Nortel Institute for Telecommunications
of the University of Toronto

@NIT

Issue 2, Fall 2000

www.nit.utoronto.ca

In this issue

Canada and France launch new bilateral initiative in Molecular and Plastic Optoelectronics

September 18 and 19 marked the first France-Canada bilateral meeting on *Molecular Photonics and Plastic Electronics: In Search of a New Technological Paradigm for the 21st Century*. Meeting at the École Normale Supérieure de Cachan, France, the participants were the Nortel Institute for Telecommunications (NIT) of the University of Toronto, the National Research Council of Canada (NRC), and the National Scientific Research Center of France (CNRS). The goal was twofold. The participants sought to develop a vision for advancing the cutting-edge field of molecular photonics and plastic electronics. They also wanted to define how Canada and France can work together to realize the vast potential of a field that is revolutionizing telecommunication and information technologies.

The meeting was opened by Dr. Geneviève Berger, Director General of CNRS, followed by Dr. Arthur Carty, President of the NRC, Prof. Peter Smith, Director, NIT, and Dr. Claudine Simson, Vice-President, Disruptive Technology, Network and Business Solutions, Nortel Networks. Co-chairs were Prof. Joseph Zyss, Director, Quantum and Molecular Photonics Laboratory, ENS Cachan, and Prof. Ted Sargent, Nortel Junior Chair in Emerging Technologies, University of Toronto. Also attending were high-level researchers and institutional and industrial decision makers.

It was clear that both France and Canada have outstanding research strengths and government, university, and industry laboratories that complement each other in the domain of molecular and plastic optoelectronics. This emerging field, all agreed, has the potential qualitatively and quantitatively to improve human-machine interaction in telecommunications. Topics explored at the meeting included the following:

Both France and Canada have outstanding research strengths and government, university, and industry laboratories that complement each other in the domain of molecular and plastic optoelectronics.

A new family of photonic components based on optoelectronic polymers to modulate or transmit light signals. These new polymers will speed up key optical telecommunications functions to record-breaking rates beyond a hundred Gigabits a second. Such high speeds are urgently needed because of tremendously increasing demand for Internet-provided services that rely on optical communications.

Electroluminescent-type polymers – a new family of materials for flat-panel displays. These materials represent a major advance compared to such current technologies as

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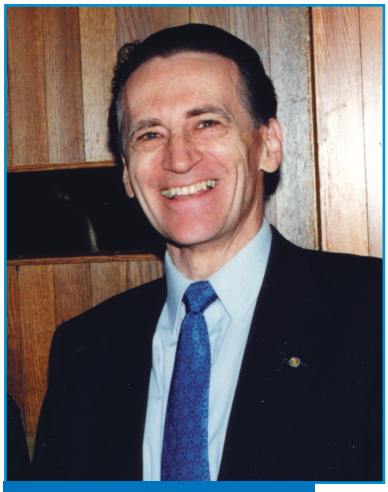
NIT provides Canadian university-based global leadership in advanced information technology and telecommunications research and innovation, strategic analysis, education, and training.

@NIT is published by the Nortel Institute for Telecommunications. We welcome your comments and suggestions.

Nortel Institute for Telecommunications
of the University of Toronto
Sandford Fleming Bldg., Rm. 1102
10 King's College Road
Toronto, ON M5S 3G4
Canada
Tel: 416.946.5610
Fax: 416.946.5635
E-mail: nortel.institute@utoronto.ca

DIRECTOR'S MESSAGE



Peter W.E. Smith

In this, our second newsletter, you will read of our progress in a number of areas.

We have been working hard on developing a new NIT research thrust in the area of polymer and organic optoelectronics. The area has been identified as one with exceptional potential for important new scientific and engineering breakthroughs and one that may hold the key to revolutionary advances in future information networks. It is clear that progress will require multidisciplinary collaborations among researchers in many areas, including chemistry, physics, engineering, and materials science.

