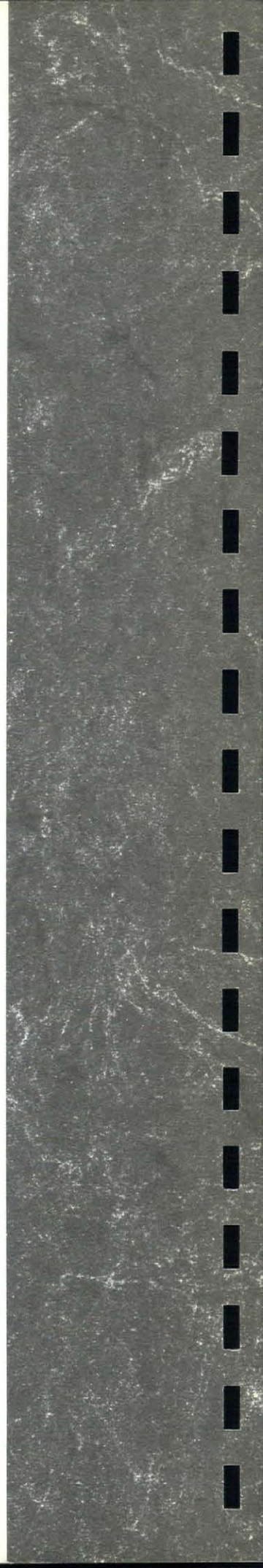
P.O. Box 251, TD Centre, Toronto, Ontario M5K 1J7

Address

(416) 864-1234

Telephone

Printed in Canada



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