

# IEEE

# Canadian Review



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The *IEEE Canadian Review* is published 3 times/year as follows: Winter (to appear in March); Spring/Summer (to appear in July); Fall (to appear in November). Its principal objective is to project an image of the Canadian electrical, electronics, communications and computer engineering professions and their associated academic and business communities to:

- (i) Canadian members of IEEE;
- (ii) Canadian members of the profession and community who are non-members of IEEE;
- (iii) the associated Canadian academic (i.e. universities, colleges, secondary schools), government and business communities.

To ensure that the *IEEE Canadian Review* has the desired breadth and depth, editors are responsible for screening articles submitted according to the following general themes:

- |                          |              |                   |
|--------------------------|--------------|-------------------|
| 1- National Affairs      | 4- Education | 6- Communications |
| 2- International Affairs | 5- Power     | 7- Computers      |
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Vijay K. Sood, Hydro-Québec

**O**ne of the reasons why I enjoy my role at the Review is the networking aspect with IEEE members and other technical people. Putting together a journal is a lot of hard work, and it is all voluntary work at that. Nobody forces it upon me, and yet I find myself working ever so hard to get the final product out. This issue is no exception. Having just returned from a prolonged vacation (in a hot hot country, far far away), it was not easy to come back to a pile of mail (mostly junk, and rude notes asking for money) and backed-up home, office, university and IEEE related work.

The job was made easier by all those very helpful people I had to deal with, and I mean that most sincerely. To name a few, Joan E from Extraordinary Conversations who worked tirelessly to put the lead paper together; my associate editor (Terry M) who finally came alive and forwarded a news item. Finally, I got a chance to visit Ottawa and meet associate editor (Vaidy C) face-to-face. President Dave Kemp was in Ottawa at the same time and I got to meet him and attend part of the EIC meeting.

The mailbox also finally kicked in at IEEE and we had letters, emails and phone calls from members about the previous issue of the Review. Some of these letters are published in this Review; it is very heartening to know that there is life out there somewhere! and the Review is being read (warts and all).

I ask you again for your interesting papers and stories, adverts and what-have-you to include in the Review. Please contact me or one of the associate editors (preferably) for any information you may need. Adverts are always welcome. The **Consultants Corner** (see announcement on page 8) is open for business, please use it. Tutorials on some special interesting topics are something I would like to explore for forth-coming Reviews. If you have any ideas (Slawo, are you reading this?), please call me.

Finally, since it will soon be Xmas (at the pace I am moving, it will be here sooner than I think), I leave you with this seasonal greeting: All the Best for the Holiday Season!



The cover photo shows Nortel Networks DMS SuperNode digital switch located at the company's Customer Network Solution Centre at its corporate head office in Brampton, Ontario. These switches are used in telco central offices and corporations around the world to reliably switch millions of calls every second of every day. Nortel's switching products lead the industry in computing reliability and dependability as reported quarterly by the FCC. Fault tolerant product knowledge was shared with Motorola to successfully expand product portfolios of both companies.

### Cover picture Photo de couverture



**L'**une des raisons pour laquelle j'aime le travail que je fais pour la « Canadian Review » est qu'il m'offre la possibilité de collaborer avec des membres de l'IEEE et avec d'autres personnes-ressources techniques. Éditer une revue n'est pas une mince tâche et en plus il s'agit de bénévolat. Personne ne m'oblige à faire ce travail, mais c'est plus fort que moi -- je travaille d'arrache-pied pour livrer la marchandise! Le présent numéro ne fait pas exception. Étant tout juste de retour d'un long congé (dans un pays chaud et lointain), il m'a été très difficile de faire face au courrier accumulé (en général de la publicité-rebut et des demandes de fonds) et de m'attaquer au travail qui s'était amassé à la maison, au bureau, à l'université et à IEEE. Ce qui m'a facilité la tâche, ce sont tous les gens très sympathiques avec qui j'ai eu la chance de travailler. Sans nommer tout le monde, il faut souligner le travail extraordinaire accompli par Joan E., qui a œuvré sans relâche à la préparation de l'article principal, ainsi que Terry M., adjoint à la rédaction, qui est enfin sorti d'hibernation et m'a envoyé un article d'actualité. De plus, j'ai eu l'occasion d'aller à Ottawa et de rencontrer en personne Vaidy C., un autre adjoint à la rédaction. Le président Dave Kemp était à Ottawa à ce moment-là et j'ai eu la chance de le rencontrer ainsi que d'assister à une partie de la réunion du Conseil du ICI avec lui.

La boîte à courrier de l'IEEE a enfin commencé à se remplir et nous avons reçu des lettres, du courrier électronique et des appels des membres au sujet du numéro précédent du journal. Vous trouverez quelques-uns de leurs commentaires dans le présent numéro; c'est très encourageant de savoir que nous réussissons à rejoindre les membres et qu'ils prennent le temps de lire ce journal (malgré tous ses défauts!).

Encore une fois, je vous invite à soumettre vos articles, faits divers, publicité et autres. Veuillez communiquer avec moi ou avec un de mes adjoints à la rédaction (de préférence) pour avoir des renseignements supplémentaires. Il va sans dire que vos annonces sont les bienvenues. Le Coin des Consultants (voir l'annonce sur page 8) est en marche et je vous invite donc à vous en servir.

De plus, j'envisage la possibilité d'organiser des tutoriels sur des sujets d'intérêt particulier. Si vous avez des suggestions à ce propos, veuillez communiquer avec moi. Enfin, il sera bientôt Noël (avec un horaire chargé comme le mien, j'ai bien peur que Noël arrive encore plus vite!) et je voudrais vous offrir mes meilleurs vœux pour la saison des Fêtes!

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## IEEE Prepares For The Future / IEEE se prépare pour l'avenir

**C**hallenges and opportunities abound as IEEE approaches the new millennium. A few of these are addressed below.

We describe ourselves as global and struggle to define what that means to members worldwide and to the various IEEE major Boards (Technical, Regional, Educational, Publications and Standards). We wrestle with the issue of varying monetary currencies as well as representative participation and decision making.



by/par Dave Kemp, FEIC, President of IEEE Canada - 1998

Electronic publishing and the Web are transforming commerce and traditional paradigms every day. IEEE is defining new ways to use these capabilities to shorten the interval to publication, provide member access, and yet preserve intellectual property and associated revenues.

We continue the quest to enhance member services and values. The Financial Advantage Program continues research into benefits which can be offered both globally and to specific niches. Were it not for restrictive and limiting regulations at state, provincial, and national levels, the programs would be more universally available. A new benefit is currently being piloted in IEEE Canada, namely an interpersonal leadership skills development workshop. In late September, the first offering took place in Toronto. The results were sufficiently encouraging that the leaders are striving to define the delivery mechanisms for this to be rolled out thus offering value to members as well as industry.

The IEEE name and logo are universally identifiable. Recent research has shown however, that not all members or potential members relate to it. As a result, in November the Board approved initiatives to evaluate, refine and improve the value of identity of various branding images and policies.

At the same Board meeting, a new standards organization was approved; the IEEE Industry Standards and Technology Organization (ISTO). Incorporated under a different legal provision than IEEE, it will enable more responsive and industry partnership approaches to the rapidly evolving standards arena.

Most of you are familiar with the technical programs offered by our local Chapters. To broaden their scope and reach, new provisions have been enabled to allow for local groups, papers and networking in topical areas such as recent graduates, women in engineering, consultants networks and life members.

For more information, I encourage you to visit the 1998 Institute Strategies for the Future Web page at [www.ieee.org/strat\\_plan/isf98](http://www.ieee.org/strat_plan/isf98). While on the Web, check out the home pages [www.ieee.org](http://www.ieee.org) as well as [www.ieee.ca](http://www.ieee.ca). There you will discover some of our more recently implemented services, programs and publications.

I hope I have demonstrated how IEEE is preparing for the future. It does so primarily through the tremendous efforts of volunteers collaborating with staff. If you would like to become involved in these new and exciting activities, please contact me at [d.kemp@ieee.org](mailto:d.kemp@ieee.org).

**New!!**

### IEEE Canadian Review on the Web

As an experiment, articles published in the *IEEE Canadian Review* will be translated into the alternative official language and be available on the World Wide Web at the following URL address:

<http://www.ieee.ca>

**A** l'aube de l'an 2000, les défis abondent à l'IEEE. Nous en examinerons quelques-uns dans les lignes qui suivent.

L'IEEE est une organisation internationale aux prises avec toutes les difficultés que cela comporte pour ses membres dispersés partout dans le monde et ses principaux conseils d'administration (les Activités techniques, régionales et éducatives, les Publications et les Normes). Les devises étrangères, la participation représentative et la prise de décisions équitables, voilà autant de questions auxquelles nous devons faire face.

L'édition électronique et internet transforment sans cesse le commerce et nos paradigmes. À l'IEEE, nous sommes à la recherche de nouvelles façons d'utiliser ces moyens de communication pour raccourcir les délais de publication et favoriser l'accessibilité aux membres, tout en préservant la propriété intellectuelle et ses revenus connexes.

Nous poursuivons l'objectif d'améliorer les bénéfices et les services offerts aux membres. Dans le cadre de notre Programme d'avantages financiers, nous sommes constamment à la recherche d'outils qui peuvent être offerts à l'échelle mondiale ou à des groupes cibles. Si ce n'était des restrictions imposées par les états et les gouvernements provinciaux et nationaux, ces programmes pourraient être offerts sur une base plus universelle. Un nouveau projet présentement à l'essai à l'IEEE Canada permettra d'offrir aux membres des séances de formation où ils pourront améliorer leurs aptitudes en matière de leadership interpersonnel. Le premier atelier a eu lieu à la fin du mois de septembre, à Toronto. Les résultats ont été tellement encourageants que les organisateurs cherchent maintenant à mettre en place les mécanismes nécessaires pour étendre ce service à ses membres et à l'industrie.

Le nom et le logo de IEEE sont reconnus de façon universelle. Cependant, des études récentes ont montré que tous les membres ou futurs membres ne s'y identifient pas nécessairement. Pour remédier à cette situation, le Conseil a approuvé, en novembre, des initiatives visant à évaluer, raffiner et améliorer les différentes images de marque de l'organisation.

À cette même réunion du Conseil, on a approuvé la création d'un nouvel organisme de normalisation; soit l'Industry Standards and Technology Organization (ISTO) de l'IEEE. Cet organisme, constitué en personne morale sous un nom différent de celui de l'IEEE, permettra de mettre sur pied des approches plus réceptives et davantage axées sur un partenariat avec l'industrie dans le domaine des normes, un domaine qui évolue rapidement.

La plupart de nos membres connaissent déjà les programmes techniques offerts par nos chapitres locaux. Afin d'élargir l'étendue de tels programmes, on a mis en place de nouveaux moyens permettant de favoriser la formation de groupes locaux, la rédaction d'articles et le réseautage dans des secteurs cibles tels que les nouveaux diplômés, les femmes ingénieurs, les réseaux de consultants et les membres à vie.

Pour avoir plus de renseignements, nous vous invitons à consulter la page Web intitulée 1998 Institute Strategies for the Future à [www.ieee.org/strat\\_plan/isf98](http://www.ieee.org/strat_plan/isf98). Pourquoi ne pas en profiter pour visiter nos pages d'accueil, à [www.ieee.org](http://www.ieee.org) et à [www.ieee.ca](http://www.ieee.ca)? Vous y découvrirez quelques-uns de nos plus récents services, programmes et publications.

J'espère vous avoir donné un aperçu des démarches entreprises par l'IEEE pour se préparer au monde de demain. C'est surtout grâce aux efforts des bénévoles qui travaillent en collaboration avec le personnel de l'IEEE que nous pourrions atteindre nos objectifs. Si vous souhaitez participer à des activités à la fois nouvelles et captivantes, n'hésitez pas à communiquer avec moi à [d.kemp@ieee.org](mailto:d.kemp@ieee.org).

