Spring / Printemps 2007, No. 54

IEEE Canadian Review

La revue canadienne de l'IEEE

BROADBAND

- Broadband over Power Line
- Broadband (Acadian) Peninsula
- Sécurité des réseaux sans fil
- Imperfections géométriques et biréfringence des fibres microstructurées

Canada Post—Canadian Publications Mail Sales
Product Agreement # 40592512

IEEE Canada
The Institute of Electrical and Electronics Engineers Inc.

Your Company Needs More Professionals Just Like You.

When your company wants to fill an important position, they should look for an important candidate - a fellow IEEE member. Refer your Human Resources colleague to the IEEE Job Site for a free posting and they'll find the best potential employees in the business.

IEEE

IEEE JobSite
The Right Candidate - Right Now!

Find the right candidate - right now! www.ieee.org/jobs/r7promo

Editorial / *Éditorial*

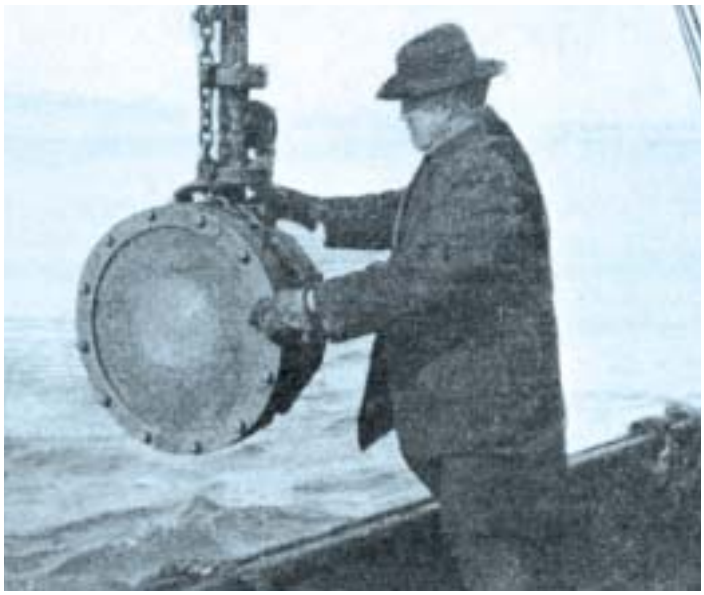
Eric Holdrinet SMIEEE, Rédacteur en chef / Managing Editor

Il y a un peu plus de 100 ans, la veille de Noël 1906, le grand inventeur canadien Reginald Aubrey Fessenden transmettait ce qui a été reconnu depuis comme la première émission de radio. Elle comprenait deux sélections musicales, un poème, et une courte allocution. Il s'agissait d'un immense progrès comparé aux transmission sans fil à base d'étincelles et en code morse de l'époque, et il faudra encore plusieurs années avant que cette innovation soit reconnue et adoptée.

De nos jours les nouvelles façons de tasser plus d'information dans les canaux de communication sont adoptées presqu'aussi vite que les bits de données voyagent sur le dos d'un photon, et elle rejoignent tous les coins de la société. Cela devient évident quand votre voisin/collègue/parent précédemment technophobique vous dit « j'ai la haute vitesse ». Non, ça ne veut pas dire qu'il doit se rendre au petit coin toutes les cinq minutes.

En pratique le terme « Haute vitesse » (Broadband) est utilisé de façon générique. Il s'applique indifféremment aux infrastructures régionales câblées (comme vous lirez dans *Broadband Peninsula*) et à votre routeur sans fil de maison (et vous devriez vous assurer que son installation d'encryption est à niveau, tel qu'expliqué dans *La Sécurité des réseaux locaux sans fil*). De nouvelles façons de livrer la haute vitesse sont même conçues pour utiliser votre filage électrique existant; cela est décrit dans *Broadband over Power Line*.

Pour ce qui est de Fessenden, un des meilleurs moyens d'honorer sa mémoire est de proposer un ingénieur canadien exceptionnel pour la Médaille d'argent R.A. Fessenden du IEEE Canada. Voir www.ieee.ca/prix pour les détails. Proposez des candidats pour toutes les médailles, proposez souvent, et envoyez-nous un article lorsque votre collègue obtient un prix majeur du IEEE. En attendant, bonne lecture.



Building on his work with radio frequency oscillators, Fessenden developed a revolutionary acoustic oscillator/detector system that received reflected signals from the bottom as well as from obstructions in the water. Photo courtesy U.S. National Oceanic and Atmospheric Administration Photo Library. http://oceanexplorer.noaa.gov/library/readings/subsignaling/media/lowering.html

Cover picture / *Photo de couverture*

Reginald Fessenden's work on voice radio was emblematic of a spectacular increase in the bandwith of the medium, with repercussions that continue to this day in business, research and society at large. Fessenden image ©Bettmann/Corbis. Background binary code spiral image ©Guy Grenier/Masterfile.

A little more than 100 years ago, on Christmas eve of 1906, the great Canadian inventor Reginald Aubrey Fessenden transmitted what has been recognized since as the first radio program. It included two musical selections, a poem, and a short talk. This was an immense progress compared to the spark-based, Morse-code carrying wireless transmissions then in use, and it would still take years for this innovation to be recognized and adopted.

Nowadays, however, novel ways of cramming more information into communication channels get adopted almost as fast as the bits of data travel on the back of a photon, and are reaching every corner of society. This becomes obvious when your erstwhile technophobic neighbour/co-worker/relative tells you "I got broadband". Believe me, it would be unadvisable at this point to mention their waist size.

In practice the term Broadband is used generically for "very fast". It is applied indifferently to cabled regionwide infrastructure (as you will read in *Broadband Peninsula*) and to your home wireless router (which you should ensure has the right encryption set up, as explained in *La Sécurité des réseaux locaux sans fil*). New ways of delivering Broadband are even devised for using your existing electrical cabling, and this is described in *Broadband over Power Line*.

As for Fessenden, one of the best ways to remember his accomplishments is to nominate an outstanding Canadian engineer for the IEEE Canada's R.A. Fessenden Silver Medal. See www.ieee.ca/awards for details. Nominate for all medals, nominate often, and send us an article when your colleague gets a big IEEE prize. In the meantime, good reading.

Contents / *Table des matières*

IEEE Canada

Officers

Director/President - Robert Hanna
Director/President Elect - Ferial El-Hawary
Past Director/President - W.O.(Bill) Kennedy
Secretary - Vijay K. Sood
Treasurer - Rob Anderson

Director Emeritus - Wally Read
Director Emeritus - Ray Findlay

Groups & Committees

External Relations: Bruno DiStefano
- Educational Activities - Saman Adham
- Industry Relations - Bin Wu
- Other Societies - Branislav Djokic
- Professional Develop. - Bruno DiStefano
- Sections/Chapters Suppt. - Gerard Dunphy

Member Services: Lori Hogan
- Advancement - Kostas Plataniotis
- GOLD - Lori Hogan
- Life Members - Ron Potts
- Membership Develop. - Elmer Bourque
- Students - Janet Bradley
- Women in Engineering - Jennifer Jessop

Publications & Communications: Om Malik
- Canadian Review - Eric Holdrinet
- CJECE -W.Kinsner & X.Maldague
- Electr. Newsletter - J. Mackinnon & A. Bot
- Translation - Christian Pépin
- Webmaster - Ahsan Upal

Student Representative - Randy Glenn

Other Committees
- Awards & Recognition - Robert Alden
- Conference Advisory - Ashfaq Husain
- Standards - Bill Lockley
- Strategic Planning - Ferial El-Hawary

Area Chairs

Canada Central: Keith Brown
Canada East: Amir Aghdam
Canada West: Lawrence Whitby

Section Chairs

Canadian Atlantic - Charles Cooke
Hamilton - Chris Maryan
Kingston - Keyvan Hashtrudi-Zaad
Kitchener/Waterloo - Shahab Ardalan
London - Maike Luiken
Montréal - Anader Benyamin
New Brunswick - Luichen Chang
Newfoundland & Labrador - Kathleen Chafe
Ottawa - Wahab Almuhtadi
Peterborough - Sean Dunne
Québec - André Morin
Northern Canada - James Brown
North Saskatchewan - Denard Lynch
Saint Maurice - Christian Pépin
South Saskatchewan - Craig Gelowitz
Southern Alberta - Philip Choy
Toronto - Alagan Anpalagan
Vancouver - Rasvan Mihai
Victoria - David Gregson
Winnipeg - Stephen Dueck

IEEE Canada Administrator

Cathie Lowell

IEEE Canadian Review General Information

The ***IEEE Canadian Review*** is published 3 times/year as follows: Spring (to appear in April-May), Summer (to appear in August-September), and Fall (to appear in December). 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	7- Computers
2- International Affairs	5- Power	8 - Electronics
3- Industry	6- Communications	

Advertising Policy

Organizations are invited to place corporate advertising in the ***IEEE Canadian Review***. For information regarding rates and copy requirements, please contact the Advertising Manager.

Circulation

The circulation of the ***IEEE Canadian Review*** is the entire membership of IEEE Canada, plus external subscribers.

Information for Authors

Authors are invited to contribute submissions in electronic form to the ***IEEE Canadian Review***. Please contact one of the editors. Responsibility for the content rests upon the authors and not the IEEE, or its members.

Annual Subscription Price

Free of charge to all IEEE members in Canada. For IEEE members outside Canada: $20.00/year. Non-members: $35.00/year. Corporations and libraries: $37.50/year. Additional copies may be ordered at a cost of $7.50 each from the Managing Editor.

Reprint Permission

Change of address

- Do-it-yourself with MyIEEE: http://www.ieee.org/myieee
- Email: address.change@ieee.org
- Tel: 1 (800) 678-4333
- Mail: IEEE Service Center
  445 Hoes Lane, P.O. Box 1331
  Piscataway, NJ 08855-1331, USA

Member of / membre constituant de
Engineering Institute of Canada
l'Institut canadien des ingénieurs

The National Library of Canada
ISSN 1481-2002
La Bibliothèque nationale du Canada

Managing Editor
Rédacteur en chef

Eric Holdrinet
Consulat général du Canada à L.A.
550 S. Hope Str., 9th Floor
Los-Angeles, CA 90405, USA
tel: (213) 346-2758
fax: (213) 346-2767
e.holdrinet@ieee.org

Associate Editors
Adjoints à la rédaction

Alexandre Abecassis
Fasken Martineau DuMoulin

Habib Hamam
Université de Moncton

Khelifa Hettak
Communications Research Centre

Dave Kemp
Past-Chair, IEEE Canada

Terrance J. Malkinson
GE Capital ITS Inc.

Samuel Pierre
École Polytechnique de Montréal

Camille-Alain Rabbath
Defence Research & Dev. Canada

Vijay Sood
Hydro-Québec IREQ

Bin Wu
Ryerson University

Alain Zarka
SEA-Network

Advertising Manager
Resp. de la publicité

John Grefford
1895 William Hodgins Lane
Carp, ON, Canada, K0A 1L0
tel: (613) 839-1108
fax: (613) 839-1406
Grefford@ieee.org

Art & Production

Communication Matters
tel: (416) 599-9229
fax: (416) 599-8718
production
@CommmunicationMatters.com

Bob Hanna, FIEEE, FEIC, FIEE, President of IEEE Canada: 2006-2007 / Président de l'IEEE Canada: 2006-2007

By the time you will be reading this column, I will have completed about a year and a half of my volunteer duties as President of IEEE Canada. I would like to share with you what we have accomplished and some of the activities that we are planning for the balance of 2007.

I am pleased to report that IEEE Canada finances are in good shape mostly due to our cost cutting measures, excellent volunteer work and increased revenues from our activities and from advertising. We are now well positioned to shift our focus onto other key priorities such as member services and working on strengthening our relationship with the industry. We have also redesigned our website (www.ieee.ca) as well as the monthly newsletter and have met our target in publishing it at the start of each month.

In addition, 2006 saw our total membership grow by 4.4% to 16,410, including a student growth of 6.7%. These good results would not have been possible without the hard work and dedication of a countless number of devoted volunteers including Elmer Bourque (membership development chair), Janet Bradley and Randy Glenn (student activities).

In 2006, we exceeded our target in seeing 122 members elevated to the senior grade. Congratulations to our new senior members as well as to 14 members who were elevated to Fellow grade for 2007. As an added service to our members, we are in the process of establishing a "Fellow Nomination Assist Committee" to assist Fellow nominators, provide guidance and help in finding Fellow references.

On March 03, 2007 the Engineering Institute of Canada (EIC) held its annual award gala in Ottawa. Congradualtions to the ten IEEE members who were elevated to EIC Fellow, to Dr. Ljiljana Tracjkovic who was awarded the Canadian Pacific Railway Engineering Medal and to Wally Read who was awarded the top EIC award, the Sir John Kennedy Medal.

Beautiful Vancouver hosted our highly successful 20th annual IEEE Canadian Conference on Electrical and Computer Engineering (CCECE 07), April 22-25. This conference was founded in 1987 by Prof. Vijay Bhargava and his dedicated team from B.C., so it was most fitting that we celebrated its 20th anniversary back again in Vancouver. A highlight of the conference banquet was the award ceremony recognizing members for their distinguished technical achievements and extraordinary services. A conference first, two new medals in the fields of power engineering and computer science were also presented, recently established by IEEE Canada.

The IEEE Canada Spring Board of Directors meeting took place on April 20-22, just prior to CCECE. The Board reviewed current activities and discussed strategic plans to enhance our organization's performance. Also, section chairs and other volunteers attended an exellent training workshop.

Our Education committee is planning for the first time to hold at least three webinars in 2007 covering topics of general interest including leadership, project management and communications. The details of these events will be announced in our monthly newsletter and are offered free to our members.

IEEE Canada, in collaboration with IEEE Montreal and Ottawa sections, is organizing a Power Engineering conference to take place in Montreal in late October 2007. The organizing committee is working on the technical program (see *Call For Papers* and other details back cover). This initiative is undertaken to build on the success of the Ottawa section in organizing a Electrical Power Symposium in the last six years. The conference web site is http://www.ieee.ca/epc07/

I appeal to all those members who have not renewed their membership yet for 2007 to do so as soon as possible. I also encourage our members to attend our section events, seminars and special meetings as well as to consider being a volunteer.

I am very grateful to all our volunteers in IEEE Canada, who work hard to serve our members across Canada.

Alors que vous lisez cette rubrique, j'aurai complété près d'un an et demi de bénévolat en tant que Président de l'IEEE Canada. J'aimerais en effet vous faire partager le travail que nous avons accompli ainsi que quelques activités prévues pour le bilan de 2007.

Je suis heureux de vous annoncer que les finances de l'IEEE Canada se portent à merveille, grâce principalement à nos mesures de compression des coûts, un excellent travail de bénévolat et des revenus accrus provenant de nos activités et de la publicité. Nous sommes maintenant bien positionnés pour nous concentrer sur d'autres priorités majeures telles les services aux membres et le renforcement de notre relation avec l'industrie. Nous avons également amélioré la conception de notre site Web <www.ieee.ca> de même que le bulletin mensuel et avons atteint notre objectif en le publiant au début de chaque mois.

De plus, en 2006 nous avons vu notre nombre total de membres croître de 4.4% à 16 410, y compris une croissance du nombre de membres étudiants de 6.7%. Ces merveilleux résultats n'auraient pas été possibles sans le travail acharné et l'implication d'innombrable bénévoles comme Elmer Bourque (président du recrutement des membres), Janet Bradley et Randy Glenn (activités étudiantes).

En 2006, nous avons dépassé notre objectif en ayant 122 membres promus au rang de membre senior. Félicitations à nos nouveaux membres seniors ainsi qu'aux 14 membres promus au rang de Fellow pour 2007. Comme service supplémentaire à nos membres, nous mettons en place un « Comité d'assistance pour la nomination de Fellows » afin d'aider les nominateurs de Fellows, fournir des conseils et l'aide nécessaire pour trouver des références.

Le 3 mars 2007, l'Institut canadien des ingénieurs (ICI-EIC) a tenu son gala des récompenses annuel à Ottawa. Félicitations aux 10 membres de l'IEEE qui ont été promus au rang de Fellow de l'ICI, au Dr. Ljiljana Tracjkovic qui a reçu la Médaille du Chemin de fer Canadien Pacifique et à Wally Read qui s'est vu décerner la plus haute récompense de l'ICI, la Médaille 'Sir John Kennedy'.

La magnifique ville de Vancouver a accueilli notre 20e Conférence Canadienne annuelle de Génie électrique et Informatique de l'IEEE (CCGEI'07) du 22 au 25 avril 2007. Cette conférence a été créée en 1987 par le professeur Vijay Bhargava et son équipe dévouée, et nous étions de retour à Vancouver pour célébrer son vingtième anniversaire. Lors du banquet de la conférence, nous avons remis des prix à des membres qui se sont distingués au niveau des réalisations techniques et des services extraordinaires. En outre, IEEE Canada a procédé à la création de deux nouvelles médailles pour l'excellence technique dans le domaine de du génie électrique et de l'informatique. Ces médailles ont été remises pour la première fois à cette occasion.

La réunion de printemps du conseil d'administration de l'IEEE Canada a eu lieu du 20 au 22 avril 2007 à Vancouver. Le conseil a passé en revue les activités courantes et discuté des plans stratégiques pour améliorer la performance de notre organisation. En outre, un atelier de formation a eu lieu pour les présidents de sections et autres bénévoles.

Pour la première fois, notre comité d'éducation planifie la tenue d'au moins trois ''webinaires'' en 2007, couvrant des sujets d'intérêt général incluant le leadership, la gestion de projet et les communications. Les détails de ces événements seront annoncés dans notre bulletin mensuel; ils seront offerts gratuitement à nos membres.

IEEE Canada, en collaboration avec les sections de Montréal et Ottawa, organise une conférence en génie électrique qui aura lieu à Montréal en octobre 2007. Le comité organisateur travaille sur le programme technique; voir l'Appel aux communications en couverture arrière de la Revue. Cette initiative est basée sur le succès de la section d'Ottawa qui a organisé un colloque sur la puissance électrique lors des six dernières années. Le site de la conférence est http://www.ieee.ca/epc07/

Je lance un appel à tous les membres qui n'ont pas encore renouvelé leur adhésion pour l'année 2007 à le faire le plus tôt possible. J'encourage également nos membres à assister à nos événements de sections, conférences et réunions spéciales, et envisager de servir comme bénévole.

Je suis très reconnaissant envers tous nos bénévoles au sein de l'IEEE Canada, qui travaillent dur pour servir nos membres à travers le pays.

Bob Hanna, P.Eng., FIEEE, FEIC, FIEE
r.hanna@ieee.org

Newslog Editor

Rédacteur des Coupures de presse

Alexandre Abecassis is a patent agent and Partner at Fasken Martineau DuMoulin LLP, Lawyers and Patent and Trade-mark Agents.

Alexandre Abecassis est agent de brevet associé chez Fasken Martineau DuMoulin S.E.N.C.R.L., s.r.l., Avocats et agent de brevets et de marques de commerce.

Send any news clippings you would like to contribute via e-mail to alexandre.abecassis@ieee.org

Veuillez faire parvenir les coupures de presse proposées par e-mail à alexandre.abecassis@ieee.org

OTTAWA, ON. Mar. 13, 2007. Telesat has announced that it has signed a consulting contract with the Pakistan Space and Upper Atmosphere Research Commission. Under the agreement, Telesat will assist the Commission in the procurement and launch of a satellite that will replace an existing one in 2010.