Over the last six months, we have been successful in putting in place the resources to mount a major effort in this area. Assisted by generous equipment donations from Westaim/iFire, the National Research Council of Canada (NRC), and Kurt J. Lesker Company, and by commitments of support from Nortel Networks, we have successfully applied for over $4 million in infrastructure and operational support from the Ontario and federal governments. With this funding, two new laboratories are being built at the University of Toronto – one for growing and characterizing new organic and polymer materials, and the other for measuring not only their ultrafast optical response, but eventually the performance of all optical devices made from them.

As part of this initiative, we have held a workshop in partnership with the Quantum and Molecular Photonics Laboratory of the École Normale Supérieure de Cachan, France – one of the top laboratories in the world in this area. This workshop has led not only to new research collaborations between NIT and the Quantum and Molecular Photonics Laboratory researchers, but also to new government-funding opportunities (see lead article).

Our polymer and organic optoelectronics initiative involves new industrial partners, new research collaborations (both locally and internationally), new NIT laboratories, and new NIT researchers (including additional students and postdoctoral fellows). It is an important initiative that furthers our strategic goals to develop large-scale interdisciplinary programs.

Among other items of note in this newsletter, you will learn of our developing plans for the NIT Open Research Facility laboratories in the Bahen building currently under construction. We are drawing on the services of expert consultants to plan the cleanroom and prototype fabrication laboratories, and are well on the road to completing the plans for the laboratory and the initial complement of equipment. We also report on the successful completion of our third Professional Summer School and the record enrolment in the NIT Master of Engineering in Telecommunications program.

Of course, such accomplishments depend on the efforts of many members of our NIT family. The professors and students who perform the research and participate in planning and carrying out our programs are the keys to building our reputation for research excellence. I would also like to acknowledge the support and guidance of our Advisory Council, the initiative and hard work of our NIT Program Manager Helen Lasthiotakis and Secretary Marjorie Boyle, and the liaison activities of our Nortel Networks On-Site Manager Dr. David MacLean.

Who's who at NIT

Director: Prof. Peter W.E. Smith

Advisory Council
Frank Dunn, CFO, Nortel Networks
Adel Sedra, Provost, University of Toronto
Claudine Simson, VP, Nortel Networks
Peter W.E. Smith, NIT Director
Safwat Zaky, Chair, Electrical & Computer Engineering, University of Toronto

Research Thrust Leaders
Network Architecture & Management: Prof. Alberto Leon-Garcia
Emerging Technologies/Device Prototyping: Prof. Peter W.E. Smith & Prof. Ted Sargent
Organic & Polymer Optoelectronics: to be selected
RF/Satellite: Prof. Keith Balmain
Wireless: Prof. John Long

Nortel Chairs
Network Architecture & Services: to be selected
Emerging Technologies: to be selected

Nortel Junior Chairs
Emerging Technologies: Prof. Ted Sargent
Software Engineering: Prof. Angelos Bilas
Communications Network: Prof. Jinwoo Choe

NIT Associates
Profs. Angelos Bilas, Jinwoo Choe, Al-Amin Dhirani, George Eleftheriades, Deepa Kundur, Eddie Law, Zheng-Hong Lu, Farid Najm, Kostas Plataniotis, Ted Sargent, Jianwen Zhu

Nortel On-site Manager: David MacLean
Program Manager: Helen Lasthiotakis
Secretary: Marjorie Boyle

New NIT research lab receives $3 million

The Nortel Institute has been awarded $3 million in funding for a new Organic and Polymer Optoelectronics Laboratory from the Canada Foundation for Innovation (CFI), matched by the Ontario Innovation Trust (OIT). The laboratory will include major in-kind equipment donations from Kurt J. Lesker Company, Westaim/iFire, and the National Research Council of Canada (NRC).

Peter W.E. Smith, Director of the Nortel Institute, hails this award as an important step. It will help develop new research capabilities for exploring the emerging leading-edge technologies that will shape Canada's telecommunications and information networks of the future.

