

## NY – MONITOR

August 2011, Vol. 59, No. 8

Editor: Amitava Dutta-Roy, PhD, Life Fellow

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## CONTRIBUTORS

The Monitor thanks the contributors from far and near for the interest they have shown in sharing their knowledge, ideas and hobbies with us and thus enriching the NY Monitor for the enjoyment and benefit of our readers. To our present and future contributors we say: please write or continue to write for us!! We would like to convey our appreciation of their suggestions especially to make this issue more interesting to Dr. Stephen Palm (for his article on home networking, Nelson Segoshi, Representative, Latin America South at IEEE PES (for his photograph that appears on the anchor page), Mel Olken, Editor-in-chief, Power and Energy Magazine and historian of the IEEE New York Section and Bill Coyne, chair of the bylaws committee also of IEEE NY Section (for sending the link to the dancing pendulums). Thank you all! – Amitava Dutta-Roy, Editor.

NOTE: To get to any of the items mentioned in the Contents above please rest the cursor on the desired item and press CTRL key when the customary little hand will show up and take you to the desired location. To get back to the same place on the Contents page please press ALT + Left (arrow) keys.



**JOIN THE IEEE AND TOGETHER WE CAN MAKE THIS WORLD A BETTER PLACE**

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### This is what a great man said . . .

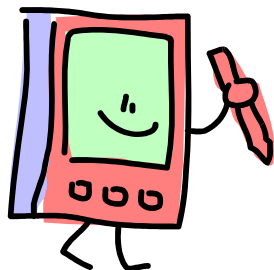
- *The five essential entrepreneurial skills for success are concentration, discrimination, organization, innovation and communication - Michael Faraday*
- *The lecturer should give the audience full reason to believe that all his powers have been exerted for their pleasure and instruction - Michael Faraday*



Michael Faraday, the English chemist and physicist was born in London on 22<sup>nd</sup> September 1791 and also died there on 22 August 1867. He was one of the founders of the theories and practice of electricity and magnetism that gave birth to electrical engineering, the provider of livelihood for most of us in the IEEE. According to Wikipedia Albert Einstein kept a photograph of Faraday with those of Isaac Newton and James Clerk Maxwell in his study. Faraday's life story is fascinating and every electrical engineer should find the time to read it!

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## A few words from the Editor



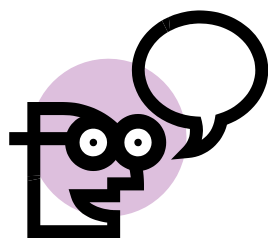
**Amitava Dutta-Roy, PhD, Life Fellow**

This is the second month in a row in which traditionally the Monitor used to go on vacation. But this year we have burnt much midnight oil for the Monitor to join the ranks of monthly publications that offer straight twelve issues in a year. It will be good to know how many of our readers think that it has been the right decision to publish our Monitor in July and August. Please send your opinion.

Thank you.

I imagine many of you regularly read online magazines and other publications on your computer or iPad (or, similar gadgets). If you are one of them you might have observed that most of the Web versions of well known publications continuously experiment with their layouts. Just look at the venerable New York Times. Its layout has gone through several incarnations even during the recent months. We at the Monitor are no exception to this general trend. There is no answer to the question, "What is the best layout?" The best will surely evolve in a Darwinian manner but the definition of the best will change over time. Technology advances and people's taste changes. However, if you have suggestions for improving our layout I would love to hear them. Many brains are certainly better than one.

## Appearance of the Monitor Web site . . . what can or cannot be done



I have received comments that the entire Monitor should be posted in pdf format. If you notice carefully, you will find that everything in the Monitor that can be written as plain text or shown as illustration is already being posted in a corresponding pdf document the link to which is clearly marked on our anchor page. You can print the text and the photos in whole or in parts, or download on your iPad and take those pages with you on your daily commute. But pdf is a format that has been developed to show static pages, i.e., its contents do not change over time while you read through them. Now, for a moment, consider a series of slides shown by a speaker at one of our Chapter meetings. Furthermore, imagine that many attendees of that Chapter meeting would like to see those slides again and the speaker graciously agrees to send them to the Monitor. Those slides are labeled dynamic because of their inherent transitional nature. We have now two options for displaying the slides. The first option is to provide a link from a text, symbol or a photo on our anchor page clicking on which would enable the interested reader to download the slides and presumably save them. The user can then view them later in a convenient manner, change of the slides automatically or by pressing on the pertinent mouse buttons. The second option for offering the slides is to embed them one after another, as if each is a static page, inside the *grand* pdf document of the month's issue. If the number of slides happens to be large, it could be most irritating for a reader to browse through them before going

on to other sections. Even if we were to ignore an average reader's convenience and decided to embed an open file, slide by slide, the size of the *single* pdf file and the time to download it will go up, and will take up more space on your computer's hard drive, all undesirable features, especially if you use your home machine to read the Monitor. Furthermore, some of you may not even be all that interested in the contents of a specific batch of slides, since your attention may lie on something entirely different. Let us not forget that at the IEEE we are a heterogeneous bunch of people. We try to get balanced and informative articles but perhaps cannot satisfy all of you all the time.