MONTREAL, QC. Oct. 13, 2007. The Department of Justice Canada has signed a seven-year agreement with Irosoft. Under this agreement, Irosoft's mandate is to ensure the maintenance and development of modules for the Lims environment of the Department of Justice Canada. The Lims environment is a legislative drafting environment, an automated act and regulation consolidation environment, a dissemination environment, an intranet, a website and a system for printing acts and regulations.

TORONTO, ON. Jan. 29, 2007. Bioscrypt, which is a provider of enterprise access control technologies, has announced that Catsa has selected a handheld rugged biometric reader from Labcal Technologies that incorporates Bioscrypt technology to authenticate employees in 29 canadian airports.

MONTREAL, QC. Feb. 15, 2007. CMC Electronics has been selected by Patria, Finland, to perform a glass cockpit avionics upgrade of fifteen BAE Systems Hawk trainers for the Finnish Air Force.

PROVO, UT. March 14, 2007. Ancestry.ca, the largest Canadian family history website, has announced a partnership with Université de Montréal to index the Drouin collection which is considered to be one of the best resources for French-Canadian family history records. The collection comprises 12 million records from 1621 to the 1940s. It comprises 37 million French-Canadian names and 3.6 million images and represents all vital records from Quebec including baptism, marriage and burial as well as a compilation of church records from Ontario, Nova Scotia, New Brunswick and various New England states in America.

MONTREAL, QC. Mar. 15, 2007. uMind has be launched following 10 years of research and development in Artificial Intelligence (AI) and will deliver two pioneering platforms that teach rather than just deploy content. More precisely, the platforms increase the learning, understanding, and retention by dynamically adapting training to each learner's existing knowledge base, skill-gaps, preferred cadence and learning style.

TORONTO, ON. Feb. 28, 2007. Musicrypt and Pando Networks have announced that they have entered into a licensing agreement extending and expanding their relationship following a pilot program. Musicrypt integrated the peer to peer technology of Pando Networks with their patented digital media distribution system in order to provide fast and secure delivery of large digital content such as television commercials, music videos and audio files via the Internet.

LONGUEUIL, QC. Feb. 21, 2007. Traveleyes, a company that specializes in organizing overseas trips for the visually impaired, now provides its clients with HumanWare's Trekker Talking GPS system. The GPS Trekker system is a talking GPS system that uses digital maps to help blind persons find their way everywhere in the world. The users can pinpoint exactly where they are, learn about area attractions and find in realtime how to get to specific destinations.

TORONTO, ON. Jan. 29, 2007. BorderWare technologies has launched a new technology and approach to combat increasingly sophisticated online threats. The patent-pending technology further enhances the company's borderware security network (BSN), a real-time reputation and behaviour analysis service for Email, Web, Instant Messaging (IM) and Voice Over IP (VoIP), by examining and tracking the content of traffic across domains and users to determine potential risks.

MONTREAL, QC. Jan. 18, 2007. Nstein technologies has announced the signing of a contract with a media company to provide a solution to centralize and normalize its collection of multimedia digital assets. The solution will further provide advanced search and retrieval functions to the organization's staff and power the repurposing of its voluminous archive for syndication and multichannel delivery.

BURNABY, BC. Jan. 16, 2007. The US Patent and Trademark office (USPTO) has issued a patent assigned to Icron for a technology which enhances the range of Universal Serial Bus (USB) without requiring extra drivers, user configuration or host controller changes. The patent is entitled "Method and apparatus for extending the range of the universal serial bus protocol".

RICHMOND, BC. Jan. 15, 2007. MacDonald, Dettwiler, a provider of essential information solutions, has announced that NASA has increased the value of its Canadarm contract with MDA by approximately 28M$C.

MONTREAL, QC. Dec. 13, 2006. Orthosoft, a leader in developing and marketing computer-assisted navigation systems that increase the accuracy of orthopaedic hip and knee replacement, recently extended the existing development and distribution agreement with one of its key worldwide implant company partners. In the non-exclusive agreement, the Orthosoft partner has committed to 2.5M$ in minimum purchases of Orthosoft navigation systems for 2007. The partner will market the systems to orthopaedic hospitals and surgeons mainly in United States.

VANCOUVER, BC. Dec. 6, 2006. Recombo has announced a business deal with consumer and credit reporting agency Equifax Canada that will integrate its real-time authentication system into the enhanced digital signature technology of Recombo. This digital signature technology enables businesses to capture digital signatures, speeding workflow processes by completing contracts and agreements through email and the Internet and now validating identities online.

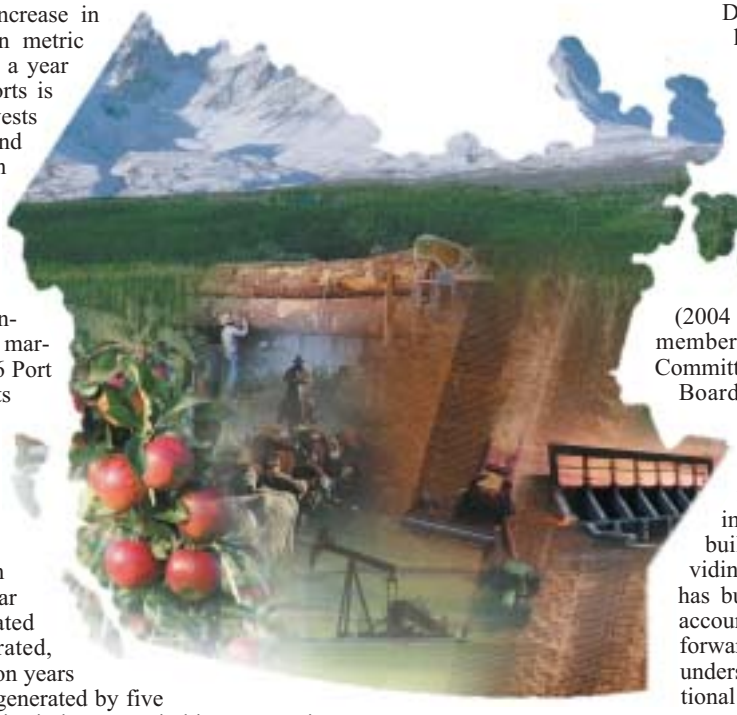
OTTAWA, ON. Nov. 23, 2006. March Networks, provider of Internet-Protocol (IP)-based digital video surveillance solutions, has announced that 190 new trains for Metronet Rail, which will operate on the London Underground's subsurface lines, will be fitted with a Bombardier transit security solution. The video surveillance of the Bombardier security solution is jointly designed and developed with March Networks and will be used by operation staff to capture video for monitoring the safe and efficient flow of passengers along with supporting efficient operations. The solution will further comprise intelligent video analytics.

Mérites du français dans les technologies de l'information:
Hydro-Québec, lauréate pour son outil GenSpec

L'Office québécois de la langue française, au Grand gala des Mérites du français tenu le 21 mars 2007, a décerné un prix Mérite à Hydro-Québec pour son logiciel GenSpec, un outil de support à l'ingénierie des exigences offert gratuitement. Toutes nos félicitations à Hydro-Québec et à l'ingénieur responsable du développement de l'outil, Mr. René Bujold ! Rappelons que La revue canadienne de l'IEEE a publié un article sur l'Ingénierie des exigences dans le numéro 48 (automne 2004) et un autre sur GenSpec dans le numéro 51 (automne 2005).

A View from the West

By Terrance Malkinson
Senator, University of Calgary



- Vancouver Port Authority http://www.portvancouver.com officials and others predict increasing commodity shipments in 2007. Total trade through area docks increased 3.7% in 2006. Much of this was due to an increase in canola shipments to 4.3 million metric tonnes in 2006 from 2.9 million a year earlier. The rise in canola exports is thought to be due to good harvests and a high global oilseed demand for producing biofuels. Asia, in particular, is a large purchaser of canola. Grain, fertilizer, coal, lumber, and petrochemical exports are other commodity products that are moving through the Port. On the import side manufactured goods from overseas markets is expected to grow. In 2006 Port of Vancouver container shipments increased 24.9%. The Vancouver Port is a major economic generator that contributes to provincial economies in Western Canada and to the nation as a whole. 43 billion dollars of goods are exchanged with 90 trading economies each year through this port. An estimated 30,100 direct jobs are generated, equivalent to almost 26,500 person years of employment. Employment is generated by five Port sectors - maritime cargo, cruise industry, capital investment in Port facilities, shipbuilding and repair and non-maritime enterprises. The Port contributes $1.8 billion in direct GDP and $4.1billion in direct Economic Output to the Canadian economy.

- After a successful pilot program in 2006 Calgary-based Meyers Norris Penny <http://www.mnp.ca>, in partnership with Alberta Economic Development, is expanding its Aboriginal self-employment training program <http://www.mnp.ca/03clients/AboriginalSEProgram.php> in Calgary, Edmonton and Siksika. Over the past 25 years the number of self-employed Aboriginals has increased from 7,000 to more than 30,000 _ four times the national average growth rate. This innovative training program is designed to assist Aboriginals with the launch of a new business venture and provide them with the tools to help them succeed. It includes management training, business plan assistance, networking support, and five hours of individual business coaching with experienced consultants. The program is free for qualified participants.

- British Columbia is leading the country in mining projects as commodity prices increase. This comes after many difficult years. This year, BC is expected to exceed the record of $265 million worth of exploration expenditures set in 2006. British Columbia accounts for 25 of 52 Canadian mine projects that are seeking development and environmental approvals. These results were revealed at the recent Mineral Exploration Roundup conference in Vancouver <http://www.amebc.ca/roundupoverview.htm> attracting more than 5,000 delegates from across Canada. Industry officials predict that commodity prices will remain high for several more years in this cyclical industry.

- Political leadership in Alberta recently changed as Edward Michael Stelmach <http://premier.alberta.ca/> became the new Premier of Alberta succeeding Ralph Klein who was premier from 1992 until 2006. Ed Stelmach was elected leader of the Alberta Progressive Conservative Party on December 2, 2006 and was sworn in as Alberta's 13th Premier on December 14th, 2006. Mr. Stelmach has been a member of the Alberta Legislative Assembly since 1993. He has held four ministerial positions, including Minister of Agriculture (1997 to 1999), Minister of Infrastructure (1999 to 2001), Minister of Transportation (2001 to 2004) and Minister of International and Intergovernmental Relations (2004 to 2006). He has also served as a member of the Agenda and Priorities Committee and as a member of Treasury Board. Premier Ed Stelmach has announced five priorities for his government: governance with integrity and transparency, managing growth pressures, improve Albertans' quality of life, building a stronger Alberta, and providing safe and secure communities. He has built a reputation as an honest and accountable politician, with a very solid forward-looking policy outlook, and an understanding of the strategic and operational needs of the province.

- In other news - Alberta's overheated Athabaska oil sands region will get a $396 million infusion of funding over the next three years to help pay for needed new medical clinics, affordable housing and upgraded water treatment facilities. British Columbia government's recently announced 2007 Energy Plan is expected to generate many new business opportunities from green power producers. Producers and environmentalists alike are praising the plan, which aims to make British Columbia energy self-sufficient by 2016. A new Kamloops high-speed wireless network will help the area attract more information technology workers and diversify the economy. A public-private partnership is set up to offer wireless connectivity to municipal employees and local businesses. The partnership will enable 80% of the Kamloops population to have wireless internet access.

Authors Note: Information compiled from a variety of sources including; regional, provincial, and municipal business publications; and websites.

About the Author

Terrance Malkinson is a proposal manager/documentation specialist, an elected Senator of the University of Calgary, a Governor of the Engineering Management Society, international correspondent for IEEE-USA Today's Engineer Online, editor-in-chief of IEEE-USA Today's Engineer Digest, and editor of IEEE Engineering Management. The author is grateful to the Haskayne School of Business Library at the University of Calgary. He can be reached at malkinst@telus.net .

Broadband Technology in the Acadian Peninsula: Report Based on a Case Study

By Sid-Ahmed Selouani[1], Habib Hamam[2], and Yacine Benahmed[1]

Université de Moncton, (Nouveau-Brunswick, Canada)
[1] Shippagan Campus, [2] Moncton Campus

Abstract

In this paper we attempt to provide preliminary and indicative evidence of broadband-induced transformations in the Acadian Peninsula with focus on Shippagan town and its parish. Special attention is given to two areas of transformations: Economic and Social. We also attempt, where possible, to outline examples of transformations which are internal to firms, households, or organizations, and those which are external. We also summarize important barriers to effective use of broadband.

The major finding of our case study research is that there is very little evidence of transformation at the business and household level. There are many examples of new uses and activities as a result of broadband adoption, but there are few examples of a change in behaviours and attitudes and relationships and operating norms as a result. This is not surprising, given that the technology has only very recently been introduced in many areas of rural New Brunswick including the Acadian Peninsula.

Sommaire

Cet article présente les résultats d'une étude sur les transformations induites par l'introduction d'Internet à large-bande dans une région rurale du Canada, à savoir la Péninsule acadienne et plus spécifiquement la région de Shippagan et sa paroisse. Un intérêt particulier est porté sur les impacts économiques et sociaux. Cette étude ambitionne de mesurer les changements induits tant à l'intérieur des organisations et des foyers que sur leurs échanges avec l'environnement socio-économique. Une indication y est également donnée sur les obstacles empêchant une utilisation plus étendue d'Internet à large bande dans ces régions.

Le fait saillant à retenir à travers cette étude est que les transformations induites aussi bien sur le monde des affaires que sur les particuliers ne sont pas aussi importantes que prévues. Il y a certes de nombreux exemples d'utilisation de nouveaux services et activités suite à l'adoption du large-bande, cependant il y a relativement peu de cas ou l'on a constaté un changement dans les comportements ou les attitudes qui auraient influé sur les relations et les procédures de travail. Ce constat est en partie justifié par le fait que la technologie large-bande n'a été que récemment introduite dans les régions rurales du Nouveau-Brunswick à l'instar de la Péninsule acadienne.

1.0 Introduction

High-speed Internet, or Broadband, can provide access to online information and services that are essential for governments, businesses, and the public, to operate effectively in the information age. For our purposes, we have defined Broadband as high-speed and "always on" Internet connectivity, with a minimum of 1.5 Mbps of data transfer facilitating the transfer of large files, especially video files [1].

1.1 A Project led by Industry Canada

A decade ago, it was estimated that New Brunswick matched the national average for Internet use adoption, but has since slipped considerably over the past 8 years (by an estimated 10 basis points). On November 18, 2003, Infrastructure Canada (through the Canadian Strategic Infrastructure Fund), the Province of New Brunswick, and Aliant announced the $44.6 million broadband infrastructure program for New Brunswick. Through the CSIP-NB project, broadband will be made accessible to an additional 327 communities located in 12 rural regions of the Province, specifically: 106,800 residences (90%), 24,240 businesses (95%), 130 schools (98%), all 29 health care centres (100%), 16 business parks (100%), all 13 First Nations communities (100%) [1].

In the period from October 2005 to March 2006, the NB Universities Broadband Research Consortium[2] completed a preliminary study of broadband adoption, use, and impacts in rural New Brunswick. This research project, led by industry Canada, originated as a result of discussions among a variety of federal, provincial, non-governmental, and private sector partners and stakeholders, each of whom were interested in understanding the economic, social, institutional, and community impacts of broadband adoption and use in rural New Brunswick. The university research community in New Brunswick was invited to collaborate on a long term, longitudinal, multi-disciplinary research project to assess these impacts. The authors of the present paper were concentrated on the Acadian Peninsula and focused on Shippagan and its rural zone.

1.2 Purpose of the study

The purpose of the study, mainly financed by Industry Canada, is to describe our understanding of the current state of broadband use as it is transforming rural New Brunswick. The area "rural" New Brunswick is defined as the geography of the province covered by the 12 rural Enterprise Agencies [1]. In addition of other factors, we attempt to identify the key criteria for economic development enabled through broadband deployments.

Census Statistics	New Brunswick	Shippagan Case Study Area
2001 Population	**729,498**	**12,156**
1996-2001 Population Change	-1.2%	-4.0%
Private Dwellings	313,609	5,035
Income ($)		
Median Individual Income	$18,257	$16,982
Median Household Income (1-person HHs)	$17,599	$17,521
Median Household Income (2 or more person HHs)	$47,051	$50,837

Table 1: Population of the New Brunswick and Shippagan area (age, education and income), Source: Statistics Canada, 2001 Census of Population.

The most important demographic data of the population of New Brunswick for our study are summarized in Tables 1 and 2.

1.3 Case study work in rural NB

The case study work was initiated in early February with first contact by researchers, and completed by March 19, 2006. The key informant interviews were conducted primarily through face-to-face interviews, although some were completed over the telephone when face-to-face was not possible. Both the business and households surveys were placed on a secure web site and were completed by respondents via the web interface. For the Shippagan case study, the research team, composed of the present authors technically assisted by graduate and undergraduate students, opted for additional tools in their field work method as will be detailed in a separate section.

Census Statistics	New Brunswick	Shippagan Area
Labour Force Status		
Worked at home	20,220	410
Participation Rate	63.1%	61.6%
Employment Rate	55.2%	53.4%
Unemployment Rate	12.5%	13.3%
Total - Experienced Labour Force	**365,040**	**5,925**
Top Industries of Employment (ranked #1 - 5)		
Agriculture and other resource-base industries		2
Manufacturing and construction industries	2	1
Wholesale and retail trade	5	5
Health and education	3	3
Business services	4	
General services	1	4
Top Occupations (ranked #1 - 5)		
Management	4	
Business, Finance and Administration	3	5
Sales and service	1	3
Trades, transport & equipment operators and related	2	4
Occupations unique to primary industry		2
Unique to processing, manufacturing, utilities	3	5

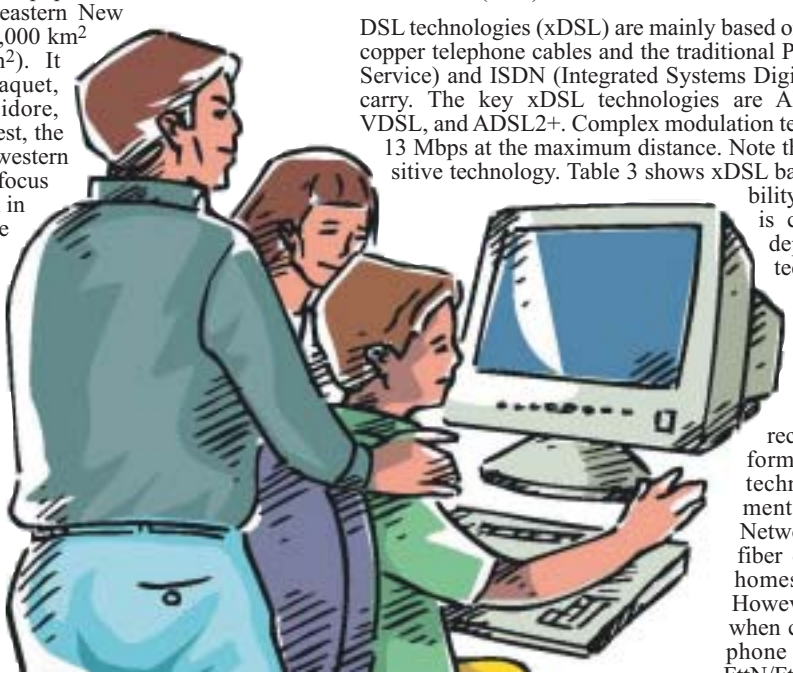
Table 2: Employment and occupation of the population of New Brunswick and Shippagan area, Source: Statistics Canada, 2001 Census of Population

2.0 Acadian Peninsula and Shippagan area

2.1 The Acadian Peninsula

It derives its name from the large Acadian population located there. The Acadian Peninsula is located in northeastern New Brunswick and covers approximately 2,000 km^2 (New Brunswick covers 73,440 km^2). It includes six civil parishes, Caraquet, Inkerman, Paquetville, Saint-Isidore, Saumarez and Shippagan, and to the west, the area of Grande-Anse, including the western part of the parish of New Bandon. We focus on the town of Shippagan and its parish in the present article. According to the 1996 census, the population of the Acadian Peninsula was 49,410 [3]. Now it is around 51,065 which represents 7.7% of the population of New Brunswick, namely 729 498 inhabitants (2003 Census) [4]. The population was around 58 000 inhabitants in April 2001 according to RDÉE Canada [5].