"new research capabilities to explore the emerging leading-edge technologies that will shape Canada's telecommunications and information networks"

The Organic and Polymer Optoelectronics Laboratory (OPOL) will launch a new thrust for NIT. OPOL will explore and exploit an emerging class of novel organic materials and devices for IT applications. Some are based on thin films made out of small organic modules. Others derive from conjugated polymers and oligomers that have the flexibility and robustness of plastics, but can process information in electronic form, generate light, sense heat and pressure – perhaps even act on information.

Two distinct research dimensions will be investigated: fabricating and characterizing the materials, and realizing and exploring the devices. The labs will be located within the Departments of Metallurgy and Materials Science, and Electrical and Computer Engineering at the University of Toronto.

Working synergistically, across disciplinary boundaries and the full spectrum from synthesis to application, will build OPOL's innovative strength and enable it to do breakthrough research. Its concentration of advanced infrastructure and outstanding international expertise in organic and polymer optoelectronic materials, devices, and systems will be unique in the world. Dr. David W. Strangway, President and CEO of the CFI, announced, "This extraordinary level of partnership will not only benefit Canada's research community, but will also play a critical role in strengthening Canada's position in the global economy."

The CFI is an independent, not-for-profit organization, established by the federal government in 1997 to address the urgent need for new, state-of-the-art research infrastructure. The Ontario Innovation Trust was created in 1999 to help Ontario's universities, community colleges, hospitals, and research institutions enhance infrastructure for scientific research and technological development.

The Organic and Polymer Optoelectronics Lab was approved by the CFI Board of Directors on the recommendation of a multidisciplinary assessment committee made up of world-class experts from a wide range of fields and disciplines. To receive funding, OPOL had to demonstrate the excellence and innovative thrust of the projects and the ways the organization will benefit Canada. In announcing the CFI awards, Dr. Strangway stated, "Our universities and research institutions play a critical role in ensuring Canada's research leadership, and in ensuring that communities across Canada reap the benefits of the knowledge-based economy."

Canada Foundation for Innovation
Fondation canadienne pour l'innovation

Ontario Innovation Trust

Kurt J. Lesker company

ifire TECHNOLOGY

NRC·CNRC

Plastic Optoelectronics researchers & principal collaborators

Marie D'Iorio, Institute for Microstructural Sciences, National Research Council of Canada
Zheng-Hong Lu, Metallurgy & Materials Science, University of Toronto
Ian Manners, Chemistry, University of Toronto
Almeria Natansohn, Chemistry, Queen's University
Ted Sargent, Electrical & Computer Engineering, University of Toronto
Peter W.E. Smith, Electrical & Computer Engineering, University of Toronto
Wayne Wang, Chemistry, Carleton University
Joseph Zyss, Molecular Quantum Photonics Lab., École Normale Supérieure de Cachan

Estimation of Mobile Terminal Position in cellular networks

A filtering system to make optimal use of the information gathered from the cellular network, and a realistic dynamic model to locate and predict mobile terminal positions.

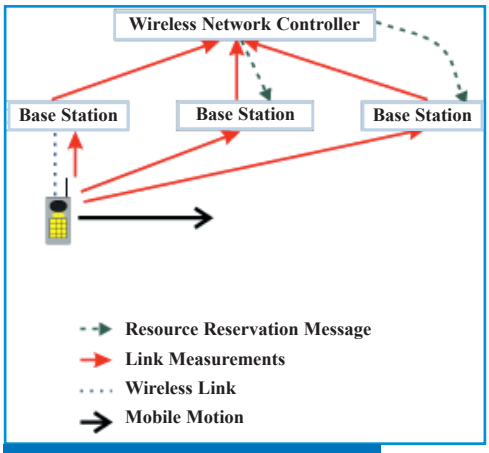


Figure 1

Wireless technology is an increasingly popular way to access cellular networks. Furthermore, no longer is the well-known cellular telephone the only method used, as industrial and academic researchers worldwide explore the wireless potential of the Internet. In our increasingly mobile society, the value of a network with location-sensitive data-browsing is critical. It allows for mapping between the real-world locations of service providers and the Internet. This capacity can have many uses; for example, in emergency services and merchandising.