# Une nouvelle approche pour un nouveau défi de formation des informatici(e)nes au Canada

## 1. Défi: pénurie de main-d'œuvre, forte croissance des TI, chômage d'ingénieurs et limites des circuits conventionnels de formation

**L**e contexte social et économique des Technologies de l'Information (TI) au Québec, au Canada et d'une façon générale en Amérique du Nord, se résume ainsi. Le secteur des technologies de l'information est celui qui enregistre la plus forte croissance, qui est le plus touché par la pénurie de main-d'œuvre qualifiée et pour lequel les circuits classiques de formation (universités, centre de formation, etc.) ne peuvent fournir à très court terme la main d'œuvre dont dépend sa croissance.

### A. Forte croissance du secteur des technologies de l'information

En 1995, le secteur des TI employait au Canada 415 217 personnes, soit 3 % de la population active canadienne. Avec un taux de croissance de l'emploi de 15 % entre 1990 et 1995, les TI font excellente figure parmi les différents secteurs d'activités économiques du Canada (tableau 1). Ce sont en particulier deux sous-secteurs qui sont responsables de cette croissance: l'industrie de l'équipement des télécommunications, avec une croissance de l'emploi de 48,1 %, et le secteur des services logiciels et informatiques, avec une croissance phénoménale de 72,1%. Dans ce dernier cas, soulignons que pour 1994-1995, dernières années pour lesquelles des données sont disponibles, la croissance de l'emploi a atteint 24,5% sur un an..

TABLEAU 1. La Croissance de L'emploi (Canada)

| SECTEUR  | 1990-95 | 1994-95 |
|--|---------|---------|
| Industrie de l'équipement des télécommunications | 48,1 %  | 14,1 %  |
| Services logiciels et informatiques              | 72,1 %  | 24,5 %  |
| TOTAL DU SECTEUR TI (tous les sous secteurs)     | 15 %    | 13,8 %  |

Source: Industrie Canada - Secteur TIC données agrégées 1990-1995

Les services logiciels et informatiques constituent donc le secteur d'activité qui, de loin, connaît la plus forte croissance de l'emploi. Dans ce secteur, de 1991 à 1995, la croissance de l'emploi observée au Québec suit les mêmes tendances que pour l'ensemble du Canada. De l'avis de tous les observateurs et intervenants, cette tendance de forte croissance est là pour durer encore plusieurs années.

### B. Pénurie de main-d'œuvre en technologies et ingénierie de l'information et du logiciel (TI)

Plusieurs indicateurs révèlent que la pénurie de main-d'œuvre qualifiée dans ces secteurs est critique, qu'elle est d'une grande envergure et qu'elle ne va pas se résorber tout naturellement au cours des prochaines années si rien n'est entrepris pour la contrer. Sans être exhaustives, les enquêtes suivantes donnent un aperçu de cette pénurie:

- Une analyse récentes commanditée par Développement des Ressources Humaines Canada [1] sur les principales problématiques du marché du travail de l'Île de Montréal, indique qu'il y a une sérieuse insuffisance de main-d'œuvre pour les professions d'ingénieur informaticien, analyste des systèmes informatiques et programmeur. Il s'agit là de professions présentant des difficultés de recrutement qui nécessitent de la nouvelle main-d'œuvre et pour lesquelles il est donc

par *Ahmed Seffah*

*Centre de recherche informatique de Montréal*

Dans le présent article, nous présentons le contexte et les principes directeurs de notre réflexion sur les nouveaux défis dans la formation continue des ingénieurs. Notre travail est mené, entre autres, dans le cadre du projet PRISE (Programme de Réorientation des Ingénieurs Sans Emploi) mis en place par le Centre de recherche informatique de Montréal (CRIM) en collaboration avec l'ordre des ingénieurs du Québec (OIQ). PRISE vise à «transformer» des ingénieurs en informaticiens afin de répondre aux défis suivants:

- diminuer la pénurie de main-d'œuvre qualifiée qui touche (ou touchera d'ici l'an 2000) plus de 80% des entreprises du secteur des technologies de l'information au Canada,
- maximiser les retombées de l'investissement consenti pour la formation continue à l'heure des coupures budgétaires et de la remise en question de la relation augmentation de productivité/informatisation des organisations,
- pallier aux difficultés, voire à l'incapacité, d'adaptation rapide de l'enseignement universitaire particulièrement dans un contexte où les technologies de l'information évoluent d'une façon rapide, continue et perpétuelle.

In this article, the context and the conceptual framework of our work on continuing education in software and information engineering is discussed. Our work has partly been undertaken within the project PRISE (Programme de Réorientation des Ingénieurs Sans Emploi) developed by the Computer Research Institute of Montreal (CRIM) in collaboration with several organizations. The objective of PRISE is to retrain engineers into software and information engineering in order to respond to the following industry challenges and needs:

- Decrease the shortage of skilled labour which affects or will affect by 2000 more than 80% of the companies in the information technology industry in Canada,
- Maximise the benefits of approved investments for continuing education at a time of financial cutbacks and questioning over the correlation between improved productivity and investments in tools;
- overcome the problems, indeed the inability, of universities to rapidly adapt to the rapid, continuous, and continuing changes in the field of information technology.

possible d'intervenir en formant des travailleurs sans emploi qui possèdent les préalables nécessaires. La Société québécoise de développement de la main-d'œuvre (SQDM) corrobore cette analyse,

- Une étude (1995) du Conseil canadien des ressources humaines du logiciel (CCRHL) établit, pour le seul secteur des logiciels et services conseils, que 173 000 personnes au Canada y travaillaient en 1995. Or ce même secteur aura besoin, selon les estimations du CCRHL, de quelque 325 000 personnes qualifiées au tournant du siècle pour maintenir sa croissance [2],
- Une enquête récente, menée par la firme Angus Reid pour le compte de la «Canadian Advanced Technology Association» (CATA), révèle que la grande majorité (88%) des entreprises membres anticipent une pénurie de main-d'œuvre TI à brève échéance, alors que 54 % disent offrir actuellement des postes qu'ils ne peuvent combler [3]. Selon la CATA, il y aurait actuellement au Canada quelques 16 000

postes disponibles en TI. On peut comparer ce chiffre à celui avancé par la Information Technology Association of America (ITAA), qui estime à 190 000 le nombre de postes en TI non comblés dans les grandes et moyennes entreprises américaines,

- Le marché de l'emploi est en effervescence, pour ne pas dire en guerre. Par exemple, il suffit de parcourir les rubriques «Carrières et professions» des journaux ou les banques d'emploi qu'on trouve sur Internet pour prendre conscience de l'importance et de la variété de l'offre dans le domaine des TI. Les services de recrutement des entreprises doivent prendre des mesures tout à fait exceptionnelles pour tenter de combler les milliers de postes qui ne trouvent pas preneurs actuellement, parmi lesquels on retrouve aussi bien les raids chez les compétiteurs que l'établissement de partenariats internationaux et, conséquemment, l'exportation du travail dans d'autres pays.

L'une des mesures prises par les organisations confrontées avec cette pénurie de main-d'œuvre qualifiée, consiste à recruter à l'étranger. Or, dans cette course autour du monde, le Canada ne part pas gagnant. La valeur de la devise canadienne et le niveau de salaire consenti ne permettent pas de soutenir la concurrence américaine. Bien plus, nombre de jeunes canadiens diplômés, fortement sollicités par le géant du sud, acceptent d'aller y faire carrière, ce qui contribue d'autant à l'aggravation de la crise au Canada.

### C. Incapacité de l'université et des centres de formation de l'industrie à atténuer cette pénurie

Sans vouloir mener ici une analyse profonde des causes de cette pénurie, on peut toutefois rappeler que la mondialisation des marchés et la déréglementation (dans le domaine des télécommunications, par exemple) ont pour beaucoup contribué à l'émergence du phénomène.

Face à une telle pénurie et une telle croissance, le nombre de diplômés qui sortent des programmes universitaires en informatique au Canada demeure stable. Les universités québécoises forment de 700 à 750 personnes par année, alors que, selon les estimations de la CATA, 4 000 postes en TI ne seraient pas comblés actuellement au Québec. Aux États-Unis, on a assisté, au cours de la dernière décennie à une baisse dramatique des inscriptions aux programmes en sciences informatiques, créant ainsi une pression énorme non seulement sur le marché américain, mais aussi sur le marché canadien.

Plus fondamentalement encore, l'image que les jeunes se font de l'exercice d'un métier dans le domaine des TI est nettement négative. Il s'agirait d'ailleurs là d'un symptôme de désaffection plus généralisée des jeunes pour les sciences et la technologie. Les collèves et les universités éprouveraient d'énormes difficultés à faire le plein d'étudiants.

Sur un autre plan, plusieurs études affirment que l'enseignement reçu par les étudiants dans un cycle universitaire devient obsolète avant la fin de leur scolarité [4]. Cette situation est particulièrement alarmante dans le secteur de l'ingénierie. L'éternel débat, dans les universités américaines, sur le langage de programmation à enseigner, est une manifestation concrète de ce phénomène.

Par ailleurs, le besoin des entreprises s'oriente de plus en plus vers une main-d'œuvre à la fois spécialisée et pluridisciplinaire. Par exemple, on souhaite que les professionnels du développement logiciel puissent concevoir des applications qui exigent, en plus de compétences techniques poussées, une connaissance approfondie du domaine (médecine, chimie, etc.) voire même des habilités en marketing et en gestion [5,6].

À notre avis, aucune approche et/ou cadre de formation continue n'est en mesure d'apporter une solution rapide, efficace et efficiente à cette impasse. Les nouvelles tendances en éducation (formation juste à temps, apprentissage de la tâche, éducation sans frontière, organisation apprenante, société du savoir) sont des éléments, qui poussent aussi à repenser notre façon d'enseigner, d'apprendre et de partager le savoir.

### **2. Approche: un curriculum à la carte, une pédagogie centrée compétences, un environnement de formation exploitant les nouvelles technologies de communication et d'information**

Le projet PRISE proposé par le Centre de recherche informatique de Montréal, en collaboration avec l'ordre des ingénieurs du Québec, se situe dans le cadre de ce contexte. Ce projet a pour principal objectif de transformer des ingénieurs en professionnels de l'informatique. Les participants à ce programme sont des ingénieurs en chômage et/ou provien-

nant de disciplines dont la croissance est en baisse (génie civil, architecture, etc.). La transformation devra être faite en un an maximum. La première promotion débutera à l'automne 1998.

Plus qu'un défi de formation, ce programme exige l'implication de chercheurs afin de trouver et de mettre en place une nouvelle approche de formation capable de répondre à ce défi. Le projet mise sur les ingrédients suivants pour atteindre ces objectifs:

1. un curriculum axé sur les nouvelles technologies de l'information,
2. un fonctionnement corporatif qui alterne stages pratiques et cours intensifs,
3. une approche de formation centrée les compétences,
4. un médium de diffusion de formation et de communication basé Internet.

Le curriculum exploite la large gamme des NTIC, particulièrement l'Internet, comme support d'un système de formation personnalisé et personnalisable. On souhaite que chaque stagiaire puisse élaborer son propre cheminement dans le curriculum et l'adapter ainsi à ses propres objectifs et à son propre rythme d'apprentissage.

Dans ce qui suit, nous allons donner un aperçu des fondements de l'approche proposée.

#### A. Un curriculum axé sur les nouvelles technologies de l'information

Le contexte que nous avons présenté ne laisse aucune chance à un curriculum fermé de type «menu fixe». Chaque étudiant devra, en fonction de son expérience personnelle comme ingénieur et de son bagage théorique, se créer son propre curriculum en composant dans un large éventail de cours afin de pouvoir exercer les fonctions rattachées à l'une ou l'autre des deux options suivantes:

- **Administrateurs de réseaux de communication**, conduisant par exemple à des fonctions d'installation et de configuration de systèmes informatiques, de maintenance et support technique, et d'administration de systèmes distribués et de réseaux,
- **Développeurs logiciels**, conduisant par exemple à des fonctions de conception, d'analyse, de programmation, de mise à l'essai, de rédaction technique, d'implantation, de logiciels.