With about 85% of its population living in settlement areas of less than 2,000 habitants, the Acadian Peninsula is a rural region that includes 13 municipalities and 41 local service districts. In ethnic and linguistic terms, it is homogeneous (94% francophone) and over 90% of the inhabitants state that they are Roman Catholic [3]. Most settlement in the peninsula occurred as a result of the Expulsion of the Acadians in 1755, where the British forcibly removed them from their homes, mostly in southern New Brunswick and Nova Scotia.



Educational purposes together with paid work and accessing office networks/files comprise only about 10% of reported high speed use; 90% of time spent is for personal use. Of the 132 respondents asked about kinds of Internet use and its impact on family time, 83% feel they have spent the same time together as a family since obtaining high speed.

2.2 Shippagan area

The Shippagan case study area is located within the Acadian Peninsula in northeast New Brunswick, about one hour's drive from Miramichi City. The case study covers a number of small towns and villages, namely the Town of Shippagan, the Village of Lameque, the Village of Le Goulet, the Village of Sainte-Marie-Sainte-Raphael, and the rural parish of Shippagan. The Town of Shippagan itself is home to a satellite campus of the Université de Moncton. Shippagan also houses research institutes on peat and the sea, which are part of the "Institut de Recherche sur les Zones Côtières" (coastal zones research institute). The case study is located in the larger geographical region that benefited from being one of Industry Canada's SMART communities, an initiative designed to provide funding and support for innovative uses of information technology. Overall, however, the region has suffered from a relatively depressed economy, when compared with that of most other parts of the economy, with many more people dependent on primary resource industries and seasonal employment opportunities. See Tables 1 and 2 for more information.

3.0 Technical Background

3.1 Competing Broadband technologies

The main technical principles behind the major fixed line broadband technologies are as follows: ADSL (Asymmetrical Digital Subscriber Line), VDSL (Very High Rate Digital Subscriber Line, also known as Fiber to the Node or Curb - FttN/FttC), Fiber to the Premises or the Home (FttP/FttH), Hybrid Fiber Coax (HFC) Cable and Broadband over Power lines (BPL) [6].

Technology	Max Upstream	Max Downstream	Max Distance	Downstream at Max Distance
ADSI	640 Kbp	12 Mbp	5.4 km	**1.5 Mbps**
SDSI	3 Mbp	3 Mbp	2.7 km	**2 Mbps**
ADSL2+	1 Mbp	26 Mbp	3.6 km	**4 Mbps**
VSDI	16 Mbp	52 Mbp	1.3 km	**13 Mbps**

Table 3: xDSL bandwidth vs. distance capability [6]

DSL technologies (xDSL) are mainly based on the use of the twisted pair copper telephone cables and the traditional POTS (Plain Old Telephone Service) and ISDN (Integrated Systems Digital Network) services they carry. The key xDSL technologies are ADSL, SDSL (symmetric), VDSL, and ADSL2+. Complex modulation techniques permit rates up to 13 Mbps at the maximum distance. Note that xDSL is a distance-sensitive technology. Table 3 shows xDSL bandwidth vs. distance capability. ADSL, including ADSL2 is currently the most widely deployed broadband access technology because it does not need to install new cables or infrastructure between homes and existing telephone exchange buildings. Regarding the fact that optical Fiber is recognized as the highest performance broadband access technology, recent developments with Passive Optical Networks (PONs) have lead to fiber deployment to millions of homes and organizations. However, many challenges arise when converting an existing telephone network to VDSL FttN/FttC, including the impact on traditional telephone exchanges and backbone networks.

Hybrid Fiber Coax Cable (HFC) networks are the other main broadband last mile technology. In fact,

Digital cable TV networks are able to provide bi-directional data transfer bandwidth in addition to voice and digital TV services. The well established DOCSIS (Data-Over-Cable Service Interface Specification) standard of HFC's provides theoretical rates of up to 30 Mbps on one 6 MHz channel [7]. Typically a service of 3-5 Mbps downstream and 128 kbps upstream is offered. It is worthy of note that depending on how many people share the connection back to the head-end, the bandwidth delivered to the customer can be lower due to excessive load.

After many years of development, BPL is being implemented by a number of manufacturers to allow for high speed data transmission over existing power lines. The main advantage of this technology is that it does not need a network overlay as it has direct access to the power utility service coverage areas. Typical data rates in current systems are 2 to 3 Mbps. At present, there is no clear upgrade path to higher rates. In addition, high investment costs are necessary to bypass transformers, to limit interferences, and to be operational beyond the low voltage grid. For these reasons, it seems unlikely that BPL will emerge as a leading broadband technology.

The right choice of broadband technologies involves many technical and practical issues with huge social and economic costs and benefits at stake.

3.2 Broadband in Acadian Peninsula

Aliant, as a telecommunications provider in the Atlantic region of Canada, has invested over $300 million over the past four years towards broadband infrastructure and services. Aliant's existing network and broadband infrastructure are mainly used to extend coverage and an affordable cost to rural communities delivered over Digital Subscriber Lines (DSL). ADSL is the only high-speed service that delivers a dedicated, unshared access connection to each customer of the Acadian Peninsula.

The authors were mainly concerned with the case study of Shippagan and its surrounding area. This population is specific in New Brunswick, as pointed out in the next subsection, and presents a typical sample of the Acadian population. This specificity has been taken into account in the authors' methodology to reach the maximum population participation in the case study. For example, although the population understands English and is very familiar with English surveys, the questionnaires and communications with the population were conducted in French. Moreover, we insisted on direct contact and in-depth explanation of the project and its interest for the population. Indeed, as expected the participation was the highest one in all case studies carried out in the framework of the global project conducted by Industry Canada in New Brunswick.

The study covered a population of 12,156. French is the native language of the vast majority of the inhabitants. However, nearly 50% of people speak both French and English. The main community contacts for the case study in the Shippagan, Lamèque, Le Goulet, and St Marie-St-Raphael region were Entreprise Péninsule (EP) and Collectivité Ingénieuse de la Péninsule Acadienne (CIPA). Université de Moncton Campus de Shippagan (UMCS) was very cooperative.

Broadband access arrived in the Shippagan area at different times. The town of Shippagan was the first to receive access in the spring of 2000, with some surrounding areas receiving it shortly thereafter. Further expansion was done in late 2005, early 2006 (see Table 4).

Broadband Penetration Rate					
Community	**Est. Homes Passed**	**Date Launched**	**Years In Service**	**Cust. Base 8-Mar-06**	**% Penetration**
Shippagan	2,038	Apr 1, 2000	5.9	638	31%
Miscou Centre	0	Planned	0.0	0	n/a
Ste-Cécile	297	Dec12, 2005	0.3	59	20%
Petit Lamèque	262	Jan 9, 2006	0.2	61	23%
Pigeon Hill	371	Jul 5, 2005	0.7	122	33%
Lamèque	1,708	Jun 2, 2000	5.7	311	18%
Ste-Marie-St Raphaël	420	Jul 4, 2005	0.7	110	26%
Le Goulet	353	Jan 6, 2006	0.2	105	30%
Shippagan Total	**5,449**			**1,406**	**26%**

Table 4: Broadband penetration in Shippagan and surrounding area

Various methods were used to obtain local participation for the business and household surveys, as well as the key informant interviews. A list of businesses was compiled by Entreprise Péninsule and is used to facilitate the localisation of businesses in the field. A community consultation meeting was held on February 10, 2006, in Tracadie-Sheila. To contact potential participants, an advertisement was placed in l'Acadie Nouvelle newspaper on Saturday, March 11, 2006 directed at Shippagan and its surrounding areas.

The paper-form of the survey was also distributed on a door-to-door basis to both businesses and households. While interviews have been undertaken with both businesses and individuals, the analysis is limited to the questionnaires to avoid subjectivity.

4.0 Results

A detailed analysis will be the subject of two future publications in journals respectively specialized in social and business studies.

4.1 Business

Sixty-eight (68) business people replied to the business survey: 62 by paper format and six through the web. Ninety-six percent of business respondents use broadband. Business people who responded have been using the internet for an average of six-and-a-half years and high speed for an average of three and a half years. Forty-six percent of respondents have websites. Ten of them use advanced processes (Extranet, B2B electronic transactions, and electronic customer order, etc).

Use of Broadband	%
Technical research	57
Purchasing (goods or services)	35
Banking	31
Advertising	30
Customer orders	25

Table 5: Top 5 uses of Internet by business

Table 5 presents the type of use of Broadband and the corresponding percentage of companies. Table 6 points out that 85% of business respondents indicated that they currently use or plan to use the Internet for electronic document transfer and 77% for communications.

Use of Broadband	Use	Plan to use	others
Electronic document transfer	82%	3%	15%
Communications	70%	7%	23%
Purchasing goods or services	55%	8%	37%
Banking operations	47%	8%	55%
Training, learning, taking various online courses or certification	33%	20%	47%
Advertising	33%	16%	51%
Customers orders	28%	13%	58%
Selling goods or services with or without on line payment	18%	18%	63%
Market research	15%	11%	74%

Table 6: Applications that are used by broadband business subscribers

Since subscribing to broadband internet 58% of business respondents have started using email and 30% have started using a Website to communicate with customers, employees and/or management.

Subscribing to broadband helped the increase of the annual pre-tax revenue for 17.5% of the businesses who responded (Table 7). They believe

Increase in annual pre-tax revenue	
No increase	83%
Less than 5,000 $	5%
Between 5,000 $ and 80,000 $	8%
More than 80,000 $	5%

Table 7: Increase of annual pre-tax income of broadband business subscribers

this is mainly due to better customer service (100%), new products/services (64%), greater sales volume (36%), and new markets (27%).

As shown in Table 8, 24.5% of businesses who responded also stated that broadband communication has helped reduce their yearly expenses. Reduced long distance call cost was mentioned by 86% of respondents, reduced paper usage (57%), postage (57%), cost of travelling (50%), increased productivity (50%) and easier shopping for better prices (43%) were also listed.

Decrease in yearly expenses	
No decrease	76%
Less than 5,000 $	15%
Between 5,000 $ and 80,000	7%
More than 80,000	2%

Table 8: Decrease in yearly expenses of broadband business subscribers

A variety of changes in their business (due to having high speed) were identified by respondents including easier daily operations (81%), improvements to customer service (61%), improvements in employee skill level (45%), new products (39%), and reaching new customers (31%).

It is worth mentioning that 36% of business respondents expressed that High Speed Internet directly affected their customer relationship management, 33% their advertising, 25% their sales and 23% their marketing. Twenty-one percent of business respondents stated the geographical reach of their business has changed since obtaining High Speed. The respondents who did answer the question (ten did not) reported a 20% decrease in local market share distribution, a 7% increase provincially, a 12% increase in the Atlantic Canada, and a 5% increase in the rest of Canada.

The case study revealed that 78% of business respondents stated that adopting broadband technology had "very important" or "more important" impact on access information, 69% to access funding, 46% to develop more expertise and 37% to acquire/use new equipment and to better meet the needs of the people their business serves.

Besides, more than the half of the respondents (52%) felt that subscribing to High Speed has made it "easy" or "easier" to deal with all levels of government as well as other businesses.

4.2 Households

One hundred and fifty-eight (158) individuals responded to the survey and told us about their households: 81 by paper and 77 by Web. Ninety-five percent of respondents use the Internet alone at home, and 90% of them have been doing so for more than two years. Ninety-four percent of the respondents have broadband access at home and 6% have dial-up access at home.

The respondents use a variety of communication tools. Some of the respondents use the telephone (84%), e-mail (60%), cell phones (49%), instant messaging and chat rooms (49%) "most days". Modes of communication used less often by respondents include letters & parcels (83% of respondents use this tool at least once a year), audio/video conferencing (29%), web forums and logs (20%), and voice over Internet telephony (7%). In general, use of communication tools has not significantly changed within the last six months among the respondents who answered our survey.

One hundred and thirty two respondents answered the question about Internet use and its impact on family time: 83% of them feel they have spent the same time together as a family since obtaining high speed. The survey revealed that the respondents use their high speed connection at home the most for personal uses (90%). Other purposes also include educational ones, paid work, and accessing office networks and files, and much more.

For business related on-line services, respondents to the household survey use them to varying degrees, but high speed Internet is used more frequently for on-line banking (35% use it two to three times a week or more) compared to contacting Service New Brunswick (48% use it once every two weeks or less) and online purchasing (24% use it once every two weeks or less).

Since broadband access, some respondents have purchased a digital camera (47%), a web cam (35%), a new computer (33%), an USB key (29%), a photo printer (28%), a wired or wireless router / switch / hub (22%), an iPod or MP3 player (14%), a LCD computer screen (12%), a telephony headset (11%), a digital video camera (11%), a scanner (11%), and a wireless network card (9%).

Besides, respondents shared a variety of concerns about the use of High Speed Internet. They identified the most common concerns as follows: fraud/confidentiality, inappropriate content, and bad influences for children, security and viruses, the costs of High Speed Internet and associated equipment, its addictiveness, and how it may lead to individuals spending less family time together. The most common challenges or barriers faced by respondents of the household survey are connectivity, viruses and popups.

5.0 Discussion

A previous study undertaken by the first author [8] showed that terrestrial solutions, compared to satellite solutions, are preferred because the former:

1. provide a community with a high throughput
2. avoid propagation delays
3. are easily resizable
4. are cost-effective

Satellite solutions are worth being used when terrestrial solutions are not feasible due to the isolation of the region. The objective of this study was to determine the number of persons (potential market) who could be served by broadband equipment designed to cover ranges of 5, 10, 15, 25 and 40 km. It showed that cells of 5 km radius are sufficient to cover almost the total area of the Acadian Peninsula. The number of necessary cells would be 27.8 and the number of inhabitants per cell would be 1440.42. If we consider that the number of persons per households in New Brunswick is 2.3, then the Acadian Peninsula has 626.3 household per cell. Every household could have access to the service. Figure 1 gives the average rate per user versus the percentage of xDSL subscribers in the Acadian Peninsula.

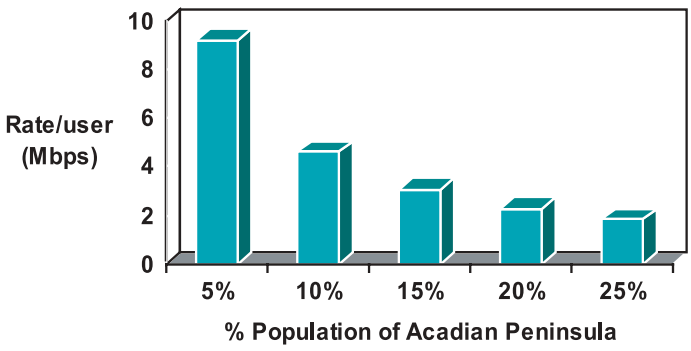


Figure 1: Average rate per user versus percentage of broadband subscribers

The present study treated the issue of the impacts of broadband on the population of the Shippagan area in particular. It revealed that the deployment of broadband to Shippagan, Lamèque, Le Goulet and Ste-Marie St-Raphaël had a positive effect of providing a competitive advantage to businesses. For example, the study revealed that broadband makes the daily operations easier for 81% of the population. It improves the access of 75% of the population to the information that they need. Access to broadband is becoming a requirement to be in business for the majority of respondents. None of the respondents imagine the future without access to broadband.

Available data does not demonstrate statistically significant impacts on revenues, incomes and employment. Nevertheless, the effects of broadband availability can be observed in the diversification of the use of many (fast) services such as improving education and expertise. Moreover, the business community is considerably enthusiastic and believes that broadband constitutes an important part of a regional effort to launch applications such as e-commerce.

In terms of challenges concerning business we enumerate the difficulties getting information about providers and the lack of online support. The networks of entrepreneurs in rural areas are verbal networks, particularly in a region like Shippagan which is identified with the processing of sea products. They are more likely to listen and speak than to send an e-mail message or newsletter on the web.

The effect of broadband may be important but not apparent. Similar to widespread computerization in the modern society, the challenge is to attribute rising economic benefits to its adoption. Nobel Prize economist Robert Solow's famous quote may well apply to broadband: "We see computers everywhere but not in the productivity statistics."

6.0 Conclusion

It turned out that evaluating impacts of broadband is very challenging because broadband technology is still evolving and is relatively new. It is also comes up against the same old challenge which consists of demonstrating that rising economic benefits are directly attributable to increased computerization. This challenge led to the Productivity Paradox articulated by the Nobel Prize economist Robert Solow, who said "We see computers everywhere but not in the productivity statistics" [9]. As with computers, the effect of broadband may be more important but it is not apparent. Broadband does not act solely on the socio-economic sphere. It is coupled to other information technology (IT) tools and applications. On the other hand (another paradox), the huge and general deployment can help in the development of these IT tools. Based on this observation and on experiences from the case study, a research could be initiated by distinguishing between "broadband using", and "broadband adding value". To capture social and economic impacts of broadband on rural communities requires a longer time period for collection of the data, and to follow the behavioural evolution of both firms and users. The ability to work with targeted local businesses or households over a longer time period could give more information about socio-economic impacts of broadband.

7.0 Acknowledgement

The authors would like to thank Industry Canada for its financial support, the "Acadie Nouvelle" and Université de Moncton - Campus de Shippagan - for their advertising effort and as well as CIPA and Entreprise Péninsule for their cooperation and fruitful advice.

8.0 References

[1] New Brunswick Universities Broadband Research Consortium, "Transforming a Rural Society: Impact of Broadband Adoption in Rural New Brunswick", Report edited for Industry Canada, April 2006.

[2] Members of the NB Universities Broadband Research Consortium include researchers from Mount Allison University (Sackville); Université de Moncton (Moncton & Shippagan campuses); Atlantic Baptist University (Moncton); University of New Brunswick (Fredericton and Saint John campuses); and St. Thomas University (Fredericton). The authors are members of this consortium.