**It would also be in the interest of everybody in the Section if the photographs taken during the 2012 Annual Dinner Dance could be placed in a special archive on the Monitor site. I imagine nobody would be interested to print all those pictures from a pdf file!! What does the editor do?**

In the past issues of the Monitor I gave you links to some articles that I read in newspapers and magazines. I could not even think of reproducing the articles themselves in these pages. I have no intention of getting caught up in a legal mess involving copyright issues.

The IEEE has offered us the WordPress platform for posting the Monitor and other such publications. The platform allows upload of individual documents that are *not* heavier than 8MB. (For example, just Dr. Rajeev Shorey's presentation slides that we published in the last edition weigh 5.5MB.) If we have one such set of slide shows and a couple of long articles with illustrations in a particular month we could not upload all of them in one single pdf document. That would create a serious problem. So, we upload the slide shows separately and give you a link to download the files. Whenever necessary, we give and will continue to give you the links to YouTube video clips. Since some clips (and texts) have very long and unwieldy URLs or their IDs (e.g., [http://www.ieee.org/portal/site/tionline/menuitem.130a3558587d56e8fb2275875bac26c8/index.jsp?&pName=institute\\_level1\\_article&TheCat=2202&article=tionline/legacy/inst2011/mar11/newscandidates.xml&](http://www.ieee.org/portal/site/tionline/menuitem.130a3558587d56e8fb2275875bac26c8/index.jsp?&pName=institute_level1_article&TheCat=2202&article=tionline/legacy/inst2011/mar11/newscandidates.xml&), the IEEE page on the presidential candidates and one story published in the Monitor has an internal ID: <http://sites.ieee.org/ny-monitor/?p=409>), to strike a balance between functionality and aesthetics, we felt more comfortable in giving you just one place to click upon for opening those pages. You can certainly print the clumsy URLs. But in any case, in order to access the sites you need to sit down at a computer or open your iPad. A written URL just does not help. However, you be the judge and let us know what is most convenient for you. Please remember that in future, we would like to give you video clips of our own events as well. Also, more often than not, the speakers send their slides in pdf format, since it is more difficult to open such a file and tamper with it unless you have the right tools. We have the tools but would it not be an unethical and disrespectful act for us to open their copyrighted files if they do not want them to be pried open at the first place?

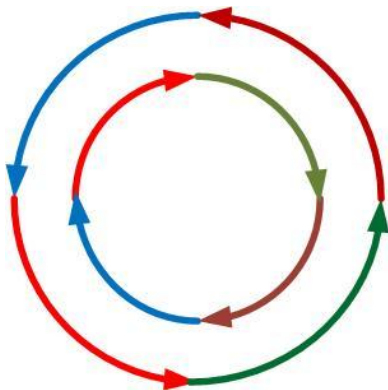
Hyperlinks surely may be embedded in the pdf documents. However, it is not possible to create links to internal documents (that is, our own media files: pdf, jpeg, wmv or MPEG) unless they are lodged in the WordPress database first. (Disclaimer: I am no expert in CSS or PHP!) The process of inserting them in the WordPress database can be done only by inserting a text or a photograph in an existing or a new page ("post" in WordPress-speak) and then linking them to a media file that is in the computer of whoever is creating the posts. The editors do not receive any special ID for the media files from the

system. Only complete posts have IDs. The media files can be opened for viewing only by clicking on the text and/or photo on the post we started with. We cannot remove the text or the photograph from the post and, as far as I know, keep the media inside the database at the same time. If we delete the text or the photograph from the posts we also lose the media files. Thus, it would not serve any purpose to embed a link in the *grand* pdf file, since we must continue to create the posts in html format. Is it not, therefore, better to give those links separately below the anchor post (with the IEEE logo). Would you agree?

We cannot change the basic structure of the WordPress platform. It is an open source and free-to-use platform developed by enthusiasts and volunteers around the world and the IEEE editors are merely its *users*; the IT department of the IEEE, as a gesture of goodwill, maintains the software in its server without levying any charge on the Section. But we are *nobody* to alter the structure of the WordPress as we are nobody to alter the basic structure of the Microsoft Word or of the Linux OS. The IEEE encourages us to use WordPress, since it is free and convenient for most Monitor-like publications. There is no need of creating special html web pages. It has been a wise move for the IEEE to save money in this manner. We also save the money that would be spent on printing and mailing hard copies of the Monitor. However, please do not forget that WordPress is basically a platform for bloggers. That is why you see the date on which a particular post goes online. We, at the Monitor and probably many others as well in the IEEE *adapt* the WordPress to our own purposes.