Ici déjà, il y a un premier défi de taille en terme de moyens et de logistique à fournir afin de supporter pédagogiquement les étudiants dans un curriculum aussi large, ouvert et avec des débouchés très diversifiés. À titre d'exemple, le cursus développeur logiciel peut conduire à exercer les fonctions de travail d'analyste programmeurs, testeur de logiciels, concepteur d'interface graphique, programmeur de réseaux de télécommunications, etc. Dans le cadre du projet PRISE, le curriculum à la carte est rendu possible en partie grâce à un vaste catalogue de cours offerts par CRIM Formation depuis plus de dix ans (<http://www.crim.ca/formation>). Ces cours sont organisés en deux sessions (Automne, Hiver) avec plusieurs séances de chaque cours (minimum de trois) à chaque session. Cela donne la possibilité à l'étudiant de suivre, quand il le faut le cours qu'il lui faut.

#### B. Un fonctionnement qui alterne stages pratiques et cours intensifs au CRIM

Le programme de formation comportera un stage en entreprise d'une durée de six mois. Il s'agira d'un véritable stage d'apprentissage et d'intégration au marché du travail. Ce mode de formation qui alterne stages/cours est une approche qui fait ses preuves dans les facultés de génie des universités nord-américaines. Les facultés de génie correspondent aux écoles d'ingénieurs françaises.

Durant le stage, l'étudiant continuera à suivre des cours intensifs au CRIM. Le problème qui se pose alors se rapporte à:

- l'identification des besoins qui justifient que l'étudiant a besoin de suivre telle ou telle formation,
- l'évaluation des connaissances des étudiants puisque qu'officiellement il n'y a aucun examen dans le curriculum,
- l'accréditation du programme par les instances gouvernementales et/ou privés.

L'équipe pédagogique mise en place par le CRIM, de concert avec les entreprises partenaires, s'assurera de l'encadrement et du suivi individuel

des stagiaires. L'Ordre des ingénieurs du Québec maintiendra un contact périodique avec ses membres participant afin de s'assurer de l'adéquation du programme de formation à leurs besoins réels. Par ailleurs ce type programme devra aussi offrir des séances d'information et de préparation aux concours de certification proposés par des:

- entreprises (MICROSOFT, ORACLE, etc.),
- associations comme l'ordre des ingénieurs du Québec, Institute for Certification of Computer Professionals (<http://www.iccp.org>).

La crédibilité du programme se construira par le biais de ce type certification.

### C. Une approche formation centrée compétences

Dans son approche systémique et dynamique, la compétence et la mobilisation ou activation de plusieurs types de savoir dans une situation et un contexte donnés:

- savoir théorique (savoir comprendre, savoir interpréter),
- savoir comment procéder, savoir procéder, savoir opérer,
- savoir-faire expérimental (savoir y faire, savoir y voir),
- savoir-faire social (savoir se comporter, savoir se conduire),
- savoir-faire cognitif (savoir traiter l'information, savoir raisonner, savoir nommer ce que l'on fait, savoir apprendre).

La compétence est définie comme une séquence de comportements coordonnés qui est normalement efficace par rapport à ses objectifs. Mais le terme compétence a évolué pour désigner aujourd'hui une habileté acquise grâce à l'assimilation d'informations pertinentes et à l'expérience. Il s'agit d'un savoir-faire ou une qualification reconnus qui permettent de circonscrire et de résoudre des problèmes spécifiques relevant d'un domaine précis.

C'est exactement cette approche que le projet exploite. Concrètement, cela se traduit de la manière suivante dans la définition du curriculum de formation:

- A- Analyser soigneusement, avec l'étroite collaboration des partenaires du milieu du travail, le travail qu'auront à accomplir les futurs professionnels et l'environnement dans lequel ils opéreront,
- B- Déterminer les compétences (connaissances, habiletés, attitudes et comportements) requises pour l'exercice du travail identifié,
- C- Considérer ces compétences comme étant les objectifs opérationnels que le curriculum devra permettre d'atteindre.

Sur un autre plan, l'approche par compétences est intimement liée à une pédagogie qui favorise l'acquisition d'un savoir agir de l'étudiant. Dans une telle approche, les études de cas, la résolution de problèmes et la réalisation de projets analogues à ceux rencontrés sur le marché du travail se situent au cœur de la démarche d'apprentissage.

Pour réussir dans cette approche pédagogique, deux exigences préalables doivent être satisfaites:

- 1- Les participants au programme doivent posséder des aptitudes et qualités personnelles requises pour une intégration harmonieuse au monde des technologies de l'information,
- 2 - La participation de formateurs du monde universitaire ne peut être considérée que si ces derniers possèdent une expérience professionnelle des milieux de travail. Le projet PRISE prévoit une «formation des formateurs du programme» afin de permettre à ces derniers de s'approprier le programme et de concerter leurs efforts dans l'esprit de l'approche.

### D. L'Internet comme médium privilégié de diffusion de formation et de communication

Dans une vision simpliste et simplifiée, l'Internet peut servir de médium à la diffusion d'information pouvant favoriser l'intégration des stagiaires. Cela consiste, par exemple, à distribuer de l'information sur:

- l'échéancier, les listes des cours, les syllabus,
- les manifestations et colloques,
- les références bibliographiques,

- les ressources d'appoint en libre service (manuels de cours en ligne, présentation multimédia, etc.).

Dans cette même vision, l'Internet facilite la communication entre étudiants et/ou professeurs. La mise en place de listes de messagerie permettra, entre autres, de supporter:

- l'échange d'expériences et savoir-faire entre étudiants inscrits au même programme mais qui ne se connaissent pas nécessairement (présence aux cours à des séances différentes),
- la diffusion rapide et personnalisée de l'information du professeur vers les étudiants et inversement.

Déjà à ce plan les avantages sont majeurs. Le tableau 2, présente une comparaison abrégée entre un cours en salle et un cours diffusé via l'Internet.

TABLEAU 2. Cours traditionnel versus cours virtuel: quelques contrastes

| Cours traditionnels  | Cours virtuels  |
|--|---|
| - Parler et écouter  | - Taper et lire   |
| - En général, le professeur parle et les étudiants écoutent (à priori...)                                | - Plusieurs étudiants peuvent s'exprimer en même temps, via un groupe de discussion par exemple   |
| - L'ensemble d'étudiants est supposé avancer au même rythme d'apprentissage                              | - Chaque étudiant peut avancer à son propre rythme et selon ses objectifs. Il établit son propre cheminement  |
| - Lieu et horaire définis pour les cours   | - Quand on veut, là où l'on le désire   |
| - Devoirs faits principalement individuellement  | - La majorité des exercices et des devoirs sont faits en groupe   |
| - L'étudiant doit prendre des notes  | - Les notes de cours sont envoyées automatiquement et elles sont disponibles en mode révision   |
| - En règle générale, très peu de ressources d'apprentissage sont disponibles en plus des notes de cours. | - L'étudiant bénéficie d'une très large librairie de ressources disponibles sur le Web. Cet éventail est construit dynamiquement au fur et à mesure que le cours en ligne est utilisé. Même les étudiants peuvent participer à l'enrichissement de la librairie |

### E. Une vision plus poussée: l'Internet comme système à la fois de formation et de travail

Devançant ses utilisations de base, l'Internet est un environnement intégrateur de plusieurs applications, novateur et économe aussi bien que dynamique, ouvert, distribué et accessible. Cet environnement combine différents médias de formation (classes distribuées, multimédia, etc.), les outils de l'Internet (messagerie électronique, fureteurs, logiciels basés Internet, etc.) et les systèmes intelligents de formation basés sur l'ordinateur (tuteurs intelligents, systèmes conseillers, compagnons, critiques). Les outils proposés sont destinés aussi bien pour les travaux des étudiants qu'au suivi pédagogique effectué par les professeurs.

L'étudiant, aussi bien que professeur, grâce à un outil de configuration qui fera parti de l'environnement, pourra adapter les outils et contenus à ses propres préférences et besoins. L'accès à cet environnement se fait à travers une interface unique à:

- des outils pour la diffusion et la consultation des contenus pédagogiques,
- des outils pour la communication et le partage de savoir-faire,
- un système d'aide à l'évaluation de connaissances et au suivi pédagogique des étudiants,

- une bibliothèque virtuelle qui offrira tous les services d'interrogation et de consultation de bibliothèques virtuelles et de centres de documentation,
- des outils que l'étudiant ou le professeur utilise habituellement dans son travail (langages de programmation, librairies logicielles). Plusieurs produits et projets en cours illustrent cette tendance. Parmi ceux-ci, nous citerons particulièrement l'architecture OLA (Oracle Learning Architecture) développé par Oracle pour supporter ses activités de formation. Plus de 150 cours en ligne sur différents aspects de l'ingénierie des TI sont disponibles dans OLA et accessibles via un extranet (<http://ola.oracle.com>).

On ne peut passer une telle occasion sans mentionner le projet LearnShare (<http://www.learnshare.com>) mis sur pied aux États-Unis et qui vise à mettre en commun des ressources d'apprentissage des plus grandes entreprises américaines. Le projet LearnShare vise à construire un environnement virtuel pour partager des ressources d'apprentissage afin maximiser la performance et minimiser l'investissement.

### 3. Défis et travaux de recherche et développement

Dans cet article, nous avons présenté le contexte au Canada et d'une façon générale en Amérique du Nord dans le domaine de la formation des informaticiens à l'aube des NTIC. Nous avons vu que, dans leur fonctionnement actuel, les circuits de formation conventionnels ne sont pas en mesure de fournir rapidement une issue acceptable pouvant soutenir la forte croissance du secteur des TI et en même temps, atténuer le chômage dans les autres disciplines de l'ingénierie. Nous avons ensuite décrit les lignes directrices de l'approche qui a été considérée dans le cadre du projet PRISE. Ce projet se fonde et profite de nos recherches sur la formation et l'utilisation des NTIC comme plate-forme de formation. Sans être exhaustif, les exemples suivants sont représentatifs:

- SAGE-ISO : un système pour la diffusion d'information sur la norme ISO, la distribution juste à temps de ressources de formation et d'aide à la tâche. Ce système est effectivement utilisé par le CRIM pour supporter sa certification ISO 9001 et son processus assurance qualité,
- Plusieurs études sur les pratiques de formation dans organisations de développement logiciels et sur les architectures d'environnements de formation basés Internet,
- Des expériences de mise en ligne de cours provenant principalement de la division formation du Centre de recherche informatique de Montréal, particulièrement dans le cadre des cours suivants: création de pages Web, conception de sites Web de nouvelle génération, atelier de conception ergonomique pour le Web et enfin développer un intranet/extranet.

Cependant, afin de tirer profit du potentiel présumé de la formation via Internet, plusieurs questions devront être considérées. Le tableau 3 résume les principales questions que nous avons identifiées et auxquelles une réponse globale et cohérente devra être apportée.

TABLEAU 3. Les questions critiques au coeur du processus de développement d'une infrastructure Internet pour la formation

|   |   |
|---|---|
| 1 | Quels sont les besoins de formation pour lesquels l'Internet est en mesure d'apporter une solution efficient ?  |
| 2 | Quelle est la stratégie pédagogique la mieux appropriée à la formation en ligne ? Existe-t-il réellement une stratégie de formation en ligne?                           |
| 3 | Quels sont les facteurs permettant de mesurer les coûts/bénéfices à posteriori de l'environnement Internet de formation et de son contenu (ressources d'apprentissage)? |
| 4 | Quelle est l'architecture technologique la mieux appropriée pour l'implantation de l'environnement?   |
| 5 | Quelles sont les stratégies qui peuvent faciliter la transition vers ce nouveau type d'environnement et favoriser l'adhésion des apprenants?                            |
| 6 | Comment favoriser l'intégration de l'environnement au système d'information et de formation?  |

### 4. Références

- [1]. Développement des ressources humaines Canada. Les principales problématiques du marché du travail de l'Île de Montréal, 1997-1998.
- [2]. Software Human Resource Council. Software and National Competitiveness: An Overview, 1996.
- [3]. CATA - Angus Reid. Information Technology Skills Shortage Survey, 1997.
- [4]. Blake, I, Jarvenpaa, S.L. (1996). "Will the Internet revolutionize business education and research?" Sloan Management Review. Spring Issue.
- [5]. Baker, S. The Global Search for Brainpower. Business Week, août 1997.
- [6]. Barlas, Stephen. How Critical Is the Shortage of IT Workers? Computer, mai 1997.