[3] Public Health agency of Canada, "Profile of the acadian peninsula" http://www.phac-aspc.gc.ca/canada/regions/atlantic/Publications/Repercussions_poverty/1_e.html

[4] Isabelle Légère, "Enjeux de la nouvelle économie sociale dans la Péninsule acadienne", Reflets : Revue ontaroise d'intervention sociale et communautaire, 9, Automne 2003. « Travail et mieux-être ». http://www.erudit.org/revue/ref/2003/v9/n2/011096ar.html

[5] Le Réseau de développement économique et d'employabilité (RDÉE Canada) "Concertation rurale Centre Péninsule (CRCP) : un modèle de développement rural", April 2001.

[6] Corning incorporated, "Broadband technology overview", White paper, WP6321, 15 June, 2005.

[7] CableLabs Research Consortium "DOCSIS technical specifications", http://www.cablemodem.com/

[8] A. Selouani, "Broadband: A preliminary study of its implementation in the Acadian Peninsula", Industry Canada Meeting in Moncton, Jan 2006.

[9] Quoted in Paul Strassmann (1997), "Will big spending on computers guarantee profitability?", DATAMATION (Feb. 1997), http://www.strassmann.com/pubs/datamation0297/

About the Authors

Sid-Ahmed Selouani received his B.Eng. degree in 1987 and his M.S. degree in 1991 both in electronic engineering from Algiers University of Technology (U.S.T.H.B). He joined the Communication Langagière et Interaction Personne-Système (CLIPS) Laboratory of Université Joseph Fourier of Grenoble taking part in the Algerian-French double degree program and then he got a Docteur d'État degree in the field of signal processing and artificial intelligence in 2000. From 2000 to 2002 he held a post-doctoral fellowship in the Multimedia Group at the Institut National de Recherche Scientifique (INRS-Télécommunications) in Montréal. He is currently an associate Professor and responsible for the Human-Machine Interaction Lab. at the Université de Moncton, Campus de Shippagan. He is also an invited Professor at INRS-Télécommunications. His main areas of research involve speech and signal processing, ubiquitous system and assistive technologies for the elderly.

Habib Hamam obtained the B.Eng. and M.Sc. degrees in information processing from the Technical University of Munich, Germany 1988 and 1992, and the PhD degree in telecommunications from Université de Rennes I conjointly with France Telecom Graduate School, France 1995. He also obtained a postdoctoral diploma, "Accreditation to Supervise Research in Signal Processing and Telecommunications", from Université de Rennes I in 2004. He is currently a full Professor in the Department of Electrical Engineering at the Université de Moncton and a Canada Research Chair holder in "Optics in Information and Communication Technologies". He is an IEEE senior member and a registered professional engineer in New-Brunswick. His research interests are in optical telecommunications, diffraction, fiber components, optics of the eye, biomedical engineering and E-Learning.

Yacine Benahmed received his B.Sc. degree in computer science from the Université de Moncton in 2005. He is currently a Masters student in electronics engineering at the Université de Moncton as well as a research assistant at the Human-Machine Interaction Lab. at the Université de Moncton, Campus de Shippagan. His main research interests involve speech and signal processing, ubiquitous system and assistive technologies.

Broadband over Power Line: An Overview

By Shamim Ziaee and Xavier N. Fernando, Senior member of IEEE

Ryerson University, Toronto, ON

Abstract

Broadband over Power Line (BPL) communication systems can deliver high-speed voice, data and video communications to end-users by transmitting radio frequency energy over existing electrical power lines. Although this technology is not new, the new achievements in deploying BPL has made it more practical in recent years. The existing infrastructure for BPL is the most considerable advantage of this technology. Since electrical power lines have reached mostly all rural areas, BPL technology can provide broadband services in those areas where the use of other technologies like cable or DSL can not be justified economically. BPL is also used in management of power distribution grids by monitoring and facilitating control of them remotely. In this paper a brief history of this technology and a general overview of it will be presented. Also some issues related to the deployment of this technology and the current status of the technology in the world will be addressed.

Sommaire

Les systèmes de communication à large bande sur lignes électriques (LBLE) peuvent livrer à haute vitesse la voix, données et vidéo aux usagers en transmettant l'énergie à fréquence radio sur les lignes électriques existantes. Quoique cette technologie ne soit pas nouvelle, les récents résultats en déploiement LBLE l'ont rendue plus facilement réalisable ces dernières années. L'infrastructure existante est le principal avantage de cette technologie. Comme les lignes électriques atteignent presque toutes les zones rurales, la technologie LBLE peut fournir des services à large bande dans ces zone où l'utilisation d'autres technologies telles le câble ou lignes numériques d'abonnés ne peuvent être justifiées économiquement. LBLE est aussi utilisé pour la gestion des réseaux de transmission électriques en surveillant et facilitant leur contrôle à distance. Dans cet article nous présentons un résumé historique et un survol de cette technologie, son statut actuel ainsi que certains problèmes reliés à son déploiement.

1.0 Introduction

The purpose of power line communications is to use power supply system for communication purpose. The demand for broadband communication is increasing rapidly. According to KOHL group, less than 30% of US residences and 40% of industries use broadband services. However these percentages will be doubled within the next 10 years. Currently, there are several methods to access broadband services. Digital Subscriber Lines (DSL) can provide broadband services mostly in urban areas. Hybrid Fiber Coaxial cable (HFC) is also another alternative which can provide access to broadband services; however its coverage is much more limited than DSL. On the other hand Broadband over Power Line (BPL) can provide a vast coverage for broadband services. This technology can achieve 14 Mbps raw data rate now and it has the potential for up to 200 Mbps in near future, which makes it competitive with cable and DSL technology [10]. Also, considering the already deployed infrastructure for this technology (power lines), the economic aspects of BPL deployment can be justified.

2.0 Worldwide Deployment

Many countries including Australia, Austria, China, Finland, Hong Kong, Hungary, Ireland, Italy, Korea, Japan, Netherlands, Poland, and Switzerland are currently studying BPL technology [3]. Internet access via BPL has been archived in Manheim, Germany, in Spain by Endesa and Iberdrola (country's leading electric utilities) and also in Chile by Enersis - the large electric utility which offers service in Chile, Brazil, Peru, Argentina, and Colombia. In the USA fully operational commercial broadband services are provided in Manassas, Virginia and Cincinnati, Ohio [5].

In Canada, Industry Canada monitors related BPL international activities very closely, especially regarding to the potential risks of Access BPL interferences with radio-communication services. Furthermore, it has started some early assessments of Access BPL technology in corporation with utilities. These assessments are intended to provide a more precise understanding of the technology and its potential risk for interferences. There are currently no specific standards to address the deployment of Access BPL systems in Canada. However, considering the similarities between the U.S. and Canadian power distribution systems, Industry Canada proposes technical harmonization with the USA [3].

3.0 Background:

Using power lines as a communication medium is not a new idea. The history of power line communications goes back to 1950 when power lines were used as a medium to send control messages. This method called Ripple Control was characterized by using low frequencies (100-900 Hz), thus providing low bit rates. Also it demanded the use of high power transmitters in the region of 10 KW. This system intially provided unidirectional communication used for load control and management of street lights. Bidirectional communication was developed in the late 1980's and early 1990's. The use of much higher frequencies and reduction of signal power have become possible since then.

During recent years several utilities and companies continued to develop the technology to provide higher bandwidth data transfer across the electric grids in Europe and the U.S. Advances in Power Line Communication (PLC) technology lead to the current BPL which allows transfer of broadband data through power lines. The use of GHz range frequencies is anticipated in near future developments to make the system capable of much higher throughput [1]. A new vendor, Corridor Systems, has recently succeeded to develop a method to transfer data in the range of 100 MHz to 10 GHz on medium voltage power lines [11].

Realizing the importance of PLC in access networks, the IEEE Communications Society has formed a Technical Committee that sponsors conference sessions, journal special issues workshops and tutorials and promotes the dissemination of technical information on PLC: http://www.comsoc.org/~plc .

4.0 Advantags of BPL

The major claim for BPL is "the infrastructure is already there". Therefore there is no need for new major infrastructure as needed for other technologies like HFC or DSL [8]. Another advantage of BPL technology is its vast geographical coverage. Access BPL technology can potentially provide broadband services for rural areas which do not have access to such services now [3]. Where technical and economical issues have limited deployments of cable and DSL, BPL can provide broadband in many underserved areas [7]. Access BPL can also improve competition in broadband field by introducing another alternative for broadband [3]. Another interesting aspect of BPL is its ability to potentially connect all electrical devices in a communicating network [7]. Power lines reach many unmanned remote locations such as water, oil and gas wells, traffic lights, subways and cars which can take advantage of this communicating network [8]. Having internet connection along power lines also facilitates SCADA (Supervisory Control and Data Acquisition), DSM (Demand-Side Management), and AMR (automated meter reading) applications for utility companies [8]. In summary, BPL can be compared with HFC cable and DSL technology as shown in Table 1.

5.0 Technology

Basically the idea of Power Line Communication is to modulate a radio signal with data and send it through power lines in a band of frequencies which are not used for supplying electricity. The used frequencies and the encoding scheme have a significant influence on the efficiency and the speed of the PLC service. The encoding scheme commonly used in BPL is orthogonal frequency division multiplexing (OFDM). This is a

Comparison	HFC Cable	DSL	BLC
Channel Media	Coaxial Cable	Twisted Pair	Electrical Power Lines
Availability of the Physical Media	Limited availability	More availability than cable	The most potentially available media
Typical Capacity	1 Mbps to 6 Mbps	1 Mbps to 6 Mbps	5 Mbps or higher [7]
Connection Type	Shared	Not-shared	Shared
Security	Uses Encryption	More secure: uses a dedicated connection.	Can Use Encryption
Typical prices per month [7]	$39 to $60	$27 to $49	$28 to $39

Table 1 - Comparison between different broadband access technologies

multi-carrier transmission technique which has been recently recognized as an excellent method for high speed data communication.

The history of OFDM goes back to 1960s. It has become popular recently since integrated circuits, which can perform the needed high speed digital operations, became economically accessible. OFDM is based on the idea of frequency division multiplexing (FDM), a technology that uses multiple frequencies to transmit multiple signals in parallel at the same time. However, in FDM 50% of the total spectrum is wasted due to guard bands which are needed between sub-carriers to ensure that they do not overlap.

OFDM is much more spectrally efficient than FDM; it reduces the required bandwidth by squeezing sub-carriers tightly together until they actually overlap with each other. This is accomplished by keeping the sub-carriers orthogonal in the complex domain so that they do not interfere with each other. The concept of OFDM is shown in figure 1. The generation of orthogonal signals is done by using an IFFT (inverse fast Fourier transform) block. Using OFDM modulation, the data is injected onto power lines.

The electric power transmission system basically consists of high voltage lines (greater than 40 kV), medium voltage lines (1 kV to 40 kV) and low voltage lines (110 V or 220 V). The backhaul connections of distribution substation will be provided by standard Telco fiber optic cables. The optical backhaul portion of BPL is closer to users compared to that of HFC users, which makes the available bandwidth of the BPL signal shared by fewer users [5]. This architecture facilitates higher bit rates over power lines.

Depending on the topology, BPL can be categorized into access BPL or in-house BPL. These are discussed next.

6.0 Access BPL

Access BPL provides internet and other broadband services like voice (IP Telephony), video, surveillance systems and entertainment (gaming) for homes and offices [4]. In this topology injectors are used to provide an interface between Internet backbone and the medium voltage power lines [3][1]. BPL signals can propagate for 1,000 to 3,000 feet before they become too distorted and weak. To transmit the signal for a longer distance repeaters are used to regenerate and amplify the signal [2]. Extractors are used to provide an interface between end-users and medium-voltage power lines. Extractors are typically placed at each distribution transformer which provides low voltage electric power for a group of homes in the area. Some extractors amplify the BPL signal strength sufficiently to make the transmission of the signal possible through the distribution transformers. Some others employ couplers to bypass distribution transformers and relay the signal to the end-users [2].

The FCC has provided the following definition for Access BPL: "A carrier current system installed and operated on an electric utility service as an unintentional radiator that sends radio frequency energy on frequencies between 1.705 MHz and 80 MHz over medium voltage lines or low

[1]BPL systems are not used on high voltage power lines yet, as hundreds of thousands of volts of electricity vibrating at an inconsistent frequency can create interference with the transmitted data [7].

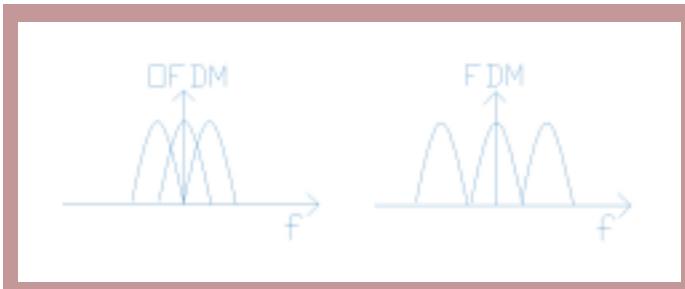


Figure 1 - OFDM spectrum versus FDM: OFDM is much more spectrally efficient than FDM

voltage lines to provide broadband communications and is located on the supply side of the utility service's points of interconnection with customer premises." [6]

Industry Canada has suggested that Access BPL systems can be generally classified as either: (A) an end-to-end system, or (B) a hybrid system [3]. In the end-to-end systems, Access BPL systems use a combination of medium voltage and low voltage lines, or only low voltage lines, the former being illustrated in Figure 2. The BPL signal is injected onto medium voltage lines and is transferred to low voltage lines using couplers, or through low voltage transformers and delivered directly to end users [3]. In the case of strictly low voltage BPL systems, the signal is injected onto the low voltage lines at the transformer or the utility meter directly.

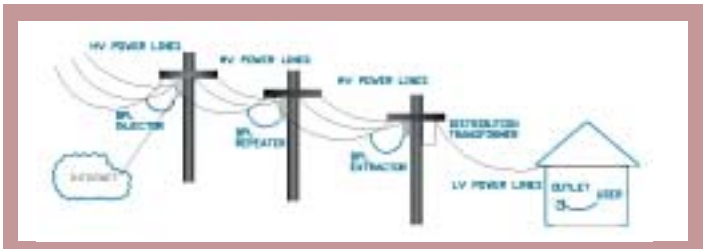


Figure 2 - Access BPL System

On the other hand, in hybrid systems a combination of power lines and wireless transmission is used. In this scenario the injected BPL signal onto medium voltage lines is extracted and delivered to the end user by using a wireless channel. Recently, another scenario has come up which is based on capturing a wireless signal and injecting it in low-power lines to be delivered to the end users [3]. Figure 3 shows an example of end to-end Access BPL using a hybrid system.

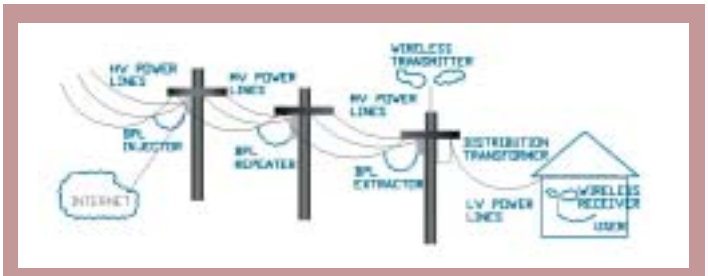


Figure 3 - Hybrid BPL System

7.0 In-house BPL

The FCC has defined In-house BPL as "A carrier current system, operating as an unintentional radiator, which sends radio frequency energy by conduction over electric power lines that are not owned, operated or controlled by an electric service provider. The electric power lines may be aerial (overhead), underground, or inside the walls, floors or ceilings of user premises. In-house BPL devices may establish closed networks within a user's premises or provide connections to Access BPL networks, or both." [6]

This application occurs within a building where both ends of the communication link are located. The distance between communication ends is typically less than 100 meters [4]. This system is attractive as no extra wiring is needed within the building. Networking and sharing common resources such as printers are the main applications of this technology [3].

8.0 Technical Challenges and Research

The main concern about BPL technology is the radio frequency interference (RFI) that it creates. According to American Radio Relay League (ARRL), BPL systems produce RFI within 75 meters for mobile radio and 150 meters for fixed radio [9]. To reduce the potential RFI, BPL providers need to reduce the transmission power - which consequently increases the number of required repeaters and the cost of the system [5]. Some vendors claim that they have overcome this issue by using adaptive techniques to notch out the interfering signals in power lines. On the other hand, Motorola has used a completely different approach to solve this problem: It uses BPL only on low-voltage power lines and provides the backhaul wirelessly. According to Motorola, because it uses only low voltage power lines, the system is less susceptible to interferences [10].

Power lines in our surroundings were installed to deliver electrical power at 50Hz to 60Hz and behave like low pass filters. Broadband data, which are transmitted at much higher frequencies, must overcome several obstacles to get through power lines. Attenuation of high frequency components in power lines is a major concern. On a common power line in the USA, the signal should be amplified at a distance much less than a mile, which makes the use of repeaters necessary every 1,000 feet to a mile [9]. Communication signals also encounter several levels of noise on power lines that are generated by connected electrical appliances [9]. Furthermore, impedance mismatching of connected appliances can result in considerable losses at particular frequencies (nulls). The location and depth of these nulls change according to the number and type of the devices connected to the power network [4].

Two schemes are proposed to overcome these issues: adaptive OFDM modulation and multi bit rate OFDM modulation. In both methods, good knowledge of channel characteristics is needed. Since power line channels have wide sense stationary properties (channel characteristics slowly change), adaptive schemes provide a good solution because the channel needs to be estimated less frequently. By loading fewer bits at the most affected frequency bands, the total throughput can be improved; this is an advantage for multi bit rate OFDM.

At Ryerson University, the ADROIT group currently focuses on developing better solutions for BPL by using adaptive and multi bit rate OFDM. In this scheme the bit rate of each OFDM sub-carrier can vary based on the channel characteristics: the sub-carriers with the least attenuation can deliver the most bit-rate. In other words, by increasing the bandwidth of the sub-carriers with better channel characteristics, the throughput can be increased. The concept of multi rate OFDM is shown in figure 4.

Higher bit-rate can be obtained on the sub-carriers with larger bandwidths. Therefore, the bandwidth of the sub-carriers on better channels can be increased to optimize the throughput of the system.

9.0 Conclusion

BPL is still a new technology which needs further advancements to be completely practical in a wide range. The main advantage of this technology is the already existing infrastructure for BPL, even in rural areas, which makes its deployment economically justified and also increases the potential coverage of the technology. On the other hand, the major issue with this technology is its interference with radio systems. This issue has limited the deployment of BPL to some extent and has increased the cost of its deployment. Various companies now claim to have overcome this problem, in which case we should soon observe widespread deployment of BPL.

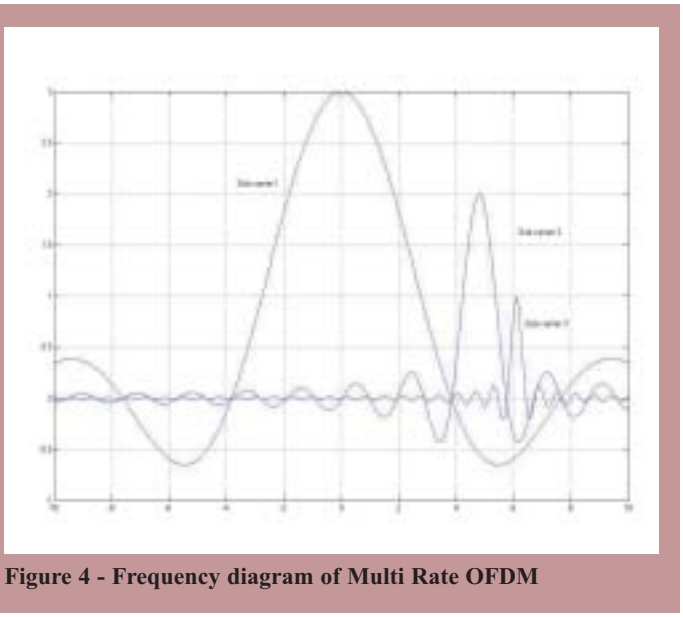


Figure 4 - Frequency diagram of Multi Rate OFDM

REFERENCES

[1] Report on the Transmission of Data over the Electricity Power Lines Hans Akkermans, AKMC, Netherlands, David Healey, Spectrum, United Kingdom, Hans Ottosson, EnerSearch, Sweden, June 1998.