The next generation of wireless terminals is going to offer broadband applications such as real-time video-on-demand, videoconferencing, and telemedicine. These applications require high-capacity networks able to support different types of data links for various users. However, to create a cellular network that supports these applications, certain issues must be addressed. First, the capacities of the cellular networks must be enlarged to handle the increased traffic. Second, ways to manage the resources of high-bandwidth multimedia links must be created so that users can move freely without interruptions in service. To overcome these problems, the network must be able to estimate the positions of its users.

The Mobile Terminal Location Estimation Group at the University of Toronto is researching solutions for such a wireless network. The Group is supervised by NIT Associate Prof. K.N. Plataniotis and by Dr. A.N. Venetsanopoulos. Working in the group, and supported by NIT, are graduate students Michael McGuire and John Kountouris of the Digital Signal Processing Group, Department of Electrical and Computer Engineering. As well, six senior undergraduate students will work in three projects in this area, under the supervision of Prof. Plataniotis, as a requirement of their fourth-year design project.

NIT Associates are selected by the NIT Research Program Committee and receive research support of $50,000 over two years. The program funds new faculty members who have innovative and significant research that fits the general mandate and scope of the Institute. In return, Associates bring value to NIT by contributing to the growth and visibility of our research programs and reputation for excellence.

The most frequently proposed method for enlarging the capacity of cellular networks is to make the elementary network areas, called cells, smaller. This reduction in size has the undesirable effect of increasing the processing needed to manage resources when users move. With smaller cells, when a user's resource demands vary, good performance depends on anticipating the user's movement. The network will predict the cells that a given user is likely to inhabit in the future and will allocate resources in those regions. Figure 1 shows a simplified version of this architecture.

To make such predictions, a filter is created that has an accurate dynamic model of the mobile terminal motion. This dynamic model describes how a mobile terminal changes its speed and direction and combines this information with the location estimates to make predictions. Figure 2 shows how a dynamic model can dramatically improve the estimates of mobile terminal motion. Note how the estimates using the

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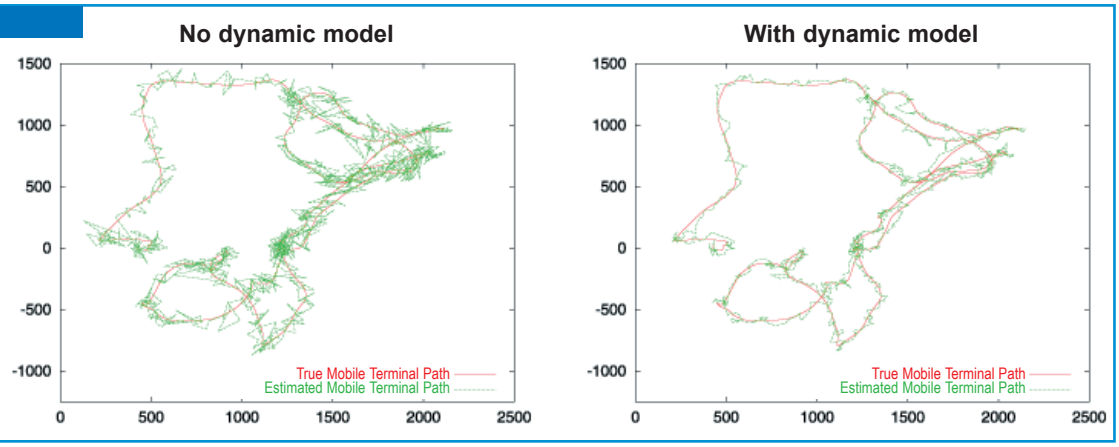
Figure 2



Unified Policy-Based Management in an experimental testbed

The Internet Engineering Task Force (IETF), an open standards body, is proposing policy-based management for the Internet. The latest policy framework suggested in a Request for Comments (RFC) contains not only a policy-rule database-access mechanism, but also a two-level system architecture. To provide greater flexibility and dynamism, Professor Eddie Law, NIT Associate, has taken the architecture a step further by designing a multilevel policy-based framework, the Unified Policy-Based Management (UPM). The UPM would be the first cross-vendor platform design that allows for adding/dropping policy managers and policy rules transparently.