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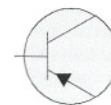
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# Teamwork Creates "Made In Canada", Next Generation Telecom Solution

## 1. Introduction

**G**lobal deregulation of telecommunications, privatization, and the growing number of multiple service providers continues to stimulate competition and growth within the telecommunications sector. Established and emerging service providers alike are demanding world-class technology and reliable network solutions to meet the needs of all network applications.

Extensive market research conducted by Nortel Networks showed that service providers wanted enhanced operation, administration, maintenance and provisioning (OAM&P) capabilities. Telephone companies needed to significantly enhance their ability to manage expanded billing and service tasks in near real time - obligations largely being driven by the global market changes, such as local number portability and deregulation.

Nortel's 1995 analysis of where network evolution was heading also considered advances in the internet, intranet and TCP/IP capabilities and trends in computing technology where computing costs were dropping and computing capacity was increasing. Central office switches continue to get larger, with features and capabilities expanding at an increasing rate. As a result, overall data generation is growing, more billing information is produced and data warehousing initiatives are underway.

## 2. State Of The Art

Worldwide deregulation of the telecommunications industry has attracted many new service providers to the business who have limited expertise in operating and administering central office switches. Established carriers and network operators are also beginning to augment high capacity, centralized "Operational Support Systems" (OSS), with a client/server architecture, thus there is more distributed computing available on the desktop and in the network.

Based on this customer intelligence, Nortel's challenges included:

- Connectivity via TCP/IP, not point to point or X. 25
- Significant increase of data through put in and out of switches
- Deregulation/competition driving simplification
- Traditional user moving from ASCII terminal to workstation/PC on the desktop

## 3. Specification Objectives -- Nortel

The Nortel SuperNode Data Management (SDM) team concluded that adding a dedicated Operations, Administration, Maintenance and Provisioning (OAM&P) platform to the DMS architecture was the logical next step in the product's evolution. The team's challenge was that call processing is a "real time" application, while these new requirements were more akin to a "data processing" environment.

The solution was a dedicated server to provide high data throughput, storage, processing and communications that would not jeopardize the DMS' market-leading reliability and robustness. The computing platform also needed to meet the stringent requirements of "NEBS" imposed on central office equipment.

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Motorola Computer Group,*

This article describes the technical challenges faced by the engineering teams behind a Canadian technology success story, the solutions each of the teams arrived at, and the new global telecom solution that resulted from their collaboration.

Cet article traite des défis techniques qu'ont du relever des équipes d'ingénieurs responsables d'une percée technologique canadienne. Des solutions trouvées par chaque équipe et de la nouvelle approche globale en télécommunication a résulté de leur collaboration.

Nortel customers take the reliability of the telephone network very seriously, and Nortel had designed the DMS switch for complete fault tolerant operation from its inception. The fact that most people can't recall when their phone service didn't work, because of a central office switch problem, is a testimony to the company's commitment to quality and reliability. Because few computer vendors could meet Nortel's stringent requirements, the team debated whether to build a fault tolerant system in-house or settle for a less reliable simplex product from a traditional computer vendor.

While Nortel was defining its specific SDM product, Motorola Computer Group was developing a fully fault tolerant platform designed for the telecom central office market to be called the FX Series. When Nortel approached MCG both teams soon realized they held the key for the other's success. Nortel knew it could bring the product to market far faster using a soon-to-be available fault tolerant, central office compliant system that could support commercial software products (e.g. protocol stacks, databases, expert systems and security packages).

Motorola saw the opportunity to collaborate with a partner who had extensive fault tolerant experience and who also understood the requirements for computing platforms in central office telecom applications, a collaborator that also had an immediate need for such a product. It was a perfect fit.

Confident in each other's commitment and culture of engineering excellence, Nortel and Motorola commenced collaborative development of the first truly fault tolerant, central office compliant AIX/Power PC-based product. Despite the significant engineering challenges they knew lay ahead, the teams set an ambitious target for product introduction of the SuperNode Data Manager in 1997.

In December 1997, Motorola Computer Group (MCG) recognized the team from Nortel Networks with the:

### "Motorola Design of the Year Award"

This award is given annually for the most innovative product designed in Canada by an original equipment manufacturer, based on MCG Technology.

As the teams set out to meet their goal, Nortel immediately brought MCG together with customers who would eventually use the equipment to ensure the fault tolerant system would not only serve an application platform purpose but would also meet the operational needs of customers in central office working environments.

## 4. Nortel Challenges

Foremost among Nortel's challenges was the successful - physical and operational - integration of the existing system and the new OAM&P applications. The application software had to interface gracefully with the call processing system and all of the underlying messaging, maintenance, alarm and user interface subsystems had to be integrated to provide a seamless subsystem extension to the overall DMS system. Hardware packaging, power, grounding and physical alarms likewise needed to be integrated.

The requirement to address marketplace expectations and also consider the needs of a large installed base presented challenges for the SDM team. Changing system interfaces from traditional RS232 asynchronous or X. 25 interfaces to a TCP/IP based LAN interface - while maintaining full support for the legacy interfaces - would also be a challenge. Because the new platform was targeting an installed customer base and not all of the switches within a given network would have this new capability, it had to be optional.

Customers implementing this new capability needed a transition approach that supported simultaneous, dual operation of various interfaces. For example, given the critical nature of billing data and the multitude of record types and formats, a flash cut-over was not considered a viable transition for customers to move from an X. 25 based interface to an FTP based Ethernet interface.

The user interface posed similar challenges. Customers did not want new commands for existing capabilities on which employees were already trained. Yet, they wanted to move from command line, ASCII terminals to graphical, point-and-click workstations and/or PC-based terminals. Customers were also clear that while legacy screens had to retain the same look and feel, new capabilities should only be provided as a graphical user interface (GUI).

Also associated with the user interface transition was the subtle challenge of security. Often overlooked, user ID's and passwords not be passed as clear text across a LAN. This is akin to sending credit card numbers over the internet - some people do not worry about information being intercepted, while others would never risk it without encryption security. Despite these challenges, the first Beta system was

delivered within 18 months. Dividing the implementation into focused, manageable activities was part of Nortel's development strategy.

The key hardware development focused on creating a new I/O interface module to be housed within the SDM which terminated the transmit and receive fiber links on the new subsystem and converted the DMS proprietary interface to link with the FX Series fault tolerant system.

The SDM team built application programming interfaces (APIs) - comprised of software in the DMS Compute Module and structured interfaces in the AIX-based SDM - to interface with the OAM&P subsystems such as billing, performance data, event/log messages, alarms, provisioning data, file systems, etc. These APIs were critical to achieving wide acceptance across all of Nortel's switching products and ensuring customers around the world would benefit from a fully integrated and supported platform.

This design now enables development teams around the world to add market-specific applications required for a particular service provider. Application software can be added, removed or augmented as required without incurring development in the underlying hardware, operating system or messaging subsystems.

The architecture team relied heavily on the client server architecture and used commercially available Distributed Computing Environment (DCE) software to address requirements such as name server simplification, centralized user ID/password administrator, time of day server, and the major challenge of security and password encryption. The concept of Remote Procedure Calls (RPC) made it possible to support the needs of network management and OSS systems very efficiently while also enabling an efficient approach for graphical user interface development to utilize the same RPC-based interfaces.

Utilizing web servers and browsers also provides the ability to address security, while coupling user access via intranets or internet to any DMS central office equipped with the SuperNode Data Manager (Fig.1).

## 5. Specification Objectives - MCG

A central challenge in developing the FX Series was the addition of fault tolerant features to the operating system while still maintaining

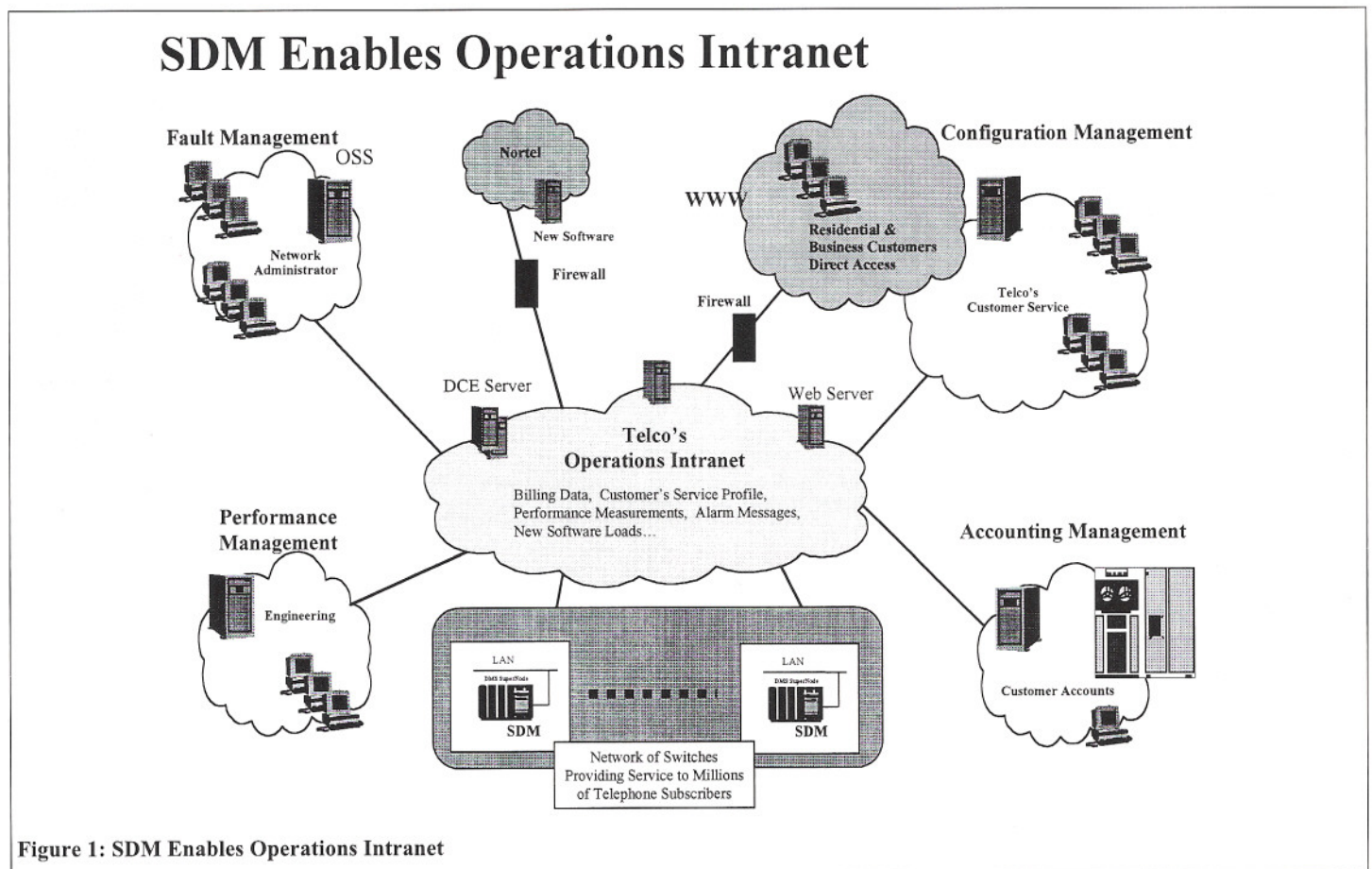


Figure 1: SDM Enables Operations Intranet

full binary compatibility with IBM's UNIX offering called AIX. This achievement would provide Nortel with a fault tolerant system capable of running standard, off-the-shelf software from IBM and other companies.