[2] Report of the Broadband over Power Lines Task Force, National Association of Regulatory Utility Commissioners, February 2005

[3] Consultation Paper on Broadband over Power Line (BPL)Communication Systems, Spectrum Management and Telecommunications, Industry Canada, SMSE-005-05, July 2005.

[4] Broadband Powerline Communications Systems - A Background Brief, Spectrum Planning Team, Radiofrequency Planning Group, Australian Communications Authority, September 2003.

[5] Broadband over Power Lines Comes of Age, Michael Kennedy, Telecommunications Americas, Mid-June 2004; 38, 7; ABI/INFORM Global pg.28.

[6] Federal Communications Commission FCC 04-245 Report and Order, In the Matter of Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems, Adopted October 14, 2004.

[7] Broadband over Power Lines - A White Paper, Ratepayer Advocate, State of New Jersey, October 28, 2005.

[8] Delivering Broad Band Internet Over Power Lines: What You Should Know Collier, S.E.; Rural Electric Power Conference, 2004, 23-25 May 2004 Page(s):A1 - 1-11 Digital Object Identifier 10.1109/REPCON.2004.1307030.

[9] Broadband over Power Line 2004: Technology and Prospects, The Electric Power Research Institute (EPRI), Oct 2004.

[10] Practical, Proven Broadband over Power Line: The Power line LV Solution, Motorola, Inc., 01 Jun 2006.

[11] PowerCorridor(tm) Technology, http://www.corridor.biz/technology.htm, retrieved on July 24, 2006.

About the Authors

Shamim Ziaee is a forth year undergraduate student in Ryerson University who studies electrical engineering. He has been working as a research assistant in communication field under supervision of Dr. X. Fernando in last two years. Currently he is studying BPL technology and optimization of this technology by employing adaptive and multi bit rate OFDM.

Xavier N. Fernando is an Associate Professor and Signal Processing and Communications Stream Coordinator at Ryerson University , Toronto , Canada . Dr. Fernando has about 45 peer reviewed publications in journals and conference proceedings. He leads the Advanced Radio Optic Integrated Technology (ADROIT) research group at Ryerson University that focuses on cost-effective broadband multimedia delivery via optical/wireless/power-line networks. He is a Senior Member of IEEE, member of SPIE, Chair of the IEEE Communications Society Toronto Chapter and licensed Professional Engineer in Ontario , Canada . He can be reached at http://www.ee.ryerson.ca/~fernando.

Analyse des effets des imperfections géométriques sur la biréfringence des fibres microstructurées

Par *Mourad Zghal[1], Faouzi Bahloul[2], Rabah Attia[2], Rihab Chatta[1], Dominique Pagnoux[3], Philippe Roy[3] et Yassine Bouslimani[4]*

[1]CirtaCom, École Supérieure des Communications de Tunis (Tunisie)
[2]SysCom, École Nationale d'Ingénieurs de Tunis (Tunisie)
[3]IRCOM, Faculté des Sciences et Techniques des Limoges (France)
[4]EMAT, Faculté d'ingénierie, Université de Moncton (Canada)

Sommaire

Dans ce article nous traitons des Fibres Microstructurées Air Silice (FMAS) affectées par des défauts de fabrication afin de quantifier l'influence des facteurs liés à la géométrie sur la biréfringence. Les résultats numériques obtenus montrent que les défauts des trous d'air de la première couronne ont un effet important sur la biréfringence des FMAS, contrairement à ceux des trous de la deuxième couronne. La très forte biréfringence des FMAS à trous elliptiques est mise en évidence. Les effets des imperfections aléatoires dans la gaine microstructurée sur la propagation du mode fondamental sont analysés en utilisant des simulations numériques basées sur la méthode de Galerkin.

Abstract

In this paper we investigate the air-silica microstructured optical fibers affected by manufacturing defects. Our goal is to evaluate the geometrical effect on birefringence. The numerical results show that the air holes close to the core have an important influence on the birefringence of the microstructured fibers, more than the others holes. The numerical results show also that elliptical holes induce an important amount of birefringence. The effect of random imperfections in the cladding on the fundamental mode propagation is examined using the Galerkin method.

1.0 Introduction

Les fibres microstructurées air silice (FMAS) sont constituées d'un arrangement périodique de trous d'air dans une matrice de silice, dont les axes sont parallèles à celui de la fibre. Le coeur est constitué par un défaut (généralement un trou remplacé par de la silice). Ces fibres sont caractérisées par l'espacement périodique Λ entre les canaux d'air de diamètre d et par le nombre de couronnes de trous d'air autour du cœur [1]. Une grande variété de méthodes de modélisations numériques sont actuellement disponibles pour la détermination des propriétés de propagation des FMAS [6, 22]. Il est naturellement plus rapide et bien plus aisé de simuler des structures parfaites dont les trous d'air sont circulaires et parfaitement ordonnés. Cependant, dans les FMAS réelles, on peut trouver des variations considérables de la taille, de la position et de la forme des trous par rapport à celles attendues [6, 13, 16]. En particulier, les trous sont susceptibles de déformations dues aux tensions superficielles lors des opérations d'étirage des fibres [10, 15, 17]. Les variations aléatoires des formes et des positions des trous d'air, inhérentes à la fabrication des FMAS, remettent en cause la validité des prévisions basées sur les fibres parfaites. Ces perturbations géométriques ont un effet considérable sur les propriétés de transmission d'une fibre, notamment sur sa biréfringence.

L'utilisation industrielle des FMAS pour la transmission unimodale, la compensation de dispersion ou la génération de continuum nécessitent une bonne compréhension des origines de la biréfringence des fibres fabriquées. D'un autre côté, en raison des nombreuses potentialités d'applications qui nécessitent le maintien de la polarisation dans les fibres, l'introduction d'une biréfringence contrôlée dans les nouvelles FMAS fait actuellement l'objet de recherches intensives. De nombreuses études ont déjà été conduites pour évaluer la biréfringence de fibres imparfaites [8]. Partant de la structure idéale d'une FMAS de symétrie hexagonale parfaite, la biréfringence peut être introduite en utilisant, soit des trous d'air circulaires de diamètre non uniforme [2, 3], soit des trous elliptiques [9-10, 14, 18-19, 24-25], soit encore des trous de diamètre uniforme distribués autour d'un cœur de section non circulaire [4-5, 7, 12, 21, 23]. Dans le cas des fibres à coeur plein avec un mode large, une biréfringence de forme peut être induite grâce à un trou elliptique de dimension nanométrique au centre du cœur tout en gardant un caractère monomode infini [26].

Dans ce papier, nous nous intéressons aux effets de quelques défauts typiques pouvant affecter des FMAS réelles. Nous utilisons la méthode de Galerkin vectorielle pour modéliser la biréfringence d'une FMAS parfaite. Puis, nous nous attachons à analyser l'évolution de la biréfringence en modifiant la forme, le diamètre et la position d'un trou dans la première et la seconde couronne. Enfin, nous montrons qu'une légère ovalisation des trous permet d'obtenir des FMAS fortement biréfringentes.

2.0 Calcul de la biréfringence des FMAS

Dans notre modèle, les équations de Helmholtz vectorielles sont résolues en utilisant la méthode de Galerkin décrite dans la référence [21]. Ceci permet de déterminer la distribution spatiale du champ électrique des modes guidés ainsi que leurs indices effectifs respectifs. La biréfringence B d'une fibre est donnée par la valeur absolue de la différence entre neffx et neffy qui représentent respectivement les indices effectifs des modes de polarisation du mode fondamental dans les directions transverses orthogonales x et y [11]. L'axe pour lequel l'indice effectif est le plus faible est appelé axe rapide parce que la vitesse de phase est la plus grande. Pour la même raison, l'axe ayant l'indice effectif le plus grand est appelé axe lent.

Dans une FMAS parfaitement symétrique dont la biréfringence est théoriquement nulle, la biréfringence trouvée par notre méthode est suffisamment faible pour que les valeurs plus importantes trouvées avec des fibres imparfaites soient fiables (biréfringence numérique de l'ordre de 10^{-6}). Nous considérons la fibre réelle montrée dans la figure 1 (FMAS1). Cette FMAS à forte proportion d'air est caractérisée par des trous d'air de diamètre d=1,8µm et un paramètre Λ=2,4µm. Compte tenu de la petite dimension du cœur, cette fibre est monomode à la longueur d'onde de travail de 1550nm et présente une symétrie apparente de Λ/3. Nous trouvons que la biréfringence de la fibre idéale, ayant une structure parfaite, vaut 1.37 10^{-5} à la longueur d'onde de 1550nm. Bien que 10 fois supérieure à la biréfringence numérique, cette biréfringence de phase reste faible.

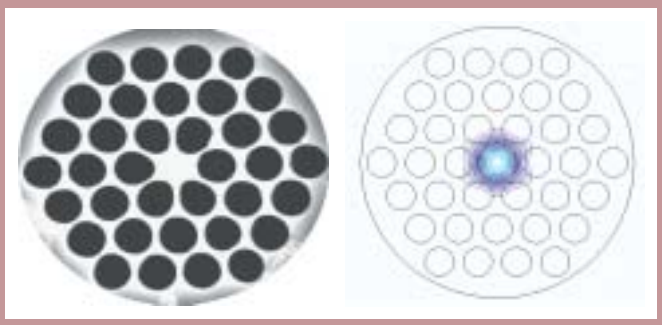


Figure 1. a) Image MEB de la FMAS1. b) Distribution du champ électrique du mode fondamental pour la fibre idéale ayant les mêmes paramètres opto-géométriques que la FMAS1.

3.0 Effet des déformations de trous de la FMAS idéale

Nous donnons dans la suite quelques exemples de biréfringence induite par des déformations des trous de la FMAS idéale.

3.1 Déformation d'un seul trou

A titre d'exemple, la distribution modale du champ électrique du mode fondamental à la longueur d'onde 1550nm est montrée dans la figure 2 quand un des trous d'air de la première couronne est remplacé par un trou elliptique dont le grand et le petit axe sont respectivement d et 0.3d.

Figure 2. Distribution modale du champ électrique du mode fondamental pour une structure déformée.

On constate comme attendu que le champ du mode fondamental se déforme et s'étend en direction du trou déformé. La biréfringence passe de $1.37x10^{-5}$ à $7.95x10^{-4}$, c'est-à-dire qu'elle est multipliée par environ 60.

Le même défaut a été créé mais pour un trou dans la deuxième couronne. Dans ce cas la biréfringence vaut seulement $1.4x10^{-5}$. Ceci s'explique par le fait que le champ modal est confiné dans la région entourée par la première couronne. Par suite, l'effet de la déformation du trou sur le champ modal des deux polarisations du mode fondamental apparaît quasi négligeable à partir de la seconde couronne. Pour fabriquer des FMAS faiblement biréfringentes, il apparaît donc crucial de veiller à maintenir une excellente uniformité des trous de la première couronne.

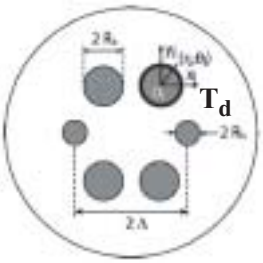


Figure 3. Défauts de taille des trous dans la première couronne de la gaine microstructurée de la FMAS idéale.

3.2 Déformation de deux trous

La fibre peut être faite pour garantir le maintien d'une polarisation rectiligne en induisant une biréfringence linéaire élevée et ce en changeant la position ou la taille de certains des trous d'air [25]. A titre d'exemple, nous considérons ici le changement de la taille de quelques trous d'air comme illustré dans la figure 3.

Nous avons calculé la biréfringence B quand le rayon Rb des deux trous d'air opposés est modifié (grossissement de 10% à 30%). Comme le montre la figure 4, la biréfringence croît avec la longueur d'onde, car l'extension du champ augmente et l'interaction entre le champ et la zone de trous déformés devient plus forte. La biréfringence augmente aussi très fortement en fonction du rapport Rb/Ra.

A la longueur d'onde de 1550nm, la biréfringence atteint $1.8x10^{-3}$ lorsque le rapport Rb/Ra vaut 1.3. La distribution spatiale des deux modes de polarisation du mode fondamental devient alors elliptique avec les dimensions des axes de l'ellipse 2Λ-2Ra et 2Λ-2Rb respectivement (voir l'image de la distribution en insert dans la figure 4). La modification de la taille de deux trous opposés nous permet finalement d'agir sur la forme du cœur et nous sommes ramenés au cas d'une fibre à cœur elliptique.

3.3 Défaut de la position

θ_j	B
0	$2.57\ 10^{-4}$
Pi/3	$3.86\ 10^{-4}$
Pi/2	$3.45\ 10^{-4}$

Table 1. Variation de la biréfringence en fonction de Θ_j.

On s'intéresse dans cette section à l'effet d'un changement de position de l'un des trous par rapport à sa position idéale en gardant l'uniformité des trous. Le trou choisi arbitrairement est repéré sur la figure 3 (trou déplacé noté Td). On fixe la valeur du déplacement du centre du trou à 0.2µm vers l'extérieur (valeur réaliste correspondant aux défauts possibles de fabrication). La direction du déplacement fait un angle Θj avec l'axe des x. La biréfringence est calculée pour plusieurs valeurs de Θj et les résultats sont rapportés dans la table 1.

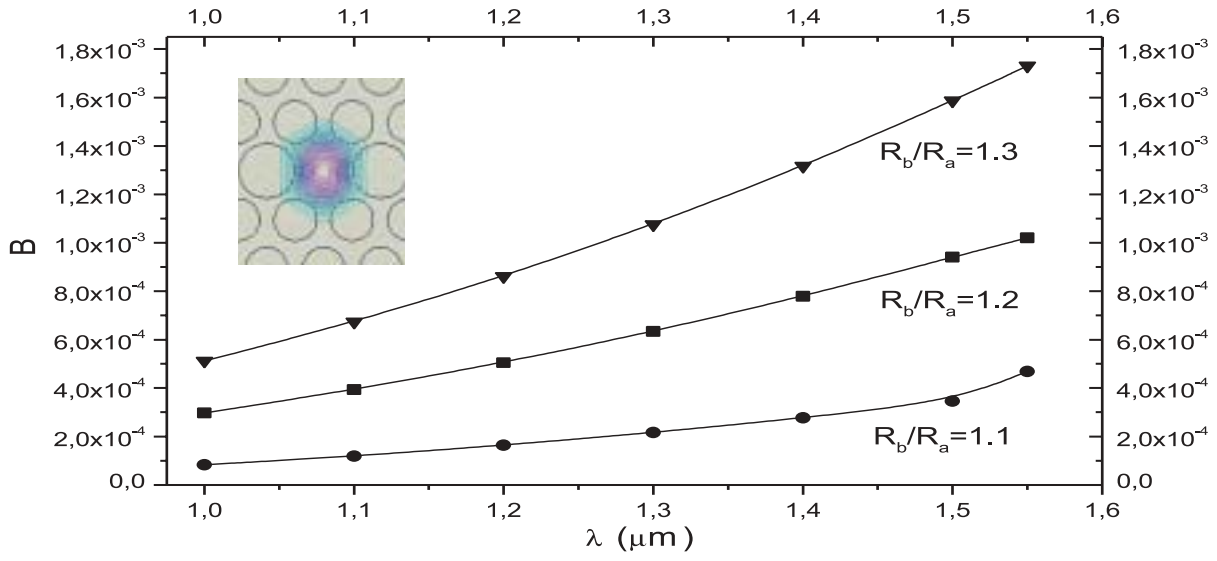


Figure 4. Biréfringence calculée pour différents rapports Rb/Ra.

La plus forte biréfringence obtenue lorsque l'angle Θj vaut π/3 s'explique par le fait que la translation est radiale pour le trou considéré, ce qui augmente la déformation du cœur par rapport aux déformations induites par les translations dans la direction des x et dans la direction perpendiculaire.

Pour comprendre l'influence du défaut de position, nous avons calculé la différence entre les deux répartitions du champ des modes fondamentaux pour une structure idéale et déformée tel qu'illustré dans la figure 5. Nous avons montré que l'effet induit par le défaut de position consiste en une concentration d'une différence résiduelle du champ autour du défaut créé. Ceci s'explique par le fait qu'il y a une cassure de la symétrie de la structure et par conséquent du champ.

4.0 Ellipticité des trous

Lors de leur étirage, les trous des FMAS peuvent subir une ovalisation due à un mauvais contrôle des conditions de température et de pression qui peuvent être inhomogènes dans le four. Par voie de conséquence, le cœur peut lui aussi devenir elliptique. Nous modélisons une fibre dont les paramètres géométriques sont ceux de la FMAS1 en inscrivant le premier hexagone de trous d'air à l'intérieur d'un cœur elliptique (ellipticité η comprise entre 1 et 1.2). L'allure de la structure modélisée est montrée en insert dans la figure 6.

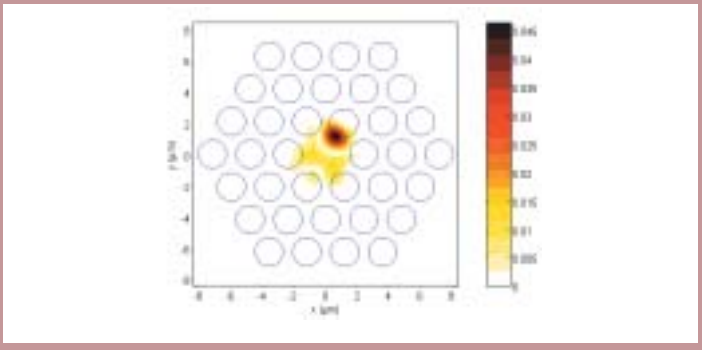


Figure 5. Différence des répartitions des champs entre une structure idéale et déformée.

La biréfringence modale de la fibre semblable à la FMAS 1 est calculée en faisant varier l'ellipticité des trous (rapport du grand axe de l'ellipse sur le petit axe) comme illustré dans la figure 6. Cette biréfringence devient très rapidement comparable à celle des fibres standard fortement biréfringentes (pour une ellipticité de l'ordre de 1.1). Comme dans les fibres conventionnelles à cœur elliptique, le mode de polarisation d'indice effectif le plus élevé est celui dont la polarisation est parallèle au grand axe de l'ellipse.