The novel UPM design introduces an intermediate entity, the policy-enforcement agent, to the middle of the system architecture. The policy-enforcement agent allows transparent communications between service request and decision points. It can intercept or bypass decisions that depend on the content of the messages from and to the edge-network routers and policy managers/servers. Adding a dynamic new information model midway between multiple policy managers and agents lets the agent operate on any of the versions of the stored policy rules in the database server by interpreting and translating request and decision messages on the fly. The design provides a powerful scalable structure that shares and balances loads between managers and agents.

Graduate student Achint Saxena is responsible for implementing and verifying a prototype of the UPM system in the NIT Client/Server laboratory currently housed within the Network Architecture Laboratory in the University of Toronto Galbraith Building. At the moment, the client/server experimental testbed is equipped with two high-end layer-three routers, the Black Diamond and the Extreme 7i; ten 4-port Linux routers, and fifty personal computers that operate as end-host systems and service servers. The layer-three routers can create any number of virtual LANs, thus resulting in many different network topologies. Moreover, with the ten Linux router systems, many kinds of network designs can be created and tested by modifying both the kernel and application layers. All new software programs for the project are written with freeware; for example, open-source implementation Lightweight Directory Access Protocol (OpenLDAP), and Linux Transmission Control Protocol (TCP) and Internet Protocol (IP) kernels.

The testbed provides an excellent setup for many research projects to be run simultaneously. For example, graduate student Richard Chen is currently carrying out a voice-over IP project using the testbed. The goal of this project is to connect the Internet-network domain with the real-telephone voice domain by using a gateway-protocol prototype, the Megaco Protocol. This innovation will enable voice and video communications (if supported) between computers connected to the Internet and normal telephone sets. The group is working on several other projects in the experimental testbed, with promising results that may produce a potentially tremendous payoff.

For more information, contact
Prof. Eddie Law, NIT Associate
eddie@comm.toronto.edu

Graduate students Achint Saxena (left) and Richard Chen (right).

This is the first cross-vendor platform design to control all vendors' network routers in the Internet.

Estimation of Mobile Terminal Position in cellular networks

dynamic model not only follow a path that is closer to the true mobile terminal motion, but are "smoother". This "smoothness" allows for predicting future locations.

The Mobile Terminal Estimation Location Group focuses on developing two things: a filtering system to make optimal use of the information gathered from the cellular network, and a realistic dynamic model to locate and predict mobile terminal positions. As well, the group will study how these predictions can be combined with managing network resources.

For more information, contact
Prof. Kostas Plataniotis, NIT Associate
kostas@dsp.toronto.edu

NIT Associates win prestigious Premier's Research Excellence Awards

Al Amin Dhirani and Zheng-Hong Lu

Two Research Associates of the Nortel Institute have won the prestigious Premier's Research Excellence Award (PREA) in round three of the competition: Profs. Al-Amin Dhirani and Zheng-Hong Lu.

Prof. Dhirani, of the Dept. of Chemistry, cross-appointed to Physics, was recognized for "research into nanotechnology with a goal to develop a hybrid microscope that can observe single molecules." Prof. Lu, of the Dept. of Metallurgy and Materials Science, was cited for "research into advanced materials and nanostructures to enable future generations of communication systems."

Another NIT Research Associate, Prof. Edward H. (Ted) Sargent, of the Dept. of Electrical and Computer Engineering, won the PREA in round two for theory, design, and realization of 3-D photonic crystals and functional photonic devices.

The PREA program assists gifted researchers in Ontario in attracting talented people to its research teams, helping to reverse the brain drain. By investing $75 million over 10 years, it intends to ensure that Ontario attracts and retains the pre-eminent researchers it requires for an international level of excellence. The recipients are principal investigators at Ontario universities, colleges, hospitals, and research institutes, who are funded for teams of graduate students, post-doctoral fellows, and research associates. The PREA recognizes researchers who can "make a difference" through the excellence of their work, the vision they bring to their endeavours, and the impact they foresee resulting from their achievements.