The areas of AIX requiring enhancement for fault tolerant operation were:

- Support for a trusted processing core
- Hardening and switchover capability for device drivers
- Intelligent rules based response for the AIX object data manager
- Enhancements to the AIX logic volume manager to manage the FX Series mirror disk subsystem
- Addition of Split Mode<sup>TM</sup> functionality

### A. Support for Trusted Processing Core

The trusted processing core contains the PowerPC and main memory in an FX Series CPU Module (Figure 2). These are configured for reliability with redundant CPU Modules running in cycle-by-cycle lockstep and checking on each other.

When CPU Modules execute I/O transactions to or from the I/O domains, they check their results. Any detected faults in the processor core cause an exception, and the corresponding exception handler performs the initial recovery from the fault. This mechanism enables all application programs, device drivers, and the operating system kernel to be free of features relating to processor core fault tolerance. To support this architecture Motorola added an AIX kernel extension and specified firmware to manage the CPU Module through synchronization faults, fault diagnosis and isolation, and subsequent re-synchronization.

### B. Hardening and Switchover Capability for Device Drivers

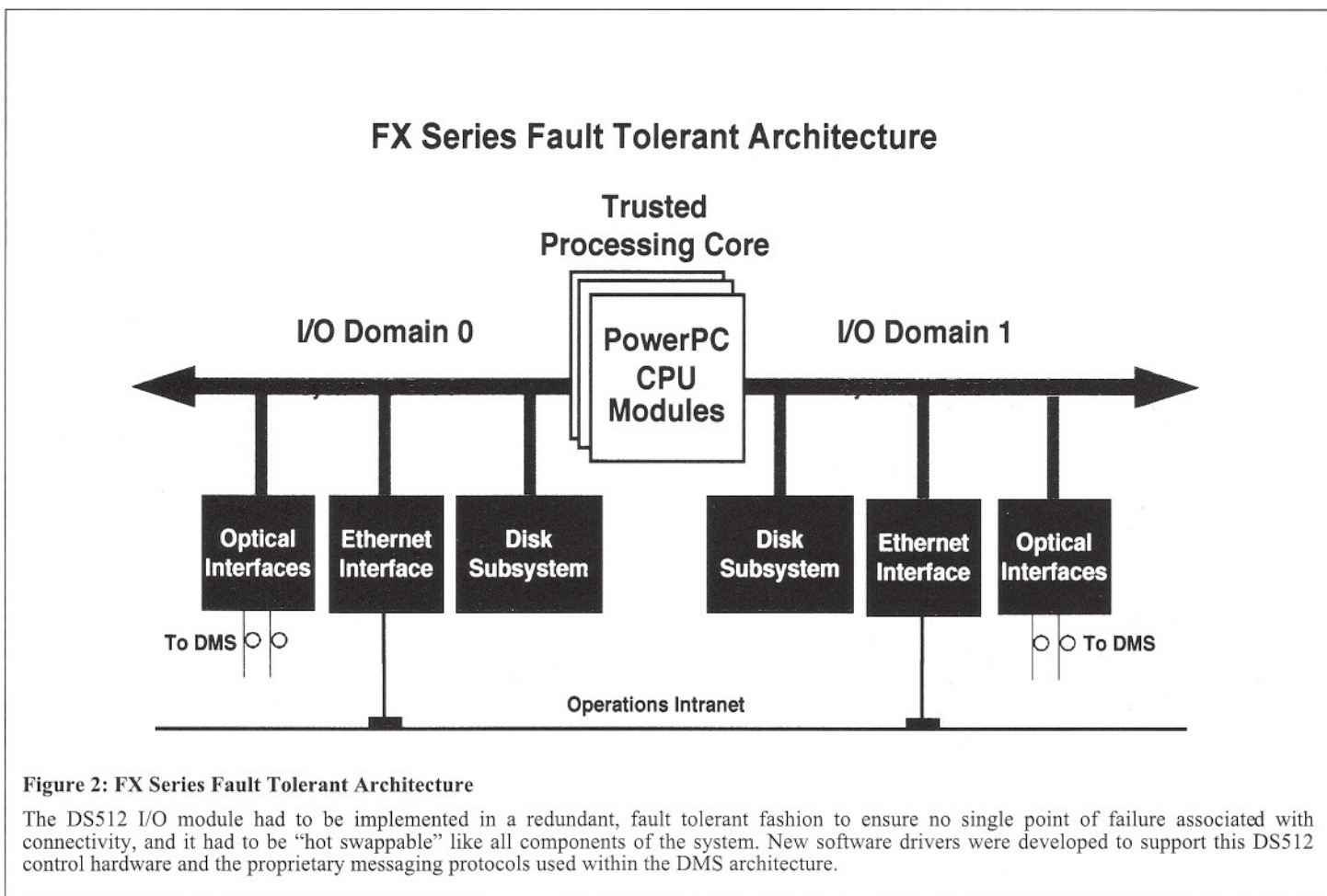
Standard UNIX device drivers are not hardened and do not support switchover between redundant devices. Adding this functionality to FX Series device drivers represented a major enhancement. Hardening is implemented in the physical layer of the device since it deals directly with the hardware. Switchover is involved with maintaining the service through the logical driver and is usually implemented in the logical layer.

Main features which shape the architecture of an FX Series device driver are:

- **Hardening:** The most critical step in the process of achieving continuous service availability is implemented so faults in the underlying hardware will not crash or hang the system. The FX Series assumes hardware will fail in strange and complex ways and the driver manages these errors.
- **Fault Detection:** The driver is the most logical place for the first level of fault detection and, in most cases, errors can be detected virtually at the point of hardware failure. Placing switchover functionality in the driver ensures a short time line from fault detection to recovery.

The driver categorizes hardware and software errors as:

- Data corruption errors: Designers must isolate areas of the driver sensitive to data corruption from bus errors or other causes, and develop protection.
- Passive and assertive protocol violations: Passive protocol violations usually occur when an I/O module has failed or halted and is simply not responding to external events. In fault tolerant environments hardware can fail at any time, hence any part of the driver that waits in a loop-type structure for an external event on the I/O module should be protected with a time-out.



An assertive protocol violation may be the first symptom of a data corruption failure mode, in most cases, a simple check against expected behavior is all that is required

- Bus related errors: After accessing a device capable of causing a bus error, the driver checks to determine if such an event has occurred. If so, the system protects itself from taking an actual processor exception and sets a flag the driver can examine. The driver responds by rewinding to the last known good state and, if appropriate, repeats the transaction using a redundant module.
  - **Time-out errors:** I/O device failures that would otherwise be missed until the I/O subsystem was accessed are detected by Watchdogs which can be implemented in either hardware or software. Software watchdogs are either static or dynamic. Static watchdogs periodically access a data area on the I/O device containing static data to provide an indication of an overall failure of the bus interface or of the module being physically removed
- Dynamic watchdogs use counters or timers in a critical area of the protocol to indicate it is running, usually linked to a time-out in the driver. An absence of activity for a certain time signals an error. Hardware based watchdogs include a free running counter on the I/O device that is periodically reset. If the firmware fails, the counter expires and triggers an interrupt line to alert the driver or leave a message for the driver to pick up.
- **Switchover:** This process of moving operations from one module to another provides a mechanism to recover from a fault using redundant hardware. In some subsystems data can be lost during fault detection and switchover. To maintain data integrity, a transport protocol is layered on top of the unreliable data transfer mechanism provided by the I/O subsystem, either within the driver or externally. It detects and corrects data transfer errors and can also notify the subsystem's device driver that an error has occurred and a switchover should be performed.
  - **Event Reporting:** The driver reports state changes to a configuration management subsystem.

### C. Intelligent Rules Based Response for the AIX Object Data Manager

The AIX Object Data Manager (ODM) is a device database used for device configuration and management. It is divided into two main sections -- pre-defined and custom data. Pre-defined data contains information on all devices that could exist on the system and custom data contains information about all of the devices actually in the system. At boot time the custom database is populated from the pre-defined database depending on what devices are seen by "probe" functions.

While a standard ODM works well in a relatively static system, it is not effective in fault tolerant systems where devices may "come and go" without any reboot and where the system must respond intelligently to changes in device state. Motorola needed to enhance the ODM to handle dynamic changes proficiently and to respond to those changes through a rule set. This was accomplished through a combination of enhanced configuration methods and creating the Configuration Management System (CMS) -- a finite state machine that models the configuration of the system.

As well as invoking device specific actions, CMS also manages all visual status indications and telecom alarms. This ensures rapid and consistent response across all devices, a significant feature for telecom fault tolerant environments. The combination of the ODM and the CMS provides a very powerful system management and fault response system while still maintaining compatibility with AIX's ODM.

### D. Enhancements to the AIX Logic Volume Manager

The FX Series system can support multiple mirrored disk subsystems. Motorola decided early in the development process to use the AIX Logical Volume Manager (LVM) to support the underlying mirroring functionality. This saved time and also reused a proven, integrated mirroring subsystem.

While the LVM was sufficient to manage a mirrored configuration in a standard system, Motorola found the fault tolerant FX Series needed particular characteristics to manage mirrored disks. Because FX Series

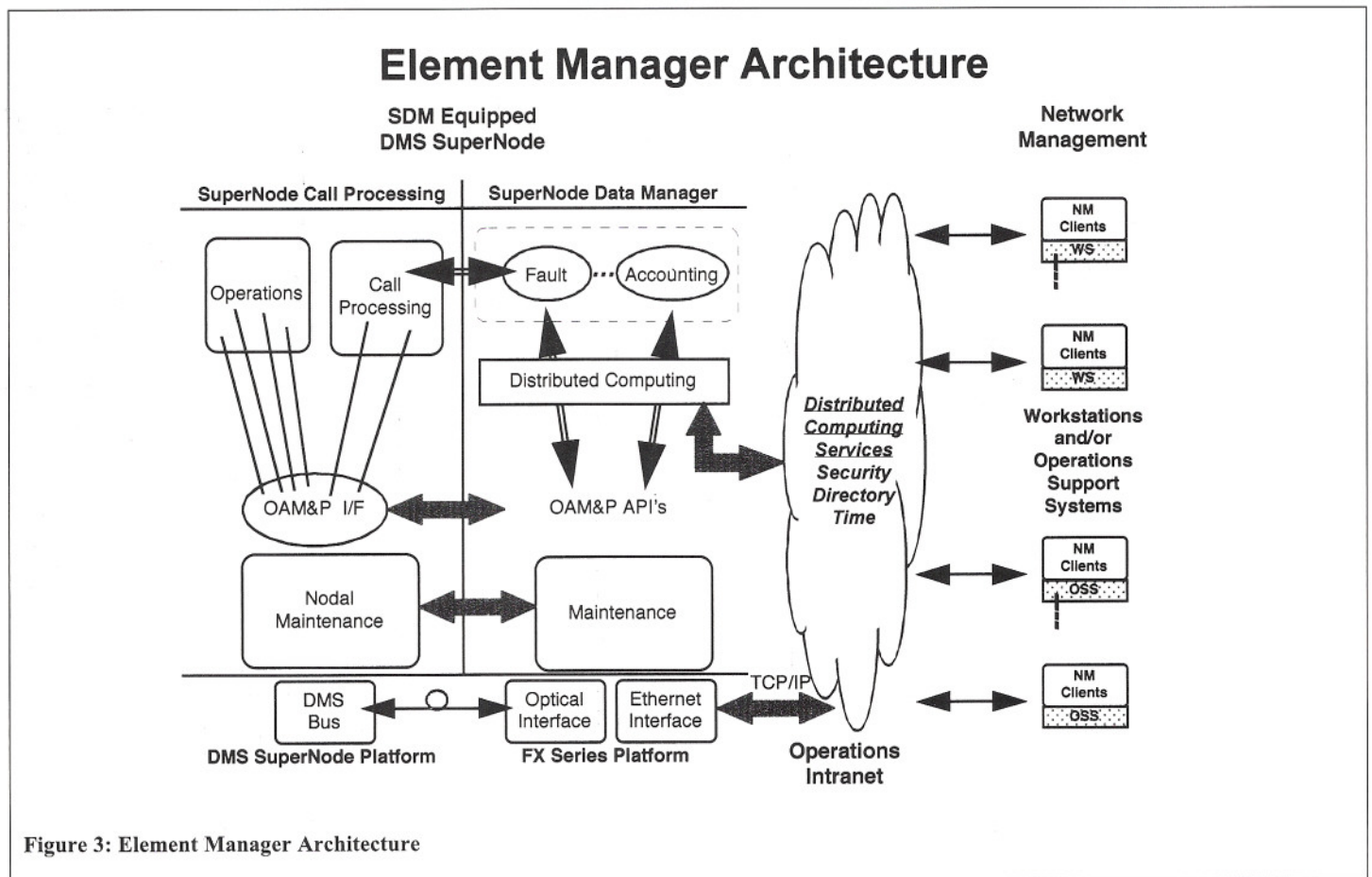


Figure 3: Element Manager Architecture

disks can be replaced without rebooting the system and matched pairs were somewhat derived from the geographical position of the modules, the LVM sub system needs to respond differently. This was addressed by creating a FT Volume Group with an associated set of rules for configuration and management. The FT Volume Group sits above the normal AIX LVM volume group and presents an interface that allows users to manage and configure the disk subsystem at the FT Volume Group Level.