It has also been suggested that the Monitor is an e-newsletter but a newsletter first. This attribute was applicable to the printed editions . . . not anymore. Anyhow a question therefore arises: “What should that newsletter consist of?” If the contents, like those of a typical newsletter, were to include only the calendar of events and the section activities I can assure you that everything could be put together in less than 3 pages flat. But our idea is to expand the scope of our Monitor and include news, views and reviews of products and books *first* to meet the expectations and needs of the majority of our readers, and then to attract authors to write high-level informative articles on technology. Sure, we want to broadcast that we are the IEEE and we are New Yorkers. We want to tell the members of our community and the mainstream IEEE that we are professionals not only at engineering but for our publications as

well. Is anything wrong with that? We also want to draw the attention of advertisers which could generate revenue for the Section; advertise in the Monitor about your products and classifieds on job opportunities. Sounds plausible?



The “e” of the Monitor, an e-publication in contemporary parlance means that it is multimedia. We want to exploit all there is available in the current multimedia technologies. Without good contents the “e” does not mean anything and without the “e” the contents are not complete. After all, isn’t IEEE “advancing technology for humanity?” The New York Section will surely not fall behind.

Well, I have tried to explain why the layout of the Monitor is as it appears on the computer screen. But I ask what about the editing —my principal responsibility — at the Monitor? If you have any comments please let me know.

## **This issue**

Our August issue starts with a couple of quotations from Michael Faraday, one of the giants on whose shoulders we stand today. Faraday was born poor and in his first jobs he was much humiliated. But he never lost faith in himself and humanity. He left a legacy of knowledge that now we all share.

Normally, reports on Section activities should follow. The last two months were lean and we had only one presentation. The topic of that presentation and few more details are in this section. One of the two speakers, Arie Makovoz of ConEd has promised us a paper based on what they presented at the PES/IAS/LMAG meeting on July 26 last. We expect to post it in the near future.

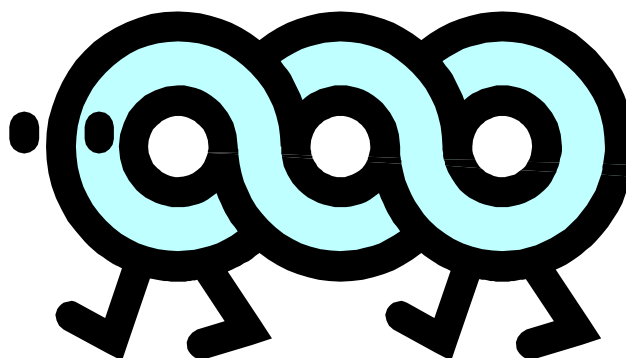
This month we have a couple of articles on home networks. The first one of them is by yours very truly. That piece is about my own tinkering with basic home control networks. This is followed by a very interesting article by Dr. Stephen Palm, senior technical director of Broadcom Corporation, Irvine, Calif.

In this month we also publish the second installment of the article “Growing up with the information age, Part II” by John LePage of PIRP (Harvard University). Mr. LeGates continues to take us along in his journey through the labyrinth of the world of networks.

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**The IEEE is yours**


**Let your voice be heard!!**



### Section Activities during July, 2011

The month of July and August are usually lean months when many of our Section members go on vacation. The weather not being kind many outside speakers also tend to decline our invitations. We were however fortunate enough to have two ConEd engineers, David Korovin and Arie Makovoz who gave us an excellent presentation on a ConEd project involving a reasonably long transmission system through urban areas of Westchester and Manhattan.

To a lay person such a job appears to be pretty straightforward. Only after listening to Korovin and Makovoz we realized how complex those projects are. They include strict environmental and safety requirements, politics, public accountability, regulatory oversight and increasing material and labor costs. The presentation revealed the technical aspects of the latest 345kV Transmission Station and its accompanying 345 kV High-Pressure Pipe-Type Cable System that brought additional 480 MW of energy from Westchester to Manhattan.

The New York Section takes this opportunity to thank David Korovin and Arie Makavoz and invites both to join the IEEE. 

#### **NEWS from IEEE-USA**

**2001 L Street, N.W., Suite 700  
Washington, DC 20036-4928**

U.S. College Students Challenged to Create Videos for Younger Students on How Engineers Improve the World; \$5,000 in Student Awards to Be Presented in 2011-12 IEEE-USA Online Engineering Video Competition

WASHINGTON (18 August 2011) -- IEEE-USA is challenging U.S. college students to create YouTube videos that reinforce for an 11-to-13-year-old "tweener" audience "How Engineers Make a World of

Difference."

The organization is seeking to tap the enthusiasm of U.S. college students to spark younger students' creativity and ingenuity and to inspire their interest in learning about engineering. IEEE-USA also seeks to expand broader public understanding of engineering through the wide dissemination of these videos.