New MET Program Director

Tony Yuen

As of July 2000, Prof. Tony Yuen has been appointed Director of the Master of Engineering in Telecommunications (MET) Program at the University of Toronto. This innovative and focused program is taught by faculty from the Department of Electrical and Computer Engineering, Faculty of Law, and Rotman School of Management, as well as industry professionals.

Prof. Yuen is an adjunct full professor in the Faculty of Applied Science and Engineering and the Rotman School of Management at the University of Toronto, where he teaches courses in the Management of Telecommunications and Information Technology at the graduate level. Prof. Yuen's current research areas include Management of Innovation and New Technologies, the Convergence of the IT/Telecom/Internet Industries, and the Impact of E-Business/E-Commerce on the Network Economy.

NIT Student Affiliate receives Centennial Award

At the June University of Toronto Engineering Convocation, Suzanne (Sue) Erickson received the Centennial Award for the best undergraduate thesis among the 108 recipients of the B.A.Sc. degree in Engineering Science. Her research, entitled *"Electrical Properties of Spacecraft Dielectrics"*, was conducted with the supervision of Prof. Keith Balmain, Nortel Institute Research Thrust Leader.

Suzanne's thesis included an extensive series of DC and RF/microwave tests on the conductivity and permittivity of both familiar and novel spacecraft-insulating materials, the novel materials having been synthesized by Prof. Ian Manners of the University of Toronto Chemistry Department. The experiments were conducted in the NIT materials measurement and characterization labs. The NIT labs are currently located in the Sandford Fleming Building, but will be relocated to become part of the NIT Open Research Facility in the Bahen Centre for Information Technology, scheduled for completion in 2002.

This work represents the start of what is expected to be a major research activity. It will explore the properties of novel materials for both spacecraft and earthbound electronics, with emphasis on high-speed digital circuits and microwave/millimetre wave applications. The NIT Microwave/Satellite research thrust is intended to capitalize on the unprecedented surge in the planned and implemented use of microwave and satellite techniques in telecommunications in Canada and, even more so, in countries with less wireline infrastructure. Research in this area cuts across a broad range of specialties, including millimetre-wave systems, integrated-circuit planar antennas and arrays, high-speed backplanes and interconnects, and novel electromagnetic materials leading to entirely new devices. Prof. Balmain noted: "The NIT investment in instrumentation for materials measurement and characterization paid off both quickly and well."

NIT Professional Summer School a great success

For the third year in a row, the NIT Professional Summer School has been filled to capacity by students and professionals. This short course is designed for the networking and information technology (IT) professional to learn about the forces dramatically restructuring the networking industry.

This year's theme was the *Impact of New Technologies on the Telecom Industry*, with special focus on disruptive business and architecture solutions that could change the structure of the entire global telecommunication service-provider industry. As in previous years, an overview was provided of the current trends in the converging IT industries, including computing and consumer electronics. A panel discussion included a debate on the implications for the Canadian market. Industry experts zeroed in on the three areas key to networks: security, storage, and performance.

Prof. Tony Yuen, Director of the Master of Engineering in Telecommunications (MET) program, notes: "The Summer School provides a unique opportunity for industry professionals and the University of Toronto faculties to interact in a real-time environment on critical business and technology issues. The leadership and contributions from the combination of University researchers and industry professionals are invaluable."

For further information about the Professional Summer School, visit www.nal.utoronto.ca/ExecCourses

Impact of New Technologies on the Telecom Industry

July 25-26, 2000
University of Toronto

Groundbreaking ceremony for future home of NIT Open Research Facility

On Wednesday, May 31, the University of Toronto held a groundbreaking ceremony for the Bahen Centre for Information Technology. On the corner of St. George and Russell Streets, the building will be the future home of the Nortel Institute Open Research Facility. The facility will cover an area of 900 square metres and will include cleanrooms, network architecture testbeds, baseband signal and microwave/RF, and millimetre-wave processing labs.