### E. Addition of Split Mode Functionality to AIX

Because upgrading operating systems, application software, or CPU Modules in standard UNIX-based systems can cause significant out-of-service time - often for many hours - the FX Series required Split Mode operation to enable half of the system to be taken out of service and upgraded while the other half continues to provide service. When confidence in the new half is established, service can be transferred with minimum downtime - as little as 16 seconds. To support Split Mode on the FX Series, Motorola had to add split mode functionality to AIX.

### F. Device Configuration

Device configuration analysis utilities were added to ensure the system could be safely split and still carry out the split operation. Later these utilities would bring the system back to full fault tolerant mode and reconstruct the device tree.

### G. Split Mode Communication

To manage the Split Mode, Motorola added a low level driver interface and application level library to enable the applications and Split Mode management utilities to communicate with each other.

### H. Split Mode Management Utilities

There are a number of steps in the Split Mode process during which Split Mode utilities, system functions, and user applications need to be coordinated. This process is managed by the Split Mode Management Utilities that provide features such as registered notification of Split Mode states and fallback to previous states. It also enables easy integration of OEM applications into the Split Mode environment.

### I. Boot Modifications

Both the firmware and AIX boot functionality were modified to support booting of the FX Series while in Split Mode. This prevents the upgraded half of the system from grabbing the devices being used by the half of the system still providing service.

## 6. Joint Testing Benefits Collaboration

The MCG fault tolerant program benefited greatly from the joint test and qualification activity shared between the Nortel and Motorola test organizations. The test teams were able to focus on different aspects of the test plan. Nortel's team focused on the operational aspects and how the system would handle a broad range of error events which can occur in the central office. The Motorola team was then able to focus on the operation of the system architecture itself under heavy stress and fault insertion scenarios. The joint effort allowed complete test coverage in the shortest possible time.

By February 1997, a fully functional beta system was installed and operational in the lab of a major Canadian customer before either company had formally announced their respective products and less than 18 months from the start of the project. After initial testing with this lead customer, the products were officially released for in-service application in May 1997.

## 7. Conclusion

The combination of Nortel's switching experience and application focus and MCG's NEBS compliant, fault tolerant computing platform expertise has enabled the switch world to be connected via high speed TCP/IP links to telco intranets.

The SDM represents the next generation in telecommunications

operational interface capabilities. For the first time, service providers around the world can access a highly reliable and continuously available server over their "operations intranet" that meets their accelerating customer-service requirements both efficiently and cost-effectively.

Customer acceptance of the new technology has clearly demonstrated the collaboration was a success, with product now being deployed in Canada, the U. S., Europe, Asia, Australia and the Caribbean. The basic system designed and introduced in Canada has become a building block for Nortel designs around the world to add new functionality for specific customer requirements.

An expert system manages alarms and events associated with the entire switch and all peripherals, simplifying maintenance. A database with high speed OSS interface and GUI-based human interface simplifies the provisioning of features and services assigned to end customer lines- often in excess of 100,000 lines per switch. High capacity storage and real time delivery makes it possible to handle well over one million billing records per hour as well as all performance monitoring information associated with the service levels provided.

This initiative will quickly lead to telecom providers offering customers direct access, via the internet, to retrieve their latest billing data or review the service profile associated with their telephone service. It's also expected that the SDM initiative will spawn new opportunities for service providers and third-parties building on the fast, efficient availability of data generated by telephone calls. These opportunities will range from real time billing systems, fraud detection systems, customer usage profiling, along with new and improved end-user access to their own feature profiles and line usage information via simple internet - point and click - from their home computers.

The collaboration between Nortel and Motorola is an excellent example of how such initiatives can produce win/win solutions for carriers, network operators, and their customers.

## 8. Legend - List of acronyms used

|        |   |
|--------|---|
| API    | Application Programming Interface                     |
| CMS    | Configuration Management System                       |
| CPU    | Central Processing Unit                               |
| DMS    | Digital Multiplex System                              |
| FTP    | File Transfer Protocol                                |
| GUI    | Graphical User Interface                              |
| I/O    | Input, Output   |
| LAN    | Local Area Network                                    |
| LVM    | Logical Volume Manager                                |
| MCG    | Motorola Computer Group                               |
| NEBS   | Network Equipment Building Standards                  |
| OAM&P  | Operation, Administration, Maintenance & Provisioning |
| ODM    | Object Data Manager                                   |
| OEM    | Original Equipment Manufacturers                      |
| OSS    | Operational Support Systems                           |
| SDM    | SuperNode Data Manager                                |
| TCP/IP | Transmission Control Protocol, Internet Protocol      |

## 9. References for further reading

- [1]. FX Series Fault Tolerant Systems Architecture Overview
- [2]. FX Series Split Mode Overview and User's Guide

Both above documents are available in PDF format at the following URL: <http://www.mcg.mot.com/literature/PDFLibrary>.

- [3]. SuperNode Data Manager Planning Guide is available by calling 1-800-4-NORTEL or at [www.nortel.com](http://www.nortel.com)

## DMS SuperNode Data Manager

Nortel's fully-featured DMS SuperNode switch (see also cover picture) is deployed in thousands of central offices around the world and meets the needs of the most demanding network applications. Capable of handling in excess of one million calls per-hour, the DMS family of switches support:

- Local (residential and business)
- Intra LATA Toll (long distance)
- Inter-exchange & Global Carriers
- International Gateway
- Wireless
- Signaling Transfer Point (STP)
- Operator Services

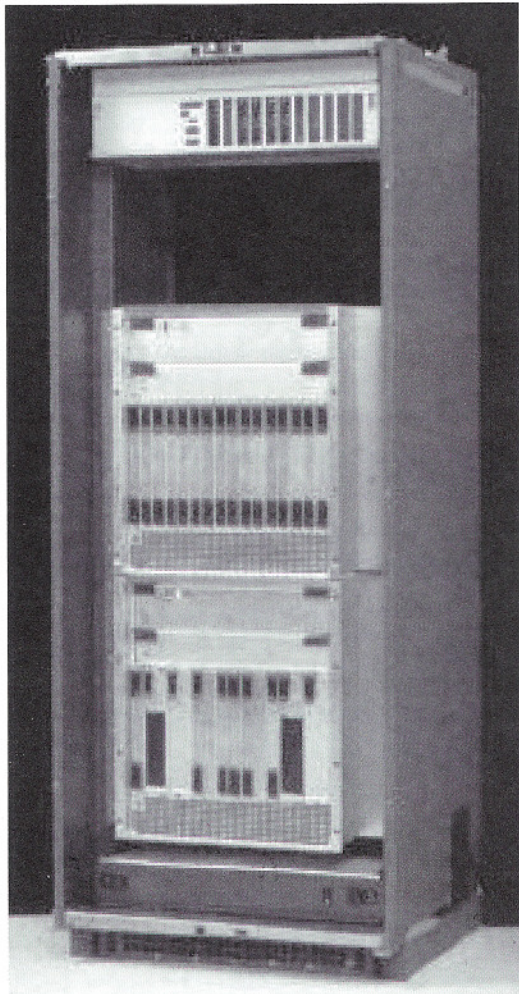


Photo of DMS SuperNode Data Manager

The Fault Tolerant SDM SuperNode is fully integrated into the DMS system line-up, power, grounding and alarm subsystem. The SDM is maintainable to the circuit pack level without shutting down the dual power feeds and is FCC EMI, NEBS and Zone 4 Earthquake compliant. Software is upgraded while the system remains in service.

## About the Author(s)

**W. M. (Mike) Campbell**, has worked for Nortel Networks for 20 years in various roles. He is currently Director, Business Line Management, responsible for DMS OAM&P Evolution and Core Hardware and Software.

Mike is an Engineering Science graduate from the University of Toronto and has an MBA from York University.



**Paul Holt**, VP/Regional Director, Central US & Canada Motorola Computer Group, is responsible for sales, distribution, support, marketing and finance for Motorola Computer Group, Technical Products Division for the Canadian and Central U. S. A. region. Major centres under his management include Chicago, Cleveland, Minneapolis, Milwaukee, and St. Louis in the U. S. A. and Vancouver, Ottawa, Calgary, Montreal and Toronto in Canada.

Paul received an MBA from York University and a Bachelor of Arts in Economics from the University of Western Ontario.



**Jerry Sidman**, Engineering Section Manager Motorola Computer Group, is responsible for all AIX and UNIX development at Motorola Computer Group for VME and FX Series Fault Tolerant computer systems. In addition to managing a number of development departments he leads the software process improvement effort for MCG's Technical Systems business unit. Jerry joined Motorola in 1992 and has held various engineering positions at Motorola.

He holds a Bachelor's Degree in Electrical Engineering from Newcastle University, and an MBA from Durham University.



**Noel Lesniak**, Product Line Manager, Telecommunications and Fault Tolerant Systems, has been with Motorola for 18 years in various roles. He is currently product line manager in the Motorola Computer Group with responsibility for the FX Series family of fault tolerant system platforms.

He attended the University of Southern California prior to serving at the U.S. Military Academy at West Point.



## Letters to the Editor / Lettres envoyées au rédacteur

### SI Units

27 August 1998

Dear Sir,

This is about standards and the way we, in the technical community, support (or frustrate) their rational use. In particular, I am concerned with the issue of all-numeric dates. As a case in point, please note Pg.7 of the current issue of our *Canadian Review*, the date "1/2/97". How is one to know whether this is a January date or a February one? The problem is further illustrated when on Pg.12, we see "2/1/97". Put in more jocular terms, would "4/1/2000" mean 4th of January or April Fool's Day?

This sort of chaos confronts the general public daily whether it be a date on a cash-register slip, a date on a medical prescription, a maturity date on a financial instrument, the validity date for an insurance policy etc., etc. The situation is as avoidable as it is unacceptable since, for over 20 years, international (ISO 8601) and Canadian (CAN3 Z234.4) standards have been in place outlining the proper formatting of all-numeric dates.

It seems to me that we, in the technical community, have an opportunity if not an obligation to encourage the use of rational standards. One way we can do this is to lead by example in the application of ISO 8601 (CAN3 Z234.4). Would you not agree?

(And in a second letter)

This is about standards of measurement and the way we, in the IEEE, apply them. In the article "Get the lead out!", (*Canadian Review* - 1998 Summer) we see use of SI units. However, it is appalling to see Metal Costs quantified in \$/in<sup>3</sup>. And, incidentally, "w/cm<sup>0</sup>C" (instead of W/cm<sup>0</sup>C).

In "Nelson River HVDC Line Failures", we see wind pressure expressed as so many "kg/m<sup>2</sup>". In SI, of course, mass is expressed in kg and force is measured in newtons.