5.0 Conclusion

En utilisant un code de modélisation basé sur la méthode de Galerkin vectorielle, nous avons étudié les variations de la biréfringence d'une fibre microstructurée dont les paramètres géométriques sont proches de ceux d'une fibre fabriquée, quand la position ou la forme de quelques trous sont modifiées. Les résultats numériques ont démontré que, pour obtenir une FMAS à faible biréfringence, un soin particulier devrait être accordé pendant la fabrication pour maintenir une excellente uniformité de la forme et de la position des trous d'air dans la première couronne. Nous avons montré que des perturbations géométriques réalistes conduisent à l'obtention de valeurs de biréfringence très élevées, comparables à celle des fibres classiques à maintien de polarisation. Les modélisations basées sur la méthode de Galerkin constituent donc un outil potentiellement performant pour guider le choix des paramètres optogéométriques lors de la fabrication des FMAS, en vue de l'obtention soit de faibles biréfringences, soit de très fortes biréfringences pour des applications où le maintien d'une polarisation linéaire est requis.

6.0 Remerciements

Ce travail de recherche est effectué grâce au financement de l'Agence universitaire de la francophonie (AUF) dans le cadre des projets de coopération scientifique interuniversitaire. Les auteurs souhaitent remercier l'agence pour son soutien et pour son support qui ont permis ce renforcement institutionnel et scientifique.

7.0 References

[1.] Birks & al.,"Endlessly single-mode photonic crystal fiber," Opt. Lett. 22, 961-963, 1997.

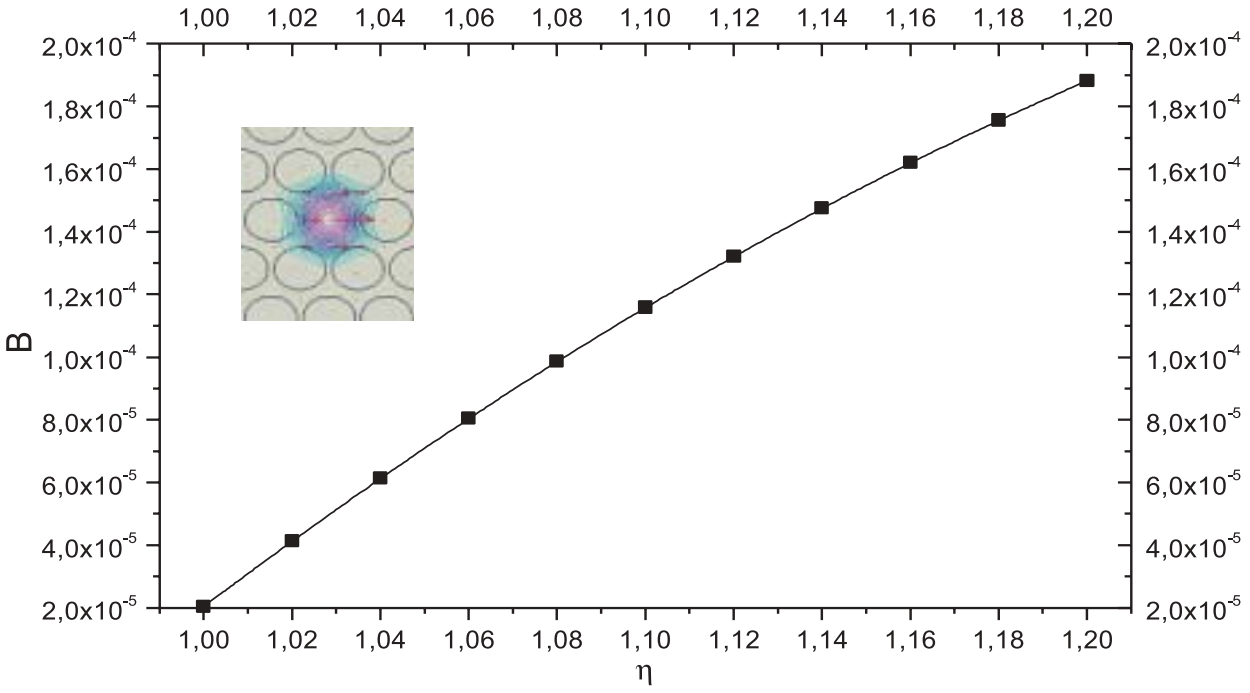


Figure 6. Variation de la biréfringence en fonction de l'ellipticité des trous.

[2.] Bjarklev & al., "Polarization properties of honeycomb-structured photonic bandgap fibres", J. Opt. A: Pure and Applied Optics, 2, pp. 584-588, 2000.

[3.] Blanch & al., "Highly birefringent photonic crystal fibers", Opt. Lett., 25, pp. 1325-1327, 2000.

[4.] Chen & al., "Highly birefringent rectangular lattice photonic crystal fibres," J. Opt. A: Pure Appl. Opt. 6, 997-1000, 2004.

[5.] Chen & al., "Polarization properties of rectangular lattice photonic crystal fibers," Opt. Com.241, 365-370, 2004.

[6.] Cucinotta & al., "Perturbation analysis of dispersion properties in photonic crystal fibers through the finite-element method," J. Lightwave Technol. 20(8), 1433-1442, 2002.

[7.] Hansen & al., "Highly birefringent index-guiding photonic crystal fiber", IEEE Photon.Technol. Lett., 13, pp. 588-590, 2001.

[8.] Hwang & al., "Birefringence induced by irregular structure in photonic crystal fiber," Opt. Exp. 11, 2799-2806, 2003.

[9.] Hwang & al., "High birefringence in elliptical hollow optical fiber," Opt. Express 12, 1916-1923, 2004.

[10.] Issa & al., "Fabrication and study of microstructured optical fibers with elliptical holes," Opt. Lett., Vol. 29, No. 12, 1336-1338, 2004.

[11.] Labonte & al., "Experimental and numerical analysis of the birefringence into microstructured optical fibres," Mo4.3.3 ECOC'04, Stockholm, 2004.

[12.] Mortensen & al., "Small-core photonic crystal fibers with weakly disordered air-hole claddings," J. Opt. A: Pure Appl. Opt. 6, 221-223, 2004.

[13.] Nielsen & al., "Modelling birefringence in isolated elliptical core photonic crystal fibers," LEOS, 2, pp. 707-708, 2001.

[14.] Pysz & al., "Comparing characteristics and prospects of multicomponent photonic crystal fibres with different lattice structures," Proc. of Spie 5576, 74-80, 2004.

[15.] Reichenbach & al., "The effects of randomly occurring nonuniformities on propagation in photonic crystal fibers," Opt. Exp., Vol. 13, No. 8, 2799-2807, 2005.

[16.] Shuqin & al., "An efficient algorithm for modeling photonic crystal fibers," Opt. Fib. Technol. 11, 34-45, 2005.

[17.] Steel & al., "Elliptical-hole photonic crystal fibers," Opt. Letters 26(4), 229-231, 2001.

[18.] Steel & al., ''Polarization and dispersive properties of elliptical-hole photonic crystal fibers," J. Lightwave Technol. 19(4), 495-503, 2001.

[19.] Steel & al., "Symmetry and degeneracy in microstructured optical fibers," Opt. Lett., Vol. 26, No. 8, 488-490, 2001.

[20.] Yang & al., "Research on the effects of air hole shape on the properties of microstructured optical fibers," Opt. Eng. 43(11), 2701-2706, 2004.

[21.] Zghal & al. "Full Vector Modal Analysis of Microstructured Optical Fiber Propagation Characteristics," Proc. of Spie 5524, pp.313-322, 2004.

[22.] Zhang & al., "Photonic crystal fibers with squeezed hexagonal lattice," Opt. Exp. 12, 2371-2376, 2004.

[23.] Zhi & al., "Dependence of mode characteristics on the central defect in elliptical hole photonic crystal fibers," Opt. Exp., Vol. 11, No. 17 1966-1979, 2003.

[24.] Zhi & al., "Mode disorder in elliptical hole PCFs," Opt. Fiber Technol. 10, 124-132, 2004.

[25.] Zhu & al., "Multipole analysis of hole-assisted optical fibers," Opt. Com.206, 333-339, 2002.

[26.] Belardi & al., "Form-induced birefringence in elliptical hollow photonic crystal fiber with large mode area," IEEE J. of Quantum Electronics, 41 (12), 1558-1564, 2005.

A propos des auteurs:

Mourad Zghal
CirtaCom
École Supérieure des Communications de Tunis (Tunisie)

Faouzi Bahloul
Laboratoire des Systèmes de Communications
École Nationale d'Ingénieurs de Tunis
(Tunisie)

Rabah Attia
Laboratoire des Systèmes de Communications
École Nationale d'Ingénieurs de Tunis
(Tunisie)

Rihab Chatta
CirtaCom
École Supérieure des Communications de Tunis (Tunisie)

Dominique Pagnoux
Institut de Recherche en Communications Optiques et Microondes,
Unité Mixte de Recherche n°6615
Faculté des Sciences et Techniques de Limoges
Limoges (France)

Philippe Roy
Institut de Recherche en Communications Optiques et Microondes,
Unité Mixte de Recherche n°6615
Faculté des Sciences et Techniques de Limoges
Limoges (France)

Yassine Bouslimani
Faculté d'ingénierie
Université de Moncton
Moncton (Nouveau-Brunswick, Canada)

La sécurité dans les réseaux locaux sans fil

Par Hakim Naifer, Samuel Pierre et José Fernandez.
École Polytechnique de Montréal, Laboratoire de Recherche en Réseautique et Informatique Mobile (LARIM).

Abstract

This article presents an overview of the various technologies used in wireless local area networks, discusses the security problems inherent to those networks, then proposes a collection of technical, architectural and management solutions to solve or else limit the impact of those problems.

Sommaire

Cet article présente un aperçu des différentes technologies utilisées dans les réseaux locaux sans fil, expose les problèmes de sécurité relatifs à ces réseaux, puis propose un ensemble de solutions techniques, architecturales et managériales permettant de résoudre sinon de limiter l'impact de ces problèmes.

1.0 Introduction

Durant ces dernières années, le développement des nouvelles technologies de l'information et des communications associé à la complexité croissante des échanges d'informations inter et intra entreprises a engendré un engouement certain pour l'informatisation et le développement de réseaux informatiques. De tels réseaux devraient être capables de gérer tous les flux de données qui transitent à travers l'entreprise, tout en assurant un degré de sécurité et de confidentialité essentiel au bon fonctionnement de cette entreprise. Les réseaux locaux sans fil ou Wireless Local Area Network (WLAN) sont l'une des catégories de réseaux qui ont connu un très grand essor de par les nombreux avantages qu'ils offrent. Bon nombre de ces réseaux se sont même multipliés dans des endroits publics comme les cafés, les hôtels et les aéroports, plus communément connus sous le nom de HotSpot. Les WLAN ont résolu beaucoup de problèmes comparativement aux réseaux locaux filaires classiques. Cependant, ils en ont introduit d'autres aussi, et notamment ceux relatifs à la sécurité des communications.

Dans cet article, nous allons, tout d'abord, donner un bref aperçu des différentes technologies utilisées dans les WLAN. Ensuite, nous exposerons succinctement les problèmes de sécurité relatifs aux WLAN. Enfin, nous présenterons un ensemble de solutions techniques, architecturales et managériales permettant de résoudre sinon de limiter l'impact de ces problèmes.

2.0 Aperçu sur les WLAN

Les WLAN sont basés sur des liaisons utilisant des ondes électromagnétiques en lieu et place des câbles habituels. Ils permettent de relier très facilement des équipements distants d'une centaine de mètres. De plus, l'installation de tels réseaux ne demande pas de gros investissements, ni de lourds aménagements des infrastructures existantes, comme c'est le cas avec les réseaux filaires, ce qui a valu un développement rapide de ce type de technologies. En contrepartie se pose le problème de la réglementation relative aux transmissions radio. En effet, les transmissions radio servent à un grand nombre d'applications (militaires, scientifiques, amateures, etc.) et sont sensibles aux interférences. C'est la raison pour laquelle une réglementation est nécessaire dans chaque pays afin de définir les plages de fréquences et les puissances auxquelles il est possible d'émettre pour chaque catégorie d'utilisation.

Les standards IEEE 802.11 [1] régissent les communications dans les réseaux locaux sans fil. Ces standards se distinguent d'une part par la fréquence d'émission utilisée et d'autre part par le débit des transmissions et la technologie de modulation :

- IEEE 802.11a utilise le multiplexage par répartition orthogonale de la fréquence (Orthogonal Frequency Divis-ion Multiplexing, OFDM) pour la transmission sur la bande de fréquences UNII (Unlicensed National Information Infrastructure) de 5.150 à 5.725 GHz et offre un débit maximal de 54 Mbps.

Une gestion stratégique du réseau contribue à l'efficacité de sa sécuritié.

- IEEE 802.11b utilise la modulation modulation à spectre étalé à séquence directe (Direct Sequence Spread Spectrum, DSSS) pour la transmission sur la bande de fréquences ISM (Industrial, Scientific and Medical) de 2.4 à 2.5 GHz, possède 3 canaux non interférants et offre un débit maximal de 11 Mbps. Par contre, les réseaux 802.11b ne sont pas compatibles avec les réseaux 802.11a.

- IEEE 802.11g combine les avantages de 802.11a et 802.11b. Il offre un débit maximal de 54 Mbps et utilise la modulation OFDM pour la transmission mais sur la bande de fréquence ISM de 2.4 à 2.5 GHz. De plus, il est compatible avec 802.11b, ce qui permet d'augmenter le débit tout en évitant une mise à jour matérielle complète, trop coûteuse, des réseaux WLAN déjà existants.

3.0 Les problèmes de sécurité dans les WLAN

De par leur nature même, les ondes hertziennes sont difficiles à confiner dans une surface géographique restreinte, il est donc facile pour une personne malveillante d'intercepter le trafic du réseau si les informations circulent en clair. Par conséquent, il est fondamental de mettre en place des dispositifs adéquats de manière à assurer la confidentialité et l'intégrité des données circulant dans les WLAN.

La sécurité des communications dans les WLAN est basée sur un mécanisme appelé WEP pour Wired Equivalent Privacy. WEP requiert une clé secrète devant être déployée aux différents points d'accès et dans les appareils sans fil des usagers mobiles (ordinateurs portatifs, assistants numériques personnels, ...). Cette clé sera utilisée d'une part pour le cryptage des données avant leur transmission et d'autre part pour la vérification de l'intégrité des données. Or plusieurs études [2,3,4,5] ont révélé et largement documenté des failles dans ce mécanisme, failles qui ont rendu les WLAN susceptibles à un ensemble d'attaques permettant notamment de retrouver la clé de chiffrement ou d'usurper l'identité d'un utilisateur honnête. Ces failles peuvent être regroupées en deux grandes catégories : les failles cryptographiques et les failles architecturales.

Les failles cryptographiques sont dues, tout d'abord, à un mauvais emploi dans WEP de l'algorithme de chiffrement RC4, lequel utilise le cryptage du flux de données et un générateur de nombres pseudo-aléatoires. Ces failles sont également dues à une mauvaise gestion des clés de cryptage et à une trop faible authentification des usagers mobiles. Les failles architecturales correspondent à une mauvaise conception du WLAN, notamment le choix de l'emplacement des points d'accès, de l'étendue de leur signal et de leur configuration intrinsèque.

4.0 Les solutions de sécurité dans les WLAN

Vu l'intérêt croissant et le développement exponentiel de l'utilisation des réseaux locaux sans fil et afin de minimiser l'impact des failles de sécurité découvertes, plusieurs solutions techniques, architecturales et managériales ont été proposées [6,7], parmi lesquelles on peut mentionner le filtrage par adresse MAC, les réseaux privés virtuels, le Wi-Fi Protected Access (WPA), le nouveau standard IEEE 802.11i et une bonne gestion stratégique du WLAN.

4.1 Le filtrage par adresses MAC

Cette technique est utilisée afin d'empêcher les accès non autorisés aux réseaux locaux sans fil et est basée sur les adresses MAC (Media Access Control) des usagers mobiles. Habituellement, chaque carte réseau possède une adresse MAC unique qui permet de la distinguer des autres. D'autre part, un point d'accès peut sauvegarder une liste de contrôle d'accès contenant les adresses MAC des utilisateurs mobiles pouvant se connecter à travers le point d'accès au WLAN, comme l'illustre la Figure 1. Par la suite, chaque usager mobile ayant une adresse MAC ne faisant pas partie de la liste de contrôle se verra automatiquement refuser l'accès. Cette technique demande un grand travail à l'administrateur réseau car il doit programmer tous les points d'accès avec les bonnes adresses et les maintenir à jour. De plus, cela limite la mobilité des utilisateurs aux points d'accès qui contiennent préalablement leurs adresses. Finalement, dans certains cas il est possible pour des usurpateurs chevronnés de changer l'adresse MAC des cartes réseaux sans fil à l'aide d'outils de modification du micrologiciel (firmware).

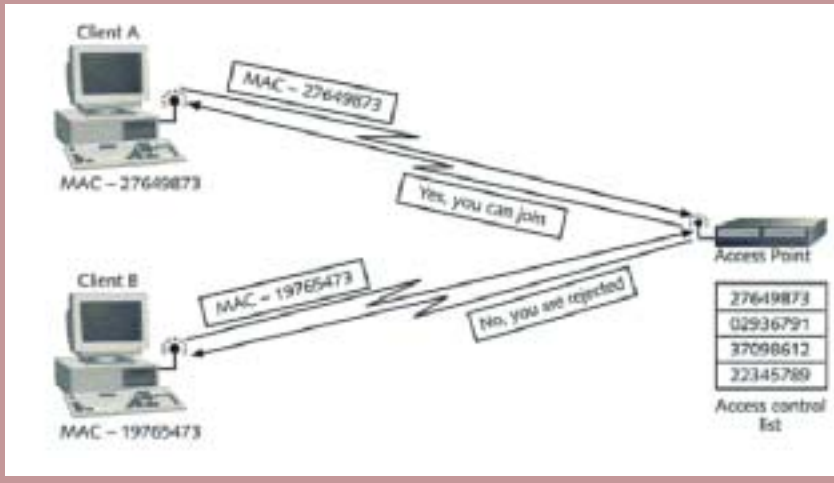


Figure 1. Sécurisation par adresses MAC

4.2 Les réseaux privés virtuels

Un réseau privé virtuel (Virtual Private Network, VPN) est une extension d'un réseau privé comportant des liens sur des réseaux publics comme Internet. Il sécurise une connexion en cryptant tout le trafic du réseau avant de l'envoyer sur Internet, puis en le décryptant lorsqu'il arrive à l'autre extrémité du réseau privé virtuel. Comme le réseau public transporte tout le trafic du réseau privé virtuel sous forme encapsulée, une connexion VPN est également appelée« tunnellisation ». Le VPN peut avoir recours aux protocoles PPTP (Point-to-Point Tunneling Protocol) ou le mode tunnel du protocole IPSec (Internet Protocol Security) pour gérer les tunnels et encapsuler les données privées. Dans le cas d'un WLAN, comme l'illustre la Figure 2, des utilisateurs mobiles distants ayant accès à Internet, dans un HotSpot par exemple, pourront alors se connecter au réseau local de l'entreprise d'une manière totalement sécuritaire via un tunnel crypté. L'inconvénient est qu'un VPN requiert une configuration minutieuse tenant compte des problèmes d'interopérabilité et de compatibilité inter plate-forme.