As part of its 2011-12 online engineering video competition, IEEE-USA will present awards totaling \$5,000 in four categories to U.S. undergraduates and graduates who create the most effective two-minute personal video profiles:

- CONTENT/MESSAGE: \$1,500 scholarship award for best conveying the message most closely aligned with the theme "How Engineers Make a World of Difference"
- PRODUCTION VALUE: \$1,500 scholarship award for best production quality and most professional look to the video
- VIEWS: \$1,500 scholarship award for the most viewed submission, as determined by the number of YouTube hits as of midnight Eastern Time on Friday, 27 January 2012
- EARLY SUBMISSION: Ten \$50 Amazon gift cards totaling \$500 to the first 10 students who submit online entries that meet the basic competition requirements

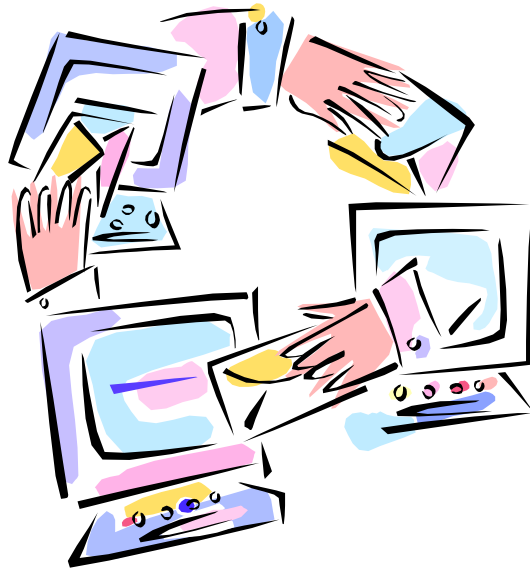
The IEEE-USA video competition is open to all U.S. undergraduate and graduate students regardless of academic discipline. However, at least one undergraduate or graduate participant must be a U.S. IEEE student member.

Entries must be submitted through YouTube by midnight Eastern Time on Friday, 27 January 2012. Winning entries will be announced and shown during Engineers Week, 19-25 February 2012, and will also be featured on PBS' "Design Squad" website.

For more detailed information on how to enter, go to [www.ieeeusa.org/communications/video\\_competition/](http://www.ieeeusa.org/communications/video_competition/).

IEEE-USA advances the public good and promotes the careers and public policy interests of 210,000 engineering, computing and technology professionals who are U.S. members of IEEE: [www.ieeeusa.org](http://www.ieeeusa.org).





## Reminiscence of tinkering with home networks

**Amitava Dutta-Roy, Editor**

To the best of my knowledge, X-10, a company based in Scotland developed the first commercially available “home control” network utilizing power lines. This was before the local area networks became the staples at offices and much before the Internet left the drawing boards of its developers.

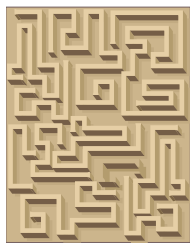
Distribution of audio, video signals and data in the home could be seen only in science fiction movies.

The X-10 technology simply enabled the user remotely control lights and other basic home appliances — e.g. switch on and off lights and dim them, or switch on a fan — by pressing buttons on a small central console. Every remotely controllable light (incandescent only) was connected to the power line through a device that had a two-digit ID, e.g., A2, B4 and C9 etc. A couch potato had only to press the ID of the desired light and on/off/dim buttons to control it. Even with its limited capabilities the technology was a big deal those days; you could impress your visitors. Since (circa) 1978 these gizmos, the central console and the remote plug-in modules had been available at affordable prices from Radio Shack stores and some thirty six years ago I acquired a set of them. It worked and my friends were awed. I even tried to

control neighbors' lights but I succeeded only if the neighbor's apartment was on the same phase of the power supply as that of ours. Stands to reason!

There was no standard for the proprietary technology patented by X-10. The manufacturers would not divulge what techniques they used to transmit the control signals; the company would not give out any of their secrets at all. We could have reverse engineered the devices but that needed a great deal of work and time. As a result, my friends and I did not go very far with our tinkering.

Many years later, in late 1999 to be more precise, I was commissioned by the IEEE Spectrum magazine to write a feature article on home networking ("Networks for homes," IEEE Spectrum, December 1999, Vol. 36. No. 12). My search for manufacturers of home networking and similar equipment revealed that by that time X-10 had developed another product which extended their "home control" technology to the control of power supply by the utilities. The company also had moved its headquarters to Hong Kong. The new product was used to remotely control a two-tier — during peak and off-peak hours —



system of supplying power to consumers. The off-peak power would be sold at a cheaper rate. The control signals from the utility's substation traveled down the power lines to actuate two-way switching mechanisms installed near the customers' premises. Those who opted for the program for cheaper power could not use many heavy appliances (e.g., washing machines and vacuum cleaners) during the peak hours. The processes of metering and reading the power were also simple, sort of a

coffee-can approach but it worked. It was a simple solution. As it was expected, these customers of the two-tiered power generally belonged to lower-income groups. The affluent did not really care. If they wanted to start their washing machines they wanted the power "then and there." This time around a little more of the X-10 technology was divulged to me. For example, the ones and zeros of the commands were sent in the form of 120-kHz bursts within 1-ms envelopes. The transmissions of the signals were synchronized by sending them as close as possible — within 200μsec — of the zero crossing points of the 60Hz (or 50Hz) power line frequency. Since the data packets were short, communication between X-10 devices could achieve a high degree of reliability.