The $88 million Bahen Centre will enable the University to position its information technology (IT) programs with the best in the world and help meet Canada's growing demand for well-educated IT practitioners. The provincial government has provided $43 million towards the Centre and its activities through the Ontario Innovation Trust, the Ontario Ministry of Education and Training Access to Opportunities Program, the Ontario Research and Development Challenge Fund, and the SuperBuild Fund. The federal government, through the Canada Foundation for Innovation program, will also be supporting the Centre.

Groundbreaking ceremony at the University of Toronto for the Bahen Centre for Information Technology.

Congratulations to
Firas Albanna
Yongfeng Chen
Hong (Rose) Wu
Luming Xu

NIT Graduate Scholars 2000-2001

As part of establishing the Nortel Institute, together the University of Toronto, Government of Ontario, and Nortel Networks have set up the **Master of Engineering in Telecommunications (MET)** scholarship program, under the Ontario Student Opportunity Trust Fund. The scholarship is awarded to exceptional students who are attending the MET program full-time. It is based on academic merit and financial need.

UNIVERSITY OF TORONTO
THE NORTEL INSTITUTE and the
EDWARD S. ROGERS SR. DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Nortel Institute Chair in Network Architecture and Services

The Nortel Institute for Telecommunications has been established at the University of Toronto to further research and education in communications and emerging technologies. It has excellent research facilities.

Applications are invited for the Nortel Institute Chair in Network Architecture and Services. The Chair holder is expected to play a leadership role in the evolving research programs of the Department and the Institute. Areas of interest include network architecture and management, optical and wireless networks and network services, hardware and software. The successful applicant will have an opportunity to engage in significant research interactions with Nortel Networks.

Applicants must have a doctoral degree, an outstanding research record, and a strong interest in teaching. Additional information can be found at: http://www.ece.toronto.edu

Applicants should send a curriculum vitae, a statement concerning teaching and research interests, and a list of at least four references by January 15, 2001, to Professor Safwat G. Zaky, Chair, Dept. of Electrical and Computer Engineering; University of Toronto; 10 King's College Road; Toronto, Ontario M5S 3G4; Canada.

The University of Toronto is committed to employment equity and encourages applications from women, visible minorities, aboriginal people, and physically challenged persons.

Canada and France launch new bilateral initiative

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cathode and plasma screens, electroluminescent diodes containing semiconductors, or liquid-crystal displays. The benefits of electroluminescent-type polymers are many. They increase luminosity. They provide a rich spectrum of emitted colours. The diversity and structural flexibility of the polymers may one day lead to printing flexible screens on very large areas with inkjet-type techniques or rotary presses.

In the field of bioelectronics, combining microelectronics and biochemistry creates new concepts and achievements, such as chips with DNA for sequencing and the first biomimetic devices.

Outcomes of the Workshop

◆ Canada and France will build on their complementary research strengths through concerted, strategic programs. Their bilateral research partnerships will use the novel properties of emerging organic and molecular materials in two particular ways. They will bring new paradigms to telecommunications devices for the Internet economy, and they will create displays, sensors, and other devices that redesign human experience.

To make rapid, lasting progress in the field requires a framework to support and promote bilateral projects. The framework must ensure that Canadian and French government, university, and industry laboratories work in partnerships with suitable human and physical capital. In view of the vast industrial potential, programs will be targeted towards the most promising industrial applications.

◆ A Canada-France Conference on Molecular Photonics and Plastic Electronics (MPPE 2001) will be held October 10-12, 2001. The conference will be sponsored by the NRC/CNRS/Nortel Institute and will be held in Canada. The conference will be coupled with the first preliminary review of Canada-France projects.

In connection with the Canada-France partnerships, NIT has initiated a new research thrust entitled *"Organic and Polymer Optoelectronics"*. The research has attracted funding to develop new laboratories, acquire advanced research infrastructure, and train highly qualified personnel in this area of critical importance to the communication and consumer-product industries.

Visit our web site at www.nit.utoronto.ca for details regarding NIT