4.3 Le Wi-Fi Protected Access

Le Wi-Fi Protected Access (WPA) est prôné par la Wi-Fi Alliance, une organisation à but non lucratif composée des leaders industriels constructeurs de matériel pour systèmes sans fil et des entreprises fournissant des services relatifs aux réseaux locaux sans fil. Elle s'occupe principalement de certifier l'interopérabilité et la compatibilité des produits répondant aux standards IEEE 802.11 et de faire la promotion de cette technologie de réseaux locaux sans fil auprès des industriels et des clients.

WPA peut être utilisé dans un environnement personnel ou professionnel. Il ne nécessite pas de mise à jour matérielle de l'infrastructure existante mais uniquement une mise à jour logicielle. WPA permet d'améliorer deux aspects importants de la sécurité sans fil, en l'occurrence le chiffrement des données et l'authentification.

Pour améliorer le chiffrement, WPA utilise le Temporal Key Integrity Protocol (TKIP) qui est basé sur une fonction de mixage de clés par

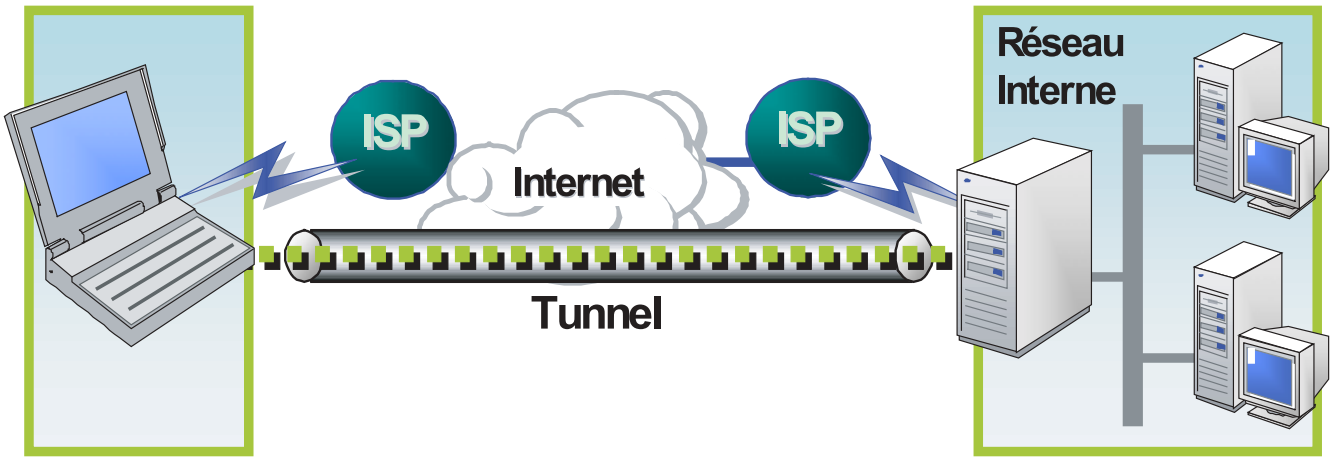


Figure 2. Sécurisation par VPN

paquet et un Message Integrity Check (MIC). Pour améliorer l'authentification, WPA introduit une méthode basée sur des mots de passe, comme l'illustre la Figure 3.

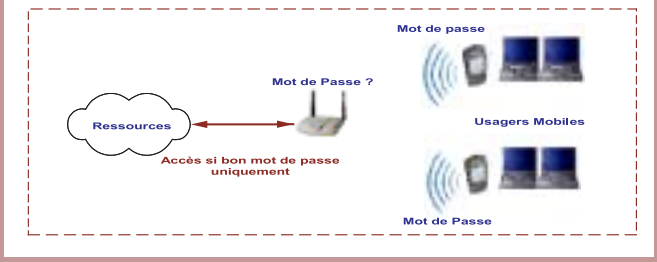


Figure 3. Authentification sécurisée avec WPA

4.4 Le nouveau standard IEEE 802.11i

Le standard IEEE 802.11i [9] présente une combinaison complexe de plusieurs protocoles et mécanismes visant à sécuriser les WLAN. En effet, pour améliorer la sécurité du chiffrement, deux protocoles cryptographiques sont ajoutés à WEP : Counter-Mode Cipher Block Chaining Message Authentication Code Protocol (CCMP) et Temporal Key Integrity Protocol (TKIP). CCMP est basé sur l'algorithme de cryptage Advanced Encryption Standard (AES), alors que TKIP utilise l'algorithme de cryptage RC4. CCMP requiert une mise à jour matérielle des points d'accès tandis que TKIP nécessite seulement une mise à jour logicielle. TKIP est principalement destiné à assurer l'interopérabilité entre anciens et nouveaux réseaux WLAN. Par conséquent, les nouveaux WLAN pourront supporter l'utilisation simultanée de trois protocoles de chiffrement : WEP, TKIP et CCMP. L'unité mobile et le point d'accès concerné utiliseront le plus haut degré de sécurité que les deux peuvent supporter mutuellement. Concernant la gestion des clés, deux nouveaux modes sont introduits : une gestion de clés manuelle et une gestion de clés automatique. La première nécessite un administrateur réseau afin de déployer manuellement les clés de chiffrement, alors que la deuxième se base sur des mécanismes nommés 4-Way Handshake et Group Key Handshake afin de gérer convenablement la distribution des clés.

4.5 Une bonne gestion stratégique du WLAN

Une contribution importante à l'efficacité de la sécurité peut être assurée grâce à une bonne gestion stratégique du réseau. En effet, un monitoring assidu et régulier de ce qui se passe sur le réseau sans fil est primordial. Il permettra aux administrateurs de mieux évaluer le degré de sécurité atteint par leur installation et par conséquent l'améliorer s'il ne répond pas aux objectifs fixés. D'autre part, la mise à jour logicielle régulière des points d'accès représente une opération critique pour maintenir un bon degré de sécurité. Beaucoup d'administrateurs prennent trop de temps avant d'installer des correctifs suite à la découverte d'une faille, ce dont profitent les pirates informatiques. Enfin, un audit régulier de l'environnement du WLAN est fortement recommandé. Il permettra de savoir exactement l'étendue du signal du réseau sans fil, comment le réseau est utilisé, par quels utilisateurs et à quelles fins. Il permettra aussi de vérifier les configurations de chaque point d'accès et de leur conformité à la politique de sécurité de l'entreprise.

5.0 Conclusion

Dans cet article, nous nous sommes intéressés à l'une des catégories de réseaux qui a connu l'un des plus grands développements ces dernières années : les réseaux locaux sans fil ou WLAN. La raison pour laquelle ce type de réseau a connu une si grande expansion est qu'il offre de nombreux avantages comme par exemple la facilité de déploiement, une meilleure mobilité des usagers ou encore des coûts de mise en place assez faibles. Par contre, l'inconvénient majeur qu'il introduit est la sécurité des communications. Comme nous l'avons illustré, les problèmes de sécurité dans les WLAN sont nombreux, diversifiés et complexes. Prétendre éliminer complètement tous ces problèmes serait utopique mais, en ayant recours à une combinaison des solutions présentées dans cet article, la sécurité des communications dans les WLAN peut être considérablement améliorée. Par ailleurs, les plus sceptiques en matière de sécurité informatique opteront pour une stratégie complètement distincte de ce que nous avons présenté jusqu'à présent : l'attentisme, qui consiste à éviter tout déploiement de WLAN jusqu'à ce que les aspects de sécurité soient mieux résolus. C'est d'ailleurs la stratégie adoptée par diverses unités du gouvernement fédéral américain, dont le Pentagone et la plupart des services militaires. De plus un rapport intitulé The National Strategy to Secure Cyberspace [8] recommande à toutes les agences gouvernementales américaines une précaution extrême envers les technologies sans fil.

6.0 Références

[1] IEEE Std 802.11-1997, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.

[2] J. S. Park, D. Dicoi. 2003. «WLAN Security: Current and Future». IEEE Internet Computing, vol. 7, no. 5, pp. 60-65.

[3] N. Borisov, I. Goldberg, D. Wagner. 2001. «Intercepting Mobile Communications: The Insecurity of 802.11». ACM. Seventh Annual International Conference on Mobile Computing And Networking: July 16-21, 2001, Roma, Italy, pp. 180-189.

[4] W. A. Arbaugh, N. Shankar, J.Y.C.Wan. 2002. «Your 802.11 Wireless Network has No Clothes». IEEE Wireless Communications Magazine, vol. 9, no. 6, pp. 44-51.

[5] N. L. Jr. Petroni, W. A. Arbaugh. 2003. «The Dangers of Mitigating Security Design Flaws : A Wireless Case Study ». IEEE Security and Privacy, vol. 1, no. 1, pp. 28-36.

[6] J. Williams. 2001. «The IEEE 802.11b Security Problem, Part 1». IEEE IT Professional, vol. 3, no. 6, pp. 91-96.

[7] J. Williams. 2002. «Providing for Wireless LAN Security, Part 2». IEEE IT Professional, vol. 4, no. 6, pp. 44-48.

[8]The White House. 2003. The National Strategy to Secure Cyberspace. http://www.whitehouse.gov/pcipb/

[9] IEEE Std 802.11i-2004, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications. Amendment 6: Medium Access Control (MAC) Security Enhancements.

Hakim Naifer est titulaire d'un baccalauréat en Génie Informatique de l'École Nationale d'Ingénieurs de Tunis (ENIT), Tunisie, en 2003 et d'une Maitrise en Génie Informatique de l'École Polytechnique de Montréal, Canada, en 2005. Il prépare présentement un Doctorat dans la même institution au sein du Laboratoire de recherche en Réseautique et Informatique Mobile (LARIM). Ses intérêts de recherche inclus l'innovation technologique dans les architectures de réseaux sans fil de nouvelle génération (4G), la gestion de la mobilité et la qualité de service dans les réseaux sans fil de nouvelle génération, la sécurité informatique et la sécurité des réseaux.

Dr. Samuel Pierre is currently a Professor of Computer Engineering at École Polytechnique de Montréal where he is Director of the Mobile Computing and Networking Research Laboratory (LARIM) and NSERC/Ericsson Industrial Research Chair in Next-generation Mobile Networking Systems. Dr. Pierre is the author or co-author of 6 books, 15 book chapters, 16 edited books, as well as more than 300 other technical publications including journal and proceedings papers. He is an EIC Fellow, senior member of IEEE and a member of ACM.

Jose M. Fernandez est professeur adjoint à l'École Polytechnique de Montréal depuis 2004. Il détient un Ph.D. (informatique quantique) de l'Université de Montréal, un M.Sc. de l'University of Toronto (cryptographie) et un double B.Sc. du MIT en génie informatique et mathématiques. Ses domaines de recherches sont la sécurité des réseaux informatiques et l'informatique quantique. Ses travaux récents portent sur la sécurité des réseaux ad-hoc sans-fil, la protection contre les attaques par déni de service et les détecteurs d'intrusions.

Technical Volunteerism

By Mitchell Shnier

I'm sure many of you occasionally feel that you'd like to give something back to your community by volunteering, or would like to do something good for others in addition to (or in place of) simply donating money – but you're concerned about your busy schedule or the travel time.

A wonderful volunteer activity for us technical people is to handle the e-mail communications for School Councils, ratepayers groups, cottager associations, and others.

E-Newsletter Distribution Software

Of course, sending e-mails is easy. But the part that nobody likes is dealing with the additions, changes, and removals of e-mail addresses from the distribution list. Fortunately, there is a technical solution to this – a "self-serve" web site where subscribers do this on their own. Another advantage of using specialized e-mail software to handle the subscriptions is that the "back-end" software can handle any number of e-mail addresses, whereas Microsoft Outlook and Hotmail (for example) have limitations.

There are two choices on for this e-mail software: commercial and free. An example of commercial software is from http://ConstantContact.com. The cost depends on the number of e-mail addresses on the distribution list (and is free for under 50 addresses), and the service includes many professionally-designed templates, and technical support. I haven't personally used this service, but I have called their technical support and they seemed very helpful and friendly.

Open Source Software

The other option (and the one I use) is open-source software. In this case, there are three components to the system:

1. The Software

I use phplist, from http://phplist.com. While this software has many configuration screens to customize the web pages and e-mails users see when they add, change, or remove their e-mail addresses, the software is also open-source, so all the source code is freely available to make any changes you may desire (for me, this has mostly been wording changes for which there were no easy-to-use configuration screens, though occasionally there are software problems which need to be fixed this way). This software is written in php, which is a very popular scripting language, and is very useful to learn. This popular software has many templates available to change the look of the web pages, and also user forums for help, and periodic updates with new features.

There are many configuration screens available in phplist to allow customization of web pages and e-mails users see in adding, changing or removing their address.

2. Web Site Hosting

This software needs to be running all the time so people can change their subscription information. While one could run this software on their own home PC, for security reasons (you don't want people trying to hack into your home computer) and because home PC IP addresses occasionally change, it is better to run this software on a server from a web hosting company.

There are a huge number of web hosting companies. It is important to choose one that supports the e-mail software you choose. It is now very common for hosting companies to support php, though other e-mail software may have other requirements.

The other reason why a hosting service is needed is to store attachments associated with the e-mails you send. This way, the e-mails are short and download quickly, but people can click for further information.

Hosting companies offer plans, which will include a combination of web storage, the data traffic allowed per month, e-mail features, and utilities (such as backup and e-mail redirection).

In my case I pay about US$80 per year. This provides all the storage and traffic I need for many uses, which currently include: three separate e-mail distribution web sites, a large family history web site, some photo-essays I created from vacation pictures, backup for important work files, a way for people to send me huge files that can't be transferred by e-mail, a web site with photo-essays on city infrastructure – which are useful for some courses I teach, and another web site about cottage lake water quality. Most web hosting plans include so much storage and traffic that hosting a web-based e-newsletter won't increase the annual cost.

3. Domain Name

A web address is needed for the hosting service; such URLs cost about US$10 per year. These can be shared with other uses (but then have a more complicated URL).

Technical Knowledge

It definitely takes time and technical interest to get all this set-up, but you'll learn a lot, and once it is done you can easily set up new sites by copying your work and only making customization changes. If I had to summarize the level of technical knowledge required, I'd say it is similar to using the advanced features of Microsoft Word. You need to understand a bit about ftp and HTML.

In my case, other people create the content and e-mail it to me. I then copy and paste it into the e-mail system, add the hot-links and format the text (such as bold and italics), upload any attachments to the web site, and send myself test e-mails before initiating the big transmission. I handle the e-newsletters for my daughter's Junior High School (weekly, 300 addresses), a committee of the School Council of my son's high school (monthly, 100 addresses), and our local ratepayers group (bi-monthly, 190 addresses).

Rewarding Work

School Councils everywhere are most interested in keeping in touch with parents, who very much appreciate the timely information. Because of field trips, music nights, Professional Development days, sports activities, fundraising events and special announcements, there is much more schools need to communicate than when we were in school. Even when the school does put together a printed newsletter, it often doesn't get to the parents and guardians. And the hard-working parent volunteers often just don't have the technical skills to handle this.

It is very rewarding work. You hear news before most everyone else, you'll understand how the school and other groups operate, you get to know very helpful people, the work can be done at any time, and from any computer on the Internet, and people far and wide will know your name and your good work.

I'd be happy to help anyone get started, I'm at Mitchell_Shnier@ieee.org.

About the Author

Mitchell Shnier received his B.A.Sc. in Electrical Engineering from the University of Toronto in 1979. He has written two books on data communications, been awarded three US patents, has been an independent data communications consultant for 20 years, and has worked on projects in the nuclear, health, and financial sectors. He presents 4- and 5-day courses on data communications to people in industry for Learning Tree Canada, and also hands-on optics presentations to students in grade 8 for *Scientists in School*. He can be contacted at Mitchell_Shnier@ieee.org

Tesla 150th Anniversary Celebrations in Vancouver

By Pieter Botman, P.Eng., SMIEEE
Communications Officer, IEEE Vancouver Section

November 2006 saw several celebrations marking the 150th anniversary of the birth of Nikola Tesla, noted inventor and pioneer in electrical engineering[1].

A Vancouver Tesla committee organized several events, including a public exhibit, an academic symposium, a theatrical performance, and a dinner reception. The IEEE Vancouver Section supported these activities by co-sponsoring the public exhibit and the academic symposium. Two prominent members of the Vancouver Section, Gruja Blagojevic (Publicity Chair) and Ljiljana Trajkovic from Simon Fraser University (Chair of the Circuits and Systems Society joint Vancouver/Victoria Chapter) were members of the committee.

The academic symposium "Tesla Day at SFU 2006", held at the IRMACS Centre at Simon Fraser University (SFU) on November 17th, attracted more than 100 attendees. Speakers included noted academics from Serbia, Switzerland, and the US as well as from SFU and the University of British Columbia (UBC).

The presentations are available on the permanent Symposium site: http://tesla2006.irmacs.sfu.ca/.

The exhibit "Nikola Tesla's Wonderful World of Electricity" was displayed in the lobby of the BC Hydro building in downtown Vancouver for a period of two weeks. This was a traveling exhibit from the Tesla Museum in Belgrade, with Vancouver being its only North American destination. Widely advertised and attended by the general public, the exhibit contained 52 panels with photos and short writings about Tesla's life, work, and inventions, along with 4 standing and 4 working models.

The exhibit was officially opened with a ceremony on November 18th, which featured a "Tesla week" proclamation from the Deputy Mayor of Vancouver and recognition of visiting dignitaries and sponsors, including the IEEE Vancouver Section, SFU and UBC, BC Hydro, BC Transmission Corp., Vector Drive Systems, and Stantec Inc.

More than 3,000 visitors included students from local schools, engineers from local corporations and the general public. Many signed the impression book and commented on the significance of the event. The IEEE logo was prominently displayed on one of the exhibit panels, while members of the IEEE Vancouver Section served as exhibit guides, giving to the Section a great deal of public exposure.

Section Chair Rasvan Mihai commented on the significance of the Nikola Tesla anniversary events. "The IEEE Vancouver Section views these events not only as a celebration of a pioneer in our field, but also as an opportunity to inform the general public about Tesla, his inventions, and the importance of Electrical Engineering in our everyday lives.

"On behalf of the Vancouver Section, I would like to congratulate all the contributors and organizers on their success, and thank them for their efforts, particularly Mr. Blagojevic and Dr. Trajkovic. It is through the efforts of dedicated volunteers such as these that the IEEE continues to benefit the profession and to educate the general public."

[1]N.Ed. See "Tesla Honoured with Niagara Falls Monument" in Canadian Review no.53, Fall 2006.

Speakers and Organizers at Tesla Symposium: Dr. Veselin Jungic (SFU), Prof. Ljiljana Trajkovic (SFU), Mr. Gruja Blagojevic (IEEE Vancouver Section), Prof. Jose Marti (UBC), Prof. Emeritus Konrad Reichert (ETH Zurich, Switzerland), Prof. Bret Heinrich (SFU), Prof. Emeritus Anthony Arrott (SFU), Academic Aleksandar Marincic (University of Belgrade), Prof. Milos Ercegovac (UCLA), Dr. Djordje Kljajic. ***Photo courtesy of The IRMACS Centre***

Tesla Museum Exhibit Comes To B.C. Hydro

Tesla Exhibition: Tesla's induction motor with egg shaped rotor called "Columbus' Egg". *Photo courtesy of Ana Ristic.*

Tesla Exhibition: Model of Tesla's induction motor with disk shaped rotor. *Photo courtesy of Ana Ristic.*

Tesla's working model of the first "true" induction motor with the rotor in short circuit. *Photo courtesy of Tesla Museum, Belgrade.*

Tesla Exhibit: Tesla's transformer. *Photo courtesy of Ana Ristic.*

Tesla exhibited this ingenious model of the induction motor (rotor is a freely rotating metal egg) at the Chicago World Exhibition, 1893. *Photo courtesy of Tesla Museum, Belgrade.*

Opened to the public first in 1955, the Nikola Tesla Museum is located in Belgrade, Serbia. Its various rooms contain original models of Tesla's numerous areas of exploration and invention, roughly 150,000 documents and some of his personal belongings.