The IEEE has made remarkable strides in promoting the use of SI in its papers, magazines etc. This note is to encourage the use of SI in *IEEE Canadian Review*. It seems to me that we, in the technical community, have an opportunity if not obligation to help lead the way out of that measurement Tower of Babel known, so familiarly to so many of us as the *Imperial System* (how's that for an oxymoron?).

Duncan Bath,  
Peterborough, Ontario

### Projet de traduction / Translation Project

Le 27 août 1998

Monsieur le rédacteur en chef,

Voici mes commentaires sur l'initiative de l'IEEE Canadian Review de publier plus de textes en français.

C'est avec grand plaisir que j'ai lu l'article en français. La qualité de la traduction est excellente. J'apprécierais beaucoup si je pouvais en discuter avec Marc Provencher. Il serait préférable, cependant, de publier des textes originaux en français pour permettre aux anglophones de pratiquer leur français.

Votre initiative aidera sûrement l'Unité Canadienne et devrait être suivie par d'autres magazines anglophones qui se disent CANADA's xyz Magazine (from coast to coast) et oublient d'insérer quelques mots en français pour les francophones qui n'ont sûrement pas les moyens de se payer un magazine en français "coast to coast".

I foresee, however, the following two negative comments from the anglophone majority:

a) "Most scientific papers are now published in English only". This may be true but the *IEEE Canadian Review* is also a news magazine for the members of IEEE Canada and some of these members are francophones. If 25% of the text is too much for the francophones there should be at

least one page in French to show the presence of francophones in Canada and IEEE Canada.

b) "The budget does not permit the cost of French translations". I am willing to help with the translation (at no cost) if this will permit the addition of the French text. I am now a retired telecommunication engineer (member of *Ordre des Ingenieurs du Quebec*) but I still follow the evolution of the IEEE which I joined in May 1968.

J'espère que mes commentaires vous seront utiles. Mes félicitations pour votre bon travail comme rédacteur en chef.

Jacques Georges Guimond, ing.,  
Longueuil, Quebec

### Articles in the IEEE Canadian Review

27 August 1998

Vijay,

I have recently read the Summer/98 issue of the *IEEE Canadian Review*. Normally, I scan this publication, finding very little of interest or value to me. NOT TRUE THIS TIME.

All three articles were of interest to me and I spent some time consuming them. The three articles were relevant and full of useful information. Two of the three were very well written.

I don't know whether this event was pure "serendepity", for me or whether it reflects a real change in this publication's editorial policy. I hope it is the latter.

To you and your staff, please keep up the good work!

Dave Duff,  
Toronto, Ontario,

### Obituary

#### Cyrus Hale Mclean, 1898 - 1998, Fellow of IEEE

It is with regret that we note the passing away on 25th August, 1998, of Cyrus Hale McLean of the Vancouver Section of IEEE. Cyrus was named a Fellow of the IEEE for his pioneering contributions to radio telephony.

His significant contributions to the communications industry were reflected by his numerous leadership roles in various companies and organizations, both local and international. The IEEE in general, and Vancouver Section in particular, appreciates Cyrus' contributions to the electrical engineering profession and industry. We extend our deepest sympathy to his family.

Henry Ng,  
Chair, Vancouver Section, Region 7

#### Editor's Note / Note de rédacteur :

I thank Mr. Bath for his observations and fully support the use of SI units and Standards and must accept responsibility for my oversight.

Merci infiniment, M. Guimond, pour vos commentaires et l'offre de devenir un traducteur bénévole; ont espère de utiliser vos services bientôt. The IEEE is a volunteer organisation and it is with the support of volunteers that we provide our services to our members.

It is very heartening to hear **all** your views - complimentary or not. Unless we hear from you, we would never know if what we do is worthwhile. Please do keep your comments coming in. On behalf of my editorial staff, we do appreciate your views Mr. Duff.

Vijay Sood

## IEEE Professional Communications Conference-- Québec City, Sept. 23-25, 1998

by Terrance Malkinson and Ron Blicq

**T**he 1998 IEEE International Professional Communication Conference was held in Quebec City, September 23-25, and was a most successful event. Concurrently SIGDOC (the Special Interest Group for Documentation of the Association for Computing Machinery) held its conference on the same dates and at the same site. Special arrangements were made so that participants from both conferences could "cross-over" to take part in the other conference.

Communication skills are the key to every professional's career growth. Since the founding of the IEEE Professional Communication Society in 1957, its mission has been to help engineers and technical communicators develop skills in written and oral presentation. Today, its mission extends to the many new communication technologies and conducting research on how to ensure effective communication in a modern engineering environment.

The theme of this year's conference was "A Contemporary Renaissance-Changing the Way We Communicate". Over 170 professionals from 12 countries exchanged ideas on both fundamental and leading edge research in communication theory and technology. In addition to oral presentations, this year's conference incorporated "Idea Markets". These were group discussion sessions that center on an idea introduced briefly and informally by the presenter who uses a flip chart and bulleted points to trigger discussion. There were 10-12 presenters spread around the room, each with his or her own "speaking stand" who described their ideas to the conference delegates standing around them in small groups. The delegates moved from one stand to another as the 90-minute session progressed. Lively discussion occurred during these exchanges, resulting in a unique educational experience for all participants.

Presentations focused on a variety of current issues of importance including knowledge management, telecommuting, Intranet/Internets, data-driven learning systems, interactive distance learning, interface design, on-line documentation, usability testing, on-line resumes, electronic portfolios, copyright issues, international communication, electronic document production, on-line document review and editing, and Web site design to name but a few. Common to many of the presentations were the themes of the merging of the information technologies and the multi-disciplinary nature of technical communication and its importance to the overall engineering endeavor. Another was the necessity for organizations to design their information base to meet the needs of their users and making it easy to access and use.

The keynote speaker for IPCC 98 was Kim Echlin, author of *Elephant Winter*. Kim is a well-known television personality in Canada. She told us about her research into infrasound between elephants. This led into a description of other types of animal communication and how music and words affect our human emotions by instilling feelings and creating reactions. The closing speaker was Henrik Wigerstand of Norway, who gave a humorous graphic electronic display of communication over the centuries.

All participants were sincerely impressed with the uniqueness of Quebec City and the friendliness of its citizens. The week of our conference was declared by the City to be International Communication Week. Many participants indicated their desire to return for a longer stay and explore all the wonders of Quebec.

Next year's meeting will be in New Orleans, September 8-10, 1999. For further information on the PCS and what we can do for you please see our Web site at [www.ieee.org/pcs](http://www.ieee.org/pcs)

## Dr. Wintle receives 1998 Dakin Award

**H**oward J. Wintle, professor of physics at Queen's University in Kingston, Ontario, Canada, one of the leading theoreticians in the field of dielectric physics for many years received the 1998 Thomas W. Dakin award on June 8, 1998 at the IEEE International Symposium on Electrical Insulation (ISEI) in Washington D.C. The Dakin Award is the highest recognition given by the DEIS for technical achievement. It is presented biennially at the ISEI for outstanding original technical contributions, as evidence by their sustained impact in advancing the science and technology of dielectrics and electrical insulation.



Born in England, Dr. Wintle obtained his B.A. in physics from Cambridge University in 1956. He then attended Woolwich Polytechnic and obtained his M.Sc. in physics (acoustics) from London University in 1959. He obtained his Ph.D. in physics (polymer physics) by part-time study in 1963 (London External).

In 1958, he joined the faculty of the Royal Military College of Science, Shrivvenham, England, becoming successively demonstrator, lecturer, and senior lecturer. In 1963, he went to the Radio and EE Division, NRC, Ottawa, Canada, as a post-doctoral fellow. In 1964 he moved to the Department of Physics, Queen's University, Kingston, Canada, where he was promoted to associate professor (1967) and then full professor (1973). He retired in 1997 and is now professor emeritus.

His sabbatical leaves were spent at UCNW, Bangor, Wales (1974-5), Technische Hochschule, Darmstadt, Germany (1987), Monash University, Australia (1988), IREQ, Varennes, Canada (1988), Heinrich-Hertz-Institute, Berlin and the University of Potsdam (1995) and the University of Connecticut (1995).

For almost forty years, Prof. Wintle has made a steady and very significant contribution to our understanding of the physics of dielectrics. His early work dealt with radiation-induced conductivity (RIC) in polymeric insulators under space conditions as well as in laboratory dosimeters. This research was followed by studies of ultraviolet-induced photoconduction with the particular aim to identify the energy thresholds and the mechanisms of charge transport in polyethylene and similar materials. In turn, this work led on to a critical analysis of the problem of what model parameters can be extracted from current-time curves and also to a major theoretical study of space-charge flow in insulators, both under open-circuit (xerographic) and short-circuit conditions (including thermally stimulated discharge experiments). A natural extension was the analysis of the transport of injected charge across insulating surfaces, thus simulating the practically relevant conditions of insulators prior to flashover.

In addition to his many theoretical studies, Prof. Wintle carried out cognate experimental research on the electrical noise and the pyroelectricity in plastic insulators. Recently he investigated the injection of charge onto polymer surfaces under various field conditions. He also did computational and analytical work on the decay of electric fields in insulators within the mixed dipolar and space-charge regime in order to see if the resulting signals could be separated into identifiable components. His present theoretical work is concentrated on simulating the surface transport of charge in experimentally relevant configurations. His work on photoconduction resulted in a series of seminal papers.

Within the IEEE, he served as a board member for the Conference on Electrical Insulation and Dielectric Phenomena (CEIDP) from 1973 to 1975 and from 1988 to 1990. He was assistant and since 1977, associate editor of the IEEE *Transactions on Dielectrics and Electrical Insulation*. Since 1985 he has been a member of the Scientific Advisory Committee for the DEIS - sponsored International Symposium on Electrets. In 1995 he was elected a fellow of the IEEE on recognition of his "experimental and theoretical studies of charge storage and transport in electrical insulation".



## IEEE Awards

IEEE Canada announces the following 1998 Student Paper Award winners:

**Eastern Canada Council Life Member Award** - Aroosh R. Elahi, of Carleton University, for his paper entitled: "Investigation into the Accuracy of the Trapezoidal Threshold Voltage Model".

**Hackbusch Award** - Barry Boyden & Todd Horn, of DalTech, for their paper entitled: "Determining Body Form"

**Central Canada Council Life Member Award** - Gorav Arora and Aly Orady, of McMaster University, for their paper entitled: "Automatic Online Handwritten Signature Verification".

**Western Canada Council Life Member Award** - Pavel Haintz, of Simon Fraser University, for his paper entitled: "Navigation, Guidance and Control System for a Blimp".

**Hackbusch Award** - Reid van Melle, Trevor Hamm, Scott Muma, and Art Peters of the University of Saskatchewan, for their paper entitled: "Internet Based Video Security System".

**Palin Award** - Sylvia Liu of Red River Community College, for her paper entitled: "Wireless Display Panel with Remote Data Entry".

Also the following awards were presented by IEEE:

**RAB Larry K. Wilson Regional Student Activities Award** to Binh Y. Ha, University of Toronto.

**IEEE Exemplary Student Branch Award** to the University of Toronto IEEE Student Branch.

Congratulations to all the winners.

## Book Review

### Intelligent System Applications in Power Engineering- Evolutionary Programming and Neural Networks

By Professor Loi Lei Lai

Published by John Wiley & Sons

ISBN 0-471-98095-1

Considering the recent interest over the past ten years, in the practical applications of Intelligent Systems (such as evolutionary programming (EP), genetic algorithms (GAs), artificial neural networks (ANNs), fuzzy logic (FL) and expert systems (ES), etc.), this is certainly a topical book which will interest a wide ranging audience varying from computer application specialists to power system engineers. At 260 pages, the book is just about the right size and covers the various power systems applications enough without going into very detailed mathematics. The book will, therefore, appeal to practical power system engineers without scaring them away with too much mathematics, and/or theory. Conversely, it may be somewhat less appealing to pure theoreticians. The author focuses on applications and provides a whole host of potential applications. Unfortunately, due to the tremendous rate of increase in applications of ANNs over the past year whilst the book was in print, the number of potential applications must have doubled. This is unfortunate, but certainly means that an update to the book will be obligatory shortly. The author deals with the applications in a straight forward manner which is clear to newcomers to the field.