Companhia Energetica de Estado de Minas Gerais, Cemig for short, the state utility company in the state of Minas Gerais in Brazil successfully utilized this technology to lessen the effect of power scarcity. Mind you, all this happened before the concept of smart grid entered as an important factor in the planning

rooms of the electric utility companies! This just goes to show how one technology developed for a specific purpose finds new applications.

Fast forward to home networking of today! Since writing my article in 1999 the concept of home networks has evolved in a manner that could not even be dreamed of some years ago. Now those who really need and can afford the latest technologies in homes would like far more amenities beyond controlling lights. They would like to access the Internet, cable TV, audio and video programs stored on servers in their homes, and make and receive phone calls without running from bedroom to the kitchen or from the TV den to the basement. The arrangement may not be good for one's physical health but there we are, keeping up with networking technologies. Owners of homes may also need closed circuit television for reasons of security and remotely watch their residences while they away. (Observe that now these security features are of a necessity especially in affluent suburban neighborhoods.) For whatever reason, the owners also may want to open a garage door from a remote location or switch on their ovens from their cars on their way back from office.

The specifications of CAT 5 and CAT 6 cables are both defined by the U.S. standard bodies. Both CAT 5 (and 5e) and CAT 6 type cable are composed of four twisted pairs of copper wires that end in Ethernet (RJ-45) connectors. The CAT 5 cable can transfer data at a rate of 10Gbps whereas the CAT 6 cable that must comply with more rigid specifications is capable of carrying data at 100GB/s.

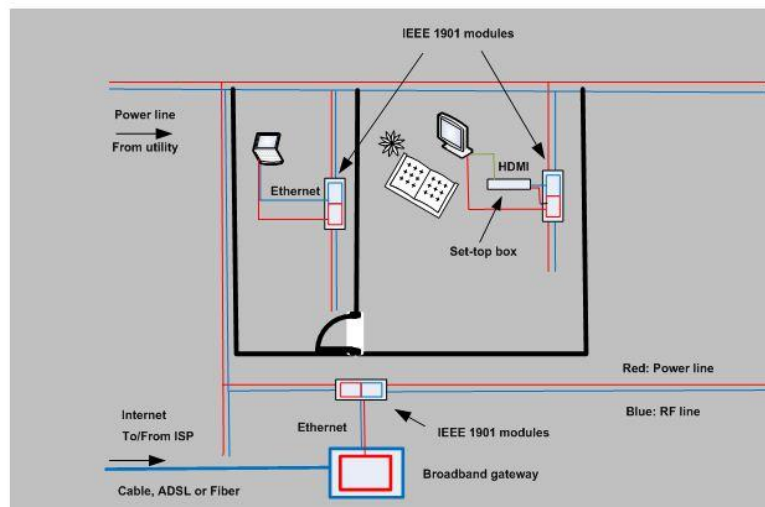
Twenty first-century technologies can offer all of the above. The present home networks are based on several types of media, the ubiquitous power lines, Ethernet cables that conform to, in the networking jargon, CAT5 and CAT6 ("CAT" meaning "category" explained in the sidebar), coaxial cable (of the cable TV variety) and also on Wi-Fi. Each of them uses a technology different from those of the others. There are advantages and disadvantages each. For power line networking, the sources (modem, router, DVD player and VCR etc.) are connected to the power line. Thus, wherever power is available users can plug a module into the nearest outlet and access the sources. For networking with Ethernet and coaxial cables, the sources and destinations must be physically connected at either end. The wireless access, of course, does not need any physical connection at all though the reception will be poor or none at all if either the source and the destination (you!) happen to be in a blind spot. The electromagnetic waves obey the laws of physics and sometimes in case of broken links it is not even possible to identify the problem. The entire network gets finicky.

Out of all these options, I guess, the least disseminated technologies are those that use the power line and the coaxial cable.

## Data over power lines in homes

In plugged-in homes the power lines carry radio frequency signals at 2 to 10MHz corresponding to digital bit speeds of 4 to 10Mbps. It is envisaged that eventually such home networks will enable metering and optimization (with audible or visible alerts to the home owner). Some of the leading automobile manufacturers such as BMW and Audi of Germany are also interested in further development of power line home networks, since the batteries of electric

In some countries power lines are also being used for connecting Internet service providers with homes. Though the technology is now approved by the U.S. Federal Communications Commission it has not made much headway in America. Much of the hurdles are caused by in-line power transformers. The technology is promising, since almost all homes in this country have power lines that supply the energy.