Coinciding with Tesla Day at SFU, the exhibition *Nikola Tesla's Wonderful World of Electricity* was on display for two weeks at B.C. Hydro Building in Vancouver, courtesy of the Museum. Photos on the left taken at the exhibition by Ana Ristic.

ICUE '06: Report on 5th International Conference for Upcoming Engineers

By Shahab Ardalan, VLSI Research Group
University of Waterloo

Named (along with Ottawa-Gatineau) amongst the Top Seven Intelligent Communities by the New York-based Intelligent Community Forum, Waterloo was well placed to host the 5th International Conference for Upcoming Engineers (ICUE) in 2006 and welcome more than 70 international delegates.

The event was organized by the IEEE Kitchener/Waterloo Section and supported by generous contributions from the following: Department of Electrical and Computer Engineering, Dean of Engineering Office, David R. Cheriton School of Computer Science at the University of Waterloo; IEEE Canadian Foundation; Research in Motion; Raytheon; and John Wiley Publisher.

Following the opening by keynote speaker Dr. Tony Ponsford from Raytheon, the conference featured paper presentations by graduate and undergraduate students, and design project demonstrations. Dr. Xavier Fernando from Ryerson University and Mr. Vincent Ross from ATI Technologies Inc. presented the technical tutorials.

More than 75 technical submissions in the area of electrical and computer engineering, and cross disciplinary areas such as nanotechnology were received and reviewed. Thirty-five accepted papers were presented in six technical sessions, and design projects were demonstrated in the Davis Center at the University of Waterloo. Active participation by industry added value to the event.

ICUE 2006 ended in a very warm and gracious manner in a banquet ceremony where the prizes for the top three technical papers and the best design project were awarded.

ICUE 2006's theme was Collaboration between Academia and Industry. The survey conducted at the end of the event highlighted the success of reaching this goal. ICUE provided the attendees with an outstanding opportunity to present their technical achievements and discuss their strategies with the best in the field.

Our thanks to the financial sponsors, the technical and organizing committees, and the participants who made ICUE 2006 a great success. ICUE 2007 will be held May 28-29 at Ryerson University where it was born, see http://www.icue.ca/ . Looking forward to see you there.

Shahab Ardalan
Chair ICUE 2006

Amir Khatibzadeh
Vice-chair ICUE 2006

AWARDS

1st Prize, Best Paper:
Mr. M. Fakharzadeh, *Miniaturized Optical Delay Lines*

2nd Prize, Best Paper:
Ms. R. Karkokli, *Plantar pressure distribution analysis system for the dynamic moving foot*

3rd Prize, Best Paper:
Mr. M. F. Baroughi, *Design of multilevel ROM for high density memory application*

1st Prize, Best Project Design:
Ms. B. Ghali & Ms. M. Kowsari, *Handy Mouse for the Physically Challenged*

The hard-working organizers of ICU 2006, left to right: Andreea Balteanu, Sara Rasooli, Shahab Ardalan (Chair), Saeed Fatholulumi, Rubil Ahmadi, Hossein Sarbishei, Sahba Ghias, Amir Khatibzadeh (Vice-Chair).

Engineering Management: What's New in the Literature?

by Terrance Malkinson

- IEEE Engineering Management Society Governor

◆ When making decisions about our careers and personal lives it is important to be proactive. One way to become informed is by reading and analyzing forecasts. The Futurist www.wfs.org, published by the World Future Society, is one of many excellent sources of information that will help facilitate your success. "Outlook 2007" is a 9 page inset in volume 40 issue #6 (November-December, 2006) that will provide you with a wealth of thought-provoking forecasts, trends, and ideas. These brief articles provide glimpses of what may happen in the future and a reference is provided to the reader for more information about the forecast. Other articles in The Futurist that you may find of value on directions that our world might go include "Technology's Promise"; 40(6): 41-50, 2006 and "The 17 Great Challenges of the Twenty-First Century" 41(1): 20-24, 2007. The World Future Society is a nonprofit educational and scientific organization that has about 25,000 members and subscribers in 80 nations and provides a number of products and services dedicated to individuals who recognize that they may shape the future by recognizing and understanding significant trends and where they may lead providing a solid foundation for decision-making. Career savvy individuals analyze trends, forecasts and other information from a variety of sources and thereby proactively manage their careers.

◆ Workaholism is common in today's increasingly competitive business environment. Expectations are for employees, particularly professionals and senior management, to put in many hours. In: "Extreme Jobs: The Dangerous Allure of the 70-hour Workweek"; Harvard Business Review; 84(12):49-59, 2006; www.hbr.com. Sylvia Ann Hewlett and Carolyn Buck Luce discuss workaholism in overachieving professionals who hold jobs requiring 60 or more hours a week. Interestingly, their research results suggest that in general, people working long hours do not feel exploited and that a large majority of them enjoy their jobs despite the long hours. The authors provide many interesting insights on the complexities of the all-consuming career that may be personally rewarding in many ways but not without danger to the individual and to society.

◆ Excellence in your career is not necessarily simple or easy to come by. In: "What it Takes to be Great"; (FORTUNE; 178(8): 88-96, 2006; www.fortune.com) Geoffrey Colvin discusses research that shows that in general, success and greatness is achieved through an enormous amount of hard work over many years. This is one of several articles in this issue of FORTUNE that focuses on Secrets of Greatness: The Excellence Issue". The commonly held belief that an innate natural gift leads to greatness is not necessarily true. When you look deeper it is often found that the individuals' success is in reality due to a motivated and disciplined approach to work over many years. Little evidence exists supportive of high-level performance without long-term (ten years of more) experience and deliberate practice. Deliberate practice is activity that's explicitly intended to improve performance. The author provides a five point "tip sheet" that will assist you with your approach. As the author concludes "greatness isn't reserved for a preordained few. It is available to you and to everyone."

◆ We are all being tested. Everyone watches the decisions that a person — regardless of their level in the organization — makes. The January 2007 issue of Harvard Business Review; 85(1); www.hbr.com focuses on the subject of "The Tests of a Leader". Eight perspectives from Global Executives about the challenging tests that shaped them as leaders are provided in the article "Moments of Truth" (pp. 15-25). Other articles in the issue continue with the issue theme. In "Becoming the Boss" (pp. 49-56) Linda Hill discusses the process of transitioning to a leadership position. Common myths about what it means to be a boss coupled with reality are discussed. In "Courage as a Skill" (pp. 58-64) Kathleen Reardon examines the issue of the difference between political courage and political suicide. In business, courageous action is a special kind of calculated risk taking. Good leaders are willing to make bold moves and strengthen their changes of success through careful deliberation and preparation. The author discusses six discrete processes that make up the courage calculation.

◆ Influencing others is something that we all have to do. In "The Art of Influence" CIO (20(3): 48-58, 2006; www.cio.com) Allan Holmes provides some very interesting perspectives on how to increase your influence on others, particularly your colleagues. Although the article is focused on the information technology industry the principles apply to all industries. Insights are provided from four business leaders who use these techniques to develop influence relationships that gain allies in the organization. In today's economy few people work alone, rather we work in multidisciplinary teams where effective communication skills such as influence are essential for career success.

◆ Twelve examples of innovation in Canada are provided in "Fast Forward" (Canadian Business; 80(4): 27-42, February 12. 2007; www.canadianbusiness.com). Examples of innovation in mining, virtual reality, marketing, telematics, nanotechnology, medicine, chemistry, and many other fields are presented. Canadians often are not as informed as they should be or tend to be very modest when promoting our past and present accomplishments. Many Canadians have made extremely important contributions for the betterment of humanity. Our educational institutions, research endeavors, and industry are in many cases the best in the world. The future looks great for Canadian innovation. Governments at all levels and the private sector are increasingly recognizing the importance of innovation to the future of the country and increasing their investment. Canadian Business, as well as many other regional, provincial and municipal publications provide a wealth of information on entrepreneurial success and business opportunities in Canada.

About the Author

Terrance Malkinson is a Governor of the Engineering Management Society, international correspondent for IEEE-USA Today's Engineer Online, editor-in-chief of IEEE-USA Today's Engineer Digest, and editor of IEEE Engineering Management. The author is grateful to the Haskayne School of Business Library at the University of Calgary. He can be reached at malkinst@telus.net .

EIC Awards, 2007

ENGINEERING INSTITUTE OF CANADA
L'INSTITUT CANADIEN DES INGÉNIEURS

Honours, Awards & Fellowships - Médailles, Distinctions et Fellowships

Presented at the EIC Awards Banquet on Saturday, March 3, 2007
Présentés lors du banquet de l'ICI le samedi 3 mars 2007

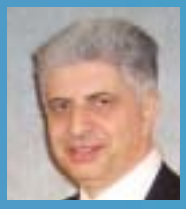
Sir John Kennedy Medal*

Wallace Stanley Read
President
Remas, Inc.

CPR Engineering Medal**

Dr. Ljiljana Trajkovic
Professor
Electrical & Computer Engineering
Simon Fraser University

EIC Fellow



Dr. Bruno N. Di Stefano
President
Nuptek Systems Ltd.

EIC Fellow

Dr. Henrietta Galiana
Professor & Chair
Biomedical Engineering
McGill University

EIC Fellow

John Grefford
Principal Engineer
CRO Engineering

EIC Fellow

Dr. William A. Gruver
Professor Emeritus
Simon Fraser University

EIC Fellow

Dr. Géza Joos
Professor
Electrical & Computer Engineering
McGill University

EIC Fellow

Dr. Graham A. Jullien
iCORE Research Chair
University of Calgary

EIC Fellow

Dr. Mohamed S. Kamel
Canada Research Chair
Director, PAMI Lab
University of Waterloo

EIC Fellow

Dr. Don Orest Koval
Professor
Electrical & Computer Engineering
University of Alberta

EIC Fellow

Dr. C. Andre T. Salama
Professor Emeritus
J.M. Ham Chair in Microelectronics
University of Toronto

EIC Fellow

Dr. Tarlochan S. Sidhu
Professor & Chair
Electrical Engineering
University of Western Ontario

* Established in 1927 and awarded every other year to commemorate the great service rendered to engineering by Sir John Kennedy, a Past President of the EIC, this medal is the most distinguished award of the Institute. It is awarded in recognition of outstanding service to the profession or for noteworthy contributions to the science of engineering or to the benfit of the Institute.

** Awarded for the first time in 1988 and Gifted by CP Rail in regognition of many years of leadership and service to the Institute and its Member societies at the regional and local levels.

IEEE Canada Award Recipients, Left to Right: Dr. Mohamed S. Kamel, Tarlochan S. Sidhu, Dr. Don Orest Koval, Wallace Stanley Read, IEEE Canada President Bob Hanna, Dottore Bruno N. Di Stefano, John Grefford.

EIC Canada Medal Recipients, Left to Right: Dr. Marc Allen Rosen, Wallace Stanley Read, EIC President Kerry Rowe, Peter C. Lighthall, Dr. David W. Devenny, Dr. Raymond Benson

When you plan your next media budget ...

Don't give us a second thought.

Think of us first.

When you advertise in the IEEE Canadian Review you reach 15,000 of the industry's brightest and best, from coast to coast. People engaged in their profession, people who make things happen. Now that's something to think about.

For rates and deadlines contact:

John Grefford
tel: (613) 839-1108
fax: (613) 839-1406
Grefford@ieee.org

EAST ...

IASTED Int'l Conference on Antennas, Radar and Wave Propagation (ARP)
2007-05-30...06-01, Montréal, QC
http://www.iasted.org/conferences/home-566.html

20th Int'l Teletraffic Congress (ITC-20)
2007-06-17...21, Ottawa, ON
http://www.itc20.ca

IEEE Int'l Conf. on Application-specific Systems, Architectures and Processors (ASAP)
2007-07-09...11, Montréal, QC
http://www.asap-conference.org/

Int'l Symposium on Signals, Systems, and Electronics (ISSSE)
2007-07-30...08-02, Montréal, QC
http://www.issse2007.polymtl.ca/index.html

10th Int'l Conference on Information Fusion (FUSION)
2007-07-09...12, Québec, QC
http://www.fusion2007.org

Joint 50th IEEE Int'l Midwest Symposium on Circuits and Systems (MWSCAS) and IEEE North-East Workshop on Circuits and Systems (NEWCAS)
2007-08-05...08, Montréal, QC
http://www.newcas.org

Int'l Conference on Image Analysis and Recognition (ICIAR)
2007-08-22...24, Montréal, QC
http://www.iciar.uwaterloo.ca/iciar07/

2nd Int'l Conference on Access Networks & Workshops (ACCESSNETS)
2007-08-22...24, Ottawa, ON
http://www.accessnets.org/2007/

IEEE Int'l Conference on Systems, Man and Cybernetics (SMC)
2007-10-07...10, Montréal, QC
http://www.smc2007.org/

41st IEEE Int'l Carnahan Conference on Security Technology
2007-10-08...11, Ottawa, ON
http://www.carnahanconference.com

IEEE Int'l Workshop on Haptic Audio Visual Environments and their Applications (HAVE)
2007-10-12...14, Ottawa, ON
http://www.discover.uottawa.ca/have2007/

WEST ...

10th Cdn Workshop on Information Theory (CWIT)
2007-06-06...08, Edmonton, AB
http://www.ece.ualberta.ca/~cwit2007

4th IEEE Int'l Workshop on Visualizing Software for Understanding and Analysis (VISSOFT)
2007-06-24...25, Banff, AB
http://www.program-comprehension.org/vissoft07/

4th Int'l Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness (QShine)
2007-08-14...17, Vancouver, BC
http://www.qshine.org

2007 IEEE Pacific Rim Conference on Communications, Computers, and Signal Processing
2007-08-22...24, Victoria, BC
http://www.ece.uvic.ca/pacrim/pacrim07

Int'l Symposium on Nonlinear Theory and Its Applications (NOLTA)
2007-09-16...19, Vancouver, BC
http://nolta07.is.tokushima-u.ac.jp

Int'l Topical Meeting on Microwave Photonics (MWP)
2007-10-02...05, Vancouver, BC
http://www.mwp2007.org

IEEE Avionics, Fiber-Optics and Photonics Technology Conference (AVFOP)
2007-10-02...05, Victoria, BC
http://www.i-leos.org

2007 IEEE Conference on Electrical Insulation and Dielectric Phenomena (CEIDP)
2007-10-14...17, Vancouver, BC
http://ewh.ieee.org/soc/dei/ceidp/ceidp2007.htm

CENTRE ...

6th Int'l Conf. for Upcoming Engineers (ICUE)
2007-05-28...29, Toronto, ON
http://www.icue.ca/

Inaugural Int'l Conference on Distributed Event-Based Systems (DEBS)
2007-06-20...22, Toronto, ON
http://www.debs.msrg.utoronto.ca/cfp.shtml

27th IEEE Int'l Conference on Distributed Computing Systems (ICDCS)
2007-06-25...29, Toronto, ON
http://www.eecg.utoronto.ca/icdcs07/

IEEE Canada

General Conference Chair:
Dr. Vijay Sood, P.Eng., FIEEE, FEIC
Hydro-Quebec (IREQ), Varennes

Steering Committee:
Dr. Amir Aghdam, P. Eng.,
Concordia University, Montreal
Dr. Branislav Djokic, P. Eng.,
National Research Council, Ottawa
Dr. Wahab Almuhtadi, P. Eng.,
Algonquin College, Ottawa
Dr. Anader Benyamin,
Advanced Research Technologies, Montreal

Technical Program Committee Chair:
Dr. Bin Wu, P.Eng.,
Ryerson University, Toronto
Secretary:
Nazih Khaddaj Mallat,
INRS, Montreal
Treasurer:
Dr. Yousef Shayan, P. Eng.
Concordia University, Montreal
Publicity Chair:
Ahmed Ghariani
SNC-Lavalin, Montreal
Workshop Chair:
Dr. Luiz Lopes
Concordia University, Montreal

Project Coordination Chair:
Dr. Sheldon Williamson
Concordia University, Montreal

IEEE Canada President & Region7 Director:
Dr. Bob Hanna, P.Eng., FIEEE, FEIC
RPM Engineering, Ontario

IEEE Canada CONAC Chair:
Kash Husain
Dillon Consulting Ltd., Ontario

Registration Chair:
Dr. Vijay Devabhaktuni
Concordia University, Montreal
Email: vijayd@encs.concordia.ca

CALL FOR PAPERS

Electrical Power Conference 2007
Renewable and Alternative Energy Resources

October 25 - 26, 2007 Montreal, Quebec, Canada

Holiday Inn Select
Montreal Downtown Convention Center
99 Viger Ave & St. Urbain St. Montreal, Quebec, H2Z 1E9

BACKGROUND: IEEE Electrical Power Conference (EPC) 2007 is focused on Renewable and Alternative Energy Resources as one of the areas in Power Systems Engineering that has been receiving a lot of attention in recent years worldwide. The conference is sponsored by IEEE Canada and organized by IEEE Montreal and Ottawa Sections. It is a natural extension/spin-off of the Electrical Power Symposia (EPS) that started in Ottawa and was, for the past six consecutive years, very successfully organized by the IEEE Ottawa Section. That approach of addressing the topics of wider interest and to have both Canadian and international speakers, was followed in 2006 as well. The crucial role of Distributed Generation and Smart Grids is increasingly getting recognition in the economy, energy, and environment, which form a basis for nation's sustainability, security, and development.

TOPICS:
Topics of interest to the conference include the following:

- Wind Power
- Solar Power
- Ethanol Power
- Hydrogen Power
- Bio-thermal Power
- Small Hydro Power
- Fuel Cells
- Wave & Tidal Power
- Energy Storage
- Smart Networks
- Smart Networks Reliability
- Smart Networks Protection
- Energy Efficiency
- Energy Conservation
- Technology Trends
- Clean & Renewable Energy Markets

IMPORTANT DATES:

Deadline for submitting extended abstract: July 9, 2007

Notice of paper acceptance: August 15, 2007

Submission of camera-ready paper (6 pages): September 12, 2007

NOTES:

Extended abstract: Minimum length of extended abstract should be 2500 words, i.e. minimum 3 pages in **IEEE PES format**: body text font size 10, single-spaced, double-column format, on 8.5 × 11 inch letter size paper.

Final paper length is 6 pages, maximum 8 and, for every page over 6, there will be an extra page charge.

Submission of a maximum of 2 papers per author/coauthor is allowed. The submitted extended abstracts will go through a peer review. The final version of an accepted paper will be included in the EPC 2007 conference digest and published in IEEE Xplore only if the paper is presented at the conference.

SPONSORS:

IEEE Canada, IEEE Montreal Section, IEEE Ottawa Section. Other sponsors are welcome.

For further information:

See our website: http://www.ieee.ca/epc07/

IEEE Ottawa Section

IEEE Montréal Section