The book contains seventeen chapters and each chapter follows roughly the same structural plan: an introduction, model of the system, problem formulation, case study, discussion and conclusions, followed by some key references. This structure is quite satisfactory. The first three chapters of the book provide the necessary background information for neural network theory and evolutionary programming. The rest of the book deals with the applications in power systems.

The first chapter deals with a novel object-oriented approach to the development of artificial neural networks (ANNs). This is quite unique



## Engineering Institute of Canada

Annual General Meeting - 21 June 1998, Ottawa

The photograph below shows John Seychuk (left), Past President and Andre Rollin (right) taking over the gavel and presidency of the EIC at the Annual Meeting in June which took place in Ottawa.

The EIC Council members are:

|   |                              |
|---|------------------------------|
| Andre Rollin, President                     | John Seychuk, Past-President |
| James Graham, CGS                           | Alan Perks, CSCE             |
| Ken Putt, CSME                              | Norm Jeffrey, CSME           |
| Dave Kemp, IEEE Canada                      | Maja Veljkovic, CSChE        |
| Linda Weaver, IEEE Canada (President-elect) |                              |
| Michael Bozozuk, Executive Director.        | Guy Gosselin, Treasurer      |



and makes use of the object modeling technique as a basis for the development of software ANN architectures. Typically, the technique derives its properties from the classes found within class clusters in the problem domain. The use of many, clear diagrams to illustrate the technique is found to be effective. This is followed in the second chapter by a similar approach to the development of Evolutionary Programming (EP). The third chapter merges the two approaches of ANNs and EP into hybrid Evolutionary artificial neural networks (EANNs). The author deals with the fundamental question to see if EANNs are more efficient than gradient-based methods used with simple ANNs. The author shows that although EANNs have longer training procedures, they produce better results when compared to traditional ANNs. Onwards from Chapters 4 to 17, the book deals with applications in power systems covering the full gambit from reactive power planning, reactive power dispatch, transmission network planning, generator parameter estimation, economic dispatch of units, power flow control, co-generation systems, fault section estimation, fault diagnosis in HVDC and transformers, harmonic evaluation, digital distance relay, transient stability assessment and short-term load forecasting. The references at the end of each chapter, although not exhaustive, provide the necessary background to the research in these key topics. Chapters 4 to 11 deal with EP applications whilst chapters 12 to 16 deal with ANN applications to power systems. The last chapter deals with the hybrid application of EANNs. Chapter 13 proposes an accurate ANN approach to diagnosis and detection of incipient faults in oil-filled power transformers on the basis of dissolved gas-in-oil analysis. The use of Fuzzy diagnosis has been shown to be more effective than the conventional IEC methodology. A comprehensive Select Bibliography is presented at the end of the book.

This concise, well-written and state-of-the-art book provides many useful and practical insights into a niche area of power systems research and development activity which until now had largely remained in academia. The book will be useful to post-graduate research students and power systems engineers alike. I found it extremely interesting and certainly recommend it to power system engineers.

Book reviewed by V.K.Sood



IEEE Canada



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# 1999 IEEE Canadian Conference on Electrical and Computer Engineering

May 9-12, 1999 v Shaw Conference Centre v Edmonton, Alberta, Canada

## CALL FOR PAPERS

The 1999 IEEE Canadian Conference on Electrical and Computer Engineering provides a forum for the presentation of electrical and computer engineering research and development from Canada and around the world and for the fostering of interaction between industrial and university researchers. We invite papers, written in English or French, on the following topics:

**Communications and Wireless Systems**

**Computers and Digital Hardware**

**Information Security and Encryption**

**Circuits, Systems, and VLSI**

**Control Theory and Applications**

**Robotics, Sensors and Mobile Robots**

**Power Systems and Power Electronics**

**Electromagnetics and Optics**

**Smart & IC Cards, Electronic Commerce**

**Biomedical Engineering**

**Computer Networks and Communications**

**Software Engineering, CAD, and CAM**

**Computer Telephony Integration**

**Signal Processing and Filter Design**

**Process Control and Industrial Automation**

**Neural, Fuzzy and Intelligent Systems**

**Microelectronics and Micro-Machining**

**Electronic and Optoelectronic Devices**

**Electrical & Computer Engineering Education**

**Reliability Engineering and Other Topics**

**Regular Paper Submission:**

Please submit *four* copies of a 500-word summary of your paper to the Program Chair using the Conference Secretariat postal address. Fax and e-mail submissions are also acceptable using the fax number and e-mail address listed on the left. When submitting, please specify a contact person with postal address, phone number, fax numbers, and e-mail address, and specify three keywords and three most appropriate topic areas from the above list of research topics for your paper in order of preference.

**Workshop, Tutorial and Invited Session Proposal Submission:**

Proposals for invited sessions and for pre- and post-conference workshops and tutorials will be accepted before January 18, 1999. Please contact the Workshop/Tutorial/Invited Session Chair using the Conference Secretariat postal address, fax number and e-mail address listed on the left for detailed information and to discuss your proposals.

**Important Dates:**

Paper submissions must be received by:

**Monday, January 4, 1999**

Special session proposals must be received by:

**Monday, January 18, 1999**

Notification of acceptance will be mailed out by:

**Monday, February 1, 1999**

Camera-ready papers must be received by:

**Monday, March 1, 1999**

**Best Student Paper Competition:**

To be eligible for the three Best Student Paper Awards, the first author of the paper must be a student with a valid student ID and "Best Student Paper Competition" must be clearly marked on the paper summary submission. A formal letter stating the participation in the Best Student Paper Competition with proof of student status must be included with camera-ready paper submission. The competition results will be based on camera-ready full paper reviews. Extended versions of the three winning best student papers will be published on the *Canadian Journal of Electrical and Computer Engineering* subject to the final editorial acceptance of the journal.

**Industrial Exhibits:**

Please contact the Exhibits Chair *Dwayne Garneau* at [dtgarno@planet.eon.net](mailto:dtgarno@planet.eon.net) for information about industrial exhibits and booth availability at the conference.

*For more information, please e-mail CCECE99 and visit the CCECE99 homepage regularly.*

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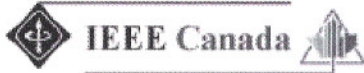


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# Conférence canadienne IEEE de Génie Électrique et Informatique 1999

du 9 au 12 mai 1999 v Centre de Congrès Shaw v Edmonton, AB, Canada

## Appel aux Communications

La Conférence canadienne IEEE de Génie Électrique et Informatique 1999 est une opportunité pour partager les résultats de recherche et développement en génie électrique et informatique. Elle favorise l'interaction entre les chercheurs industriels et universitaires au Canada et dans le monde. Nous sommes en voie de solliciter des communications en anglais et en français dans les thèmes suivants:

Communications et réseaux numériques  
Théorie de commande et ses applications  
Systèmes neuronaux, flous et intelligents  
Dispositifs électroniques et optoélectroniques  
Automatisation industrielle et contrôle de procédé  
Cartes intelligentes et de CI, commerce électronique  
Sécurité de L'information et cryptage  
Circuits, systèmes, et intégration à très grande échelle  
Enseignement en génie électrique et informatique  
Traitement de signal et conception de filtres

Communications et systèmes sans fil  
Ordinateurs et matériel numérique  
Systèmes et électronique de puissance  
Génie biomédical  
Electromagnétisme et optique  
Génie logiciel, CAO et FAO  
Intégration informatique/téléphonie  
Robotique, capteurs et robots mobiles  
Micro-machines et microélectronique  
Génie de fiabilité et autres sujets

### Soumission des Communications:

Veillez soumettre une copie d'un compte-rendu de 500 mots par courrier air, télécopieur, ou courrier électronique au Responsable du Programme via le Secrétariat (adresse à gauche). Avec la soumission, veuillez joindre le nom, l'adresse postale, les numéros de téléphone et de télécopieur, et l'adresse de courrier électronique du point de contact, ainsi que les trois sujets de session les plus convenables par ordre de préférence.

### Soumission pour Ateliers, Sessions Pratiques, et Sessions Sollicitées:

Avant le 18 janvier 1999, nous accepterons des propositions pour des ateliers (avant et après la conférence, payés séparément), des sessions pratiques, et des sessions sollicitées. Veuillez en informer le Responsable Ateliers et Sessions Pratiques/Sollicitées via le Secrétariat.

### Dates Clés:

Les soumissions pour communications doivent être reçues avant: **lundi le 4 janvier 1998**  
Les propositions pour sessions spéciales doivent être reçues avant: **lundi le 18 janvier 1998**  
Les avis d'acceptation seront expédiés avant: **lundi le 1 février 1999**  
Les versions finales prêtes pour reproduction doivent être reçues avant: **lundi le 1 mars 1999**

### Compétition "Meilleure Communication d'Étudiant":

Afin d'être éligible pour les trois prix " Meilleure Communication d'Étudiant", le premier auteur doit être étudiant(e) inscrit(e), et le compte-rendu doit porter l'inscription "Best Student Paper Competition". La version finale de la communication doit être accompagnée d'une lettre formelle pour déclarer sa participation dans la compétition et porter la preuve du statut d'étudiant. Les résultats de la compétition seront basés sur une évaluation des versions finales telles que soumises. Le "Canadian Journal of Electrical and Computer Engineering" publiera les versions détaillées des trois meilleures communications sous réserve d'approbation du comité d'édition du journal.

### Expositions industrielles:

Merci de contacter le Responsable des Expositions Dwayne Garneau par courrier électronique à [dtgarno@planet.eon.net](mailto:dtgarno@planet.eon.net) pour de plus amples informations sur les expositions industrielles et la disponibilité de stands à la conférence.

Pour plus d'informations, contactez le CCGEI '99 par courrier électronique et visitez régulièrement le site internet CCGEI '99.

### Parrains de la Conférence canadienne IEEE de Génie Électrique et Informatique 1999



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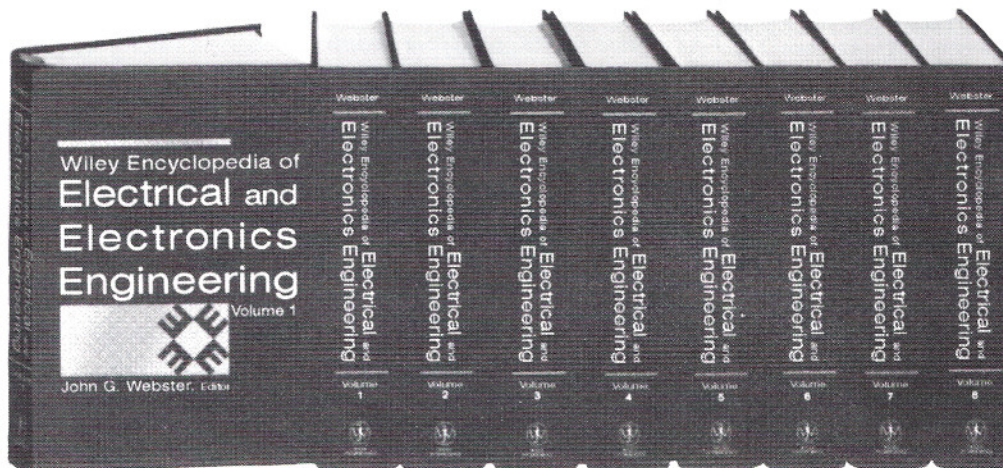
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#### About the Editor

**John G. Webster**, Ph.D., is Professor of Electrical and Computer Engineering at the University of Wisconsin, Madison. His many honors and awards include the Association for the Advancement of Medical Instrumentation, the AAMI Foundation Laufman-Greatbatch Prize, and the University of Wisconsin Chancellor's Award for Excellence in Teaching.



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