A general scheme of broadband network over power lines

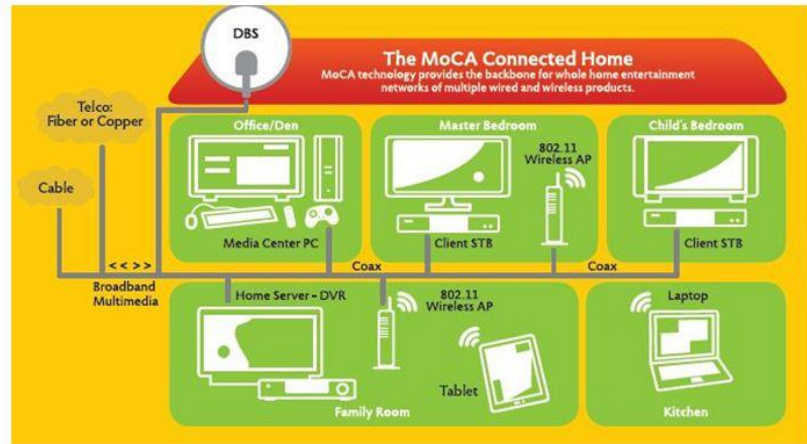
HomePlug Alliance. Many firms — big and small — in the networking industry (chip manufacturers, system integrators and service providers etc.) are involved in this alliance. For more details please see <https://www.homeplug.org>.

## Data over coaxial cables

It seems to me that the other technology not disseminated well in this area is the one that uses coaxial cables as media for carrying data. Most home users of the Internet know that there is a warfare going on

vehicles will be usually charged at home and this charging process may be controlled through the network either locally or remotely. The utilities are keen on this technology because networked homes may be better served by smart grids. The plug-in modules comply with the IEEE 1901 standards. The work on the standardization of device specifications have been the responsibility of a trade group called

between the telcos and the cable TV distributors. The latter are trying to attract more customers by offering triple-play (TV, telephone and access to the Internet) at a heavily discounted rates (remember that these rates are valid for one year only!). But after the cable brings into the Internet to the home then what? Many



This illustration taken from the MoCA brochure shows how data (data, audio and video can be distributed inside a home

connect the output of the modem to a router that can feed several PCs and WiFi clients in that home. There is another way of distributing the multimedia Internet signals to some strategic points in the home. That can be achieved by using coaxial cables. Sure, it is necessary that install cables in a home unless it is already wired. Installation of coaxial cables is not all that difficult, especially in new homes under construction though much attention is required at the bends. While twisted pairs of Ethernet (10BASE-T or 100BASE-T) need one-to-one connection between a source and its destination, the signals traveling on the coaxial cables (just "coax" in the networking jargon) can be tapped from RF splitters. To accelerate the development of products and standards for home networking an alliance of chip makers, system integrators and service providers was formed and it is known as Multimedia over Coax Alliance (MoCA). The standardization of MoCA products is the responsibility of Society of Cable Telecommunications Engineers (SCTE), a non-profit body that works, like the IEEE, with the American National Standards Institute (ANSI). Mind you, the MoCA technology has nothing to do with the Data over Cable Systems Interface Specifications (DOCSIS) developed by another though allied trade consortium, the CableLabs that are geared to data transfer over cable TV lines from the Internet service providers to the homes. As the accompanying illustration shows the broadband connection to the outside world can be brought into a home by either telcos or cable TV providers. The coax home network is agnostic in this respect. The MoCA 1.1 equipment can deliver data at 175Mbps inside homes. The second generation of MoCA will raise the throughput to 400 or even up to a blazing 800Mbps.

The data over cable technology for inside of homes needs some advance planning before its deployment. Is the existing cable infrastructure adequate or do the user's perceived demands require that some new cables are installed? What are the costs? How many rooms need to be hooked to a computer, a wireless router, TV set-top boxes, analog TVs (yes, they still exist!) or high definition

multimedia interface (HDMI – see the illustrations in the power-line technology section above) for watching videos streamed over the Internet? Many mix-and-match and interoperable products are available at affordable prices in the retail market to cater to the taste of an average home owner. The entire projects depend only on financial resources of the owners. More about MoCA is available at <http://www.mocalliance.org/>.

## **Wireless**

Perhaps, the most known data communications technology after the Ethernet (invented at Xerox PARC in 1973 by Dr. Robert Metcalfe, born in New York city, Fellow and recipient of a medal of honor of the IEEE), the harbinger of networking, is the Wi-Fi, since it is easy to install, easy to operate and many public spaces such as public libraries and airports offer free service to anybody with a laptop or tablet computer. The Wi-Fi technology is standardized by (you guessed it right!) the IEEE. It keeps our standards department buzzing. Wi-Fi stands for wireless fidelity and operates in either 2.4 or 5MHz band. These two are also known as the ISM (short for Industrial, Scientific and Medical) bands. Machines, laboratory apparatus or home appliances that use these bands do not need any license for their operation. This is true not only for the U.S.A. but it is true all over the world. Your laptop will work in other countries too. The latest incarnation of the Wi-Fi protocol for networking is 802.11g that can deliver 54Mbps.

## **Unification of home networking technologies**

A typical home owner is usually not an expert on networking technology. He or she may want to invest in “something” that is affordable, standard-compliant and thus interoperable, and robust. MoCA spearheaded the efforts to unify the home networking standards that would give incentives to equipment manufacturers to come up with an ideal solution. The next generation of home networks hopefully will unify the existing technologies so that there will always be a redundant network available. If the Wi-Fi fails, the cable will take up the slack. If the cables do not cooperate the power line will come to the rescue. Thus, a home owner whose work and leisure are woven around an “all connected” network will never be inconvenienced.

In this game of networking a crucial element is the central chip that will control operations of a device. Irvine, Calif.-based Broadcom Corporation has been a mega networking chip maker. We invited Dr. Stephen Palm, senior technical director and an IEEE member to write an article explaining the progress

of the next generation of the technology that will unify all home networking technologies. His article is next in this issue. Keep reading!



**Promenade on the Hudson, New York city [Photo: Amitava Dutta-Roy]**

## **Designing the Next-Generation of Home Networks (Invited paper)**

**Stephen Palm\***

The concept of sharing digital content throughout a home – be it a TV program, photos, Internet video, or music – continues to evolve. Faster broadband speeds and digital access technology gives consumers more choices in the selection of content along with the ability to download multimedia faster and on multiple screens. The ever-increasing variety of digital devices and data formats has made seamless connectivity between devices an essential facet of a “connected” home. The goal of home networking technology is to let the consumers access any content from any device in any room without having to know whether the content they are watching is being streamed from a hard drive on a PC upstairs, coming over the Internet, playing back from a handset, or pulled from a set-top box digital video recorder (DVR).

Home connectivity is entering its second generation and is evolving so as to provide the quality of service and transparent accessibility that both service providers and consumers desire. The underlying technology is ready. However, new deployments will need to support every type of digital device without the need for complex configuration or connection mechanisms. They will also have to support existing services as well as new services such as multi-room DVR capabilities. In addition, any next-generation home network technology must support ubiquitous connectivity throughout the home.

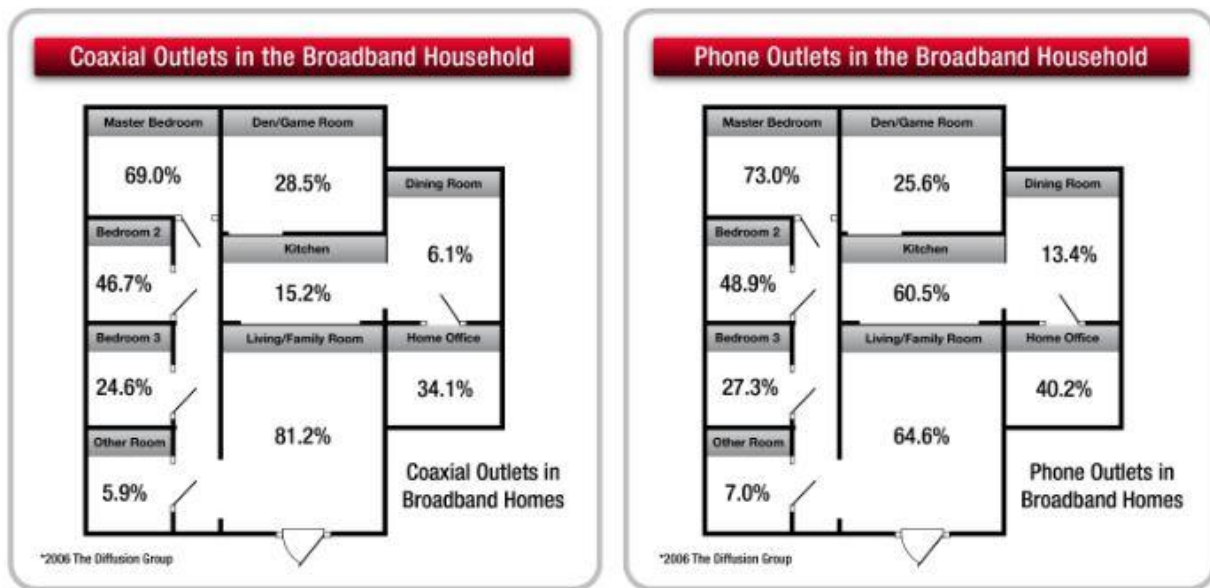
Moreover, the manufacturers of devices must ensure that their devices interoperate with the accepted standards for ubiquitous connectivity. The home network infrastructure needs to be able to transport data quickly and reliably to ensure the delivery of multiple streams of high quality content, ushering in the fully interoperable home networking evolution.

### Ubiquitous Coverage with No New Wires

Most consumers already have a number of networks installed in their homes. For example, a satellite or cable link feeds one or more set-top boxes over coax, a PC connects to other PCs using power line communications (PLC), and Wi-Fi is used to distribute a shared Internet access connection among several laptops and handsets. While Ethernet networks provide very reliable connectivity, installation of CAT5 wiring — that connects two Ethernet end points — is expensive, so some users try to reuse existing “wiring” such as coax or power line or air:

<u>Media</u>	<u>Protocols</u>
CAT5/6	Ethernet
Coaxial cable	MoCA
Power line	HomePlug
Air	Wi-Fi

However, no single connectivity technology has 100 percent coverage in every room and in every region (e.g., basement and upper floors) of a home. Even as of recently, only 11 percent of homes had CAT5 wiring installed in them and most of that was not properly terminated for Ethernet. In some regions, coaxial outlets are installed in a variety of rooms, but perhaps not in all of them (see Figure 1). While nearly every room in a home has at least one power outlet, a part of a home may be on another phase of the power supply from the utility or be susceptible to interference. This reduces the performance and the effective throughput of PLC. Even wireless coverage is not guaranteed, as accessibility is dependent upon home layout, construction, and materials density.



**Fig. 1: No single connectivity technology has 100 percent coverage in every region in every home. For example, coax and telephone outlets are typically installed in a variety of rooms, but not universally**

The next-generation of home networks will provide full coverage by building upon and combining the existing infrastructure available throughout a home – Ethernet, coax, power line, and wireless resources – and bridging them seamlessly. For example, while any one of these technologies may not provide whole-home coverage, a hybrid network comprising of multiple communications technologies dramatically improves the situation. Each room in a home can be serviced by at least one of these technologies and, in many cases, several of them.

The use of multiple technologies to create a hybrid network also provides redundant coverage in principal rooms of a home. Consider a couple watching a show streaming off the Internet. In this scenario, the data carrying the program would initially flow to the bedroom TV via a power line, coax, or wireless connection. At some point of time, that particular connection may get congested when some other occupants of the home decide to watch another program. Interference may also significantly reduce the throughput. In such cases, the “conduit” for the streaming can be shifted to another connection so that the reliability of the connection, as well as the quality of the content, are maintained regardless of the changing nature of the operating conditions within that home.

Since each connectivity technology addresses a different media and a different set of protocols, they have what, in networking jargon, are known as “orthogonal impairment mechanisms”. For example, a

noise source that causes interference over the power lines is likely to have little impact on wireless throughput. Thus, the probability that all connections into a room will fail at the same time is lower than just using a single connectivity technology.

The use of multiple connectivity technologies may also increase the quality of content that are capable of being delivered throughout a home. Load-sharing techniques can be used to distribute the contents over multiple channels. Instead of having one channel remain inactive while another channel operates at high capacity with a greater probability of congestion, two or more channels can share the data load. Each of them then would carry lower loads that would result in better reliability and lower latency (see Figure 2).



Fig. 2: The use of multiple connectivity technologies provides redundant coverage in key rooms in the home so that the quality of content can be maintained regardless of changing operating conditions. The numbers in magenta in the left half of the figure signify the data throughputs in different rooms if only one technology per room is used; the yellow figures indicate the throughputs only with a different technology. The green numbers on the right side of the figure show the effective throughput when both technologies are used simultaneously. The red ball is the location in the home where broadband entry point is located. All measurements are in Mbps

Another advantage of the next-generation home network is universal connectivity. Because of the reuse of existing infrastructure, devices that consumers own and operate today will be able to connect to a hybrid home network as well. Bridging capabilities built inside the network will support seamless data transport between the different connectivity technologies and, as a consequence, consumers will be

able to access content from any device without having to know about its source, or where or how the content is actually stored. Furthermore, individual storage devices or a network attached storage (NAS), where the diverse contents may reside, need not know whether they are being streamed to a PC, TV, or a handset.

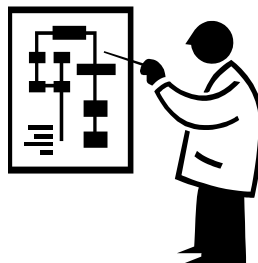
By leveraging the existing infrastructure and connectivity technologies deployed in homes, the next-generation home network will be able to provide complete coverage within a residence with redundant capacity and without the need for the installation of new wires. This is particularly important to both service providers, who want to be able to deliver new services throughout the home without expensive truck rolls, and consumers, who want connectivity without complexity and at the lowest price with no hassle.

### **Unifying the Home Network**

Many service providers and equipment manufacturers understand the need for a hybrid network that seamlessly connects all types of devices in a home. The difficulty posed by first-generation home networks has been that, in the absence of a unifying standard that would allow transparent use of multiple networks, each device on the network must be configured, managed, and operated independently.

The new standard P1905.1 that is currently being developed by an IEEE Working Group provides the underlying mechanisms for unifying the diverse connectivity technologies that make up the home network. The P1905.1 standard defines a common data and control Service Access Point for hybrid networks based on Wi-Fi, HomePlug, MoCA, and Ethernet. Data can be exchanged over any interface, regardless of protocol and media in use.

The P1905.1 brings seamless bridging to the home network by introducing a software layer between layers 2 and 3 that abstracts the particular operational details of each interface in use (see Figure 3) and aggregates data across different interfaces. This layer also makes it possible to provide a feature for high-level management of the network. For example, users no longer need enter a different password for every media to which a device may connect; only a simple press on a button is needed. P1905.1 also specifies harmonized quality of service (QoS) mechanisms, handles device discovery and configuration, and establishes secure connections, among other advanced network management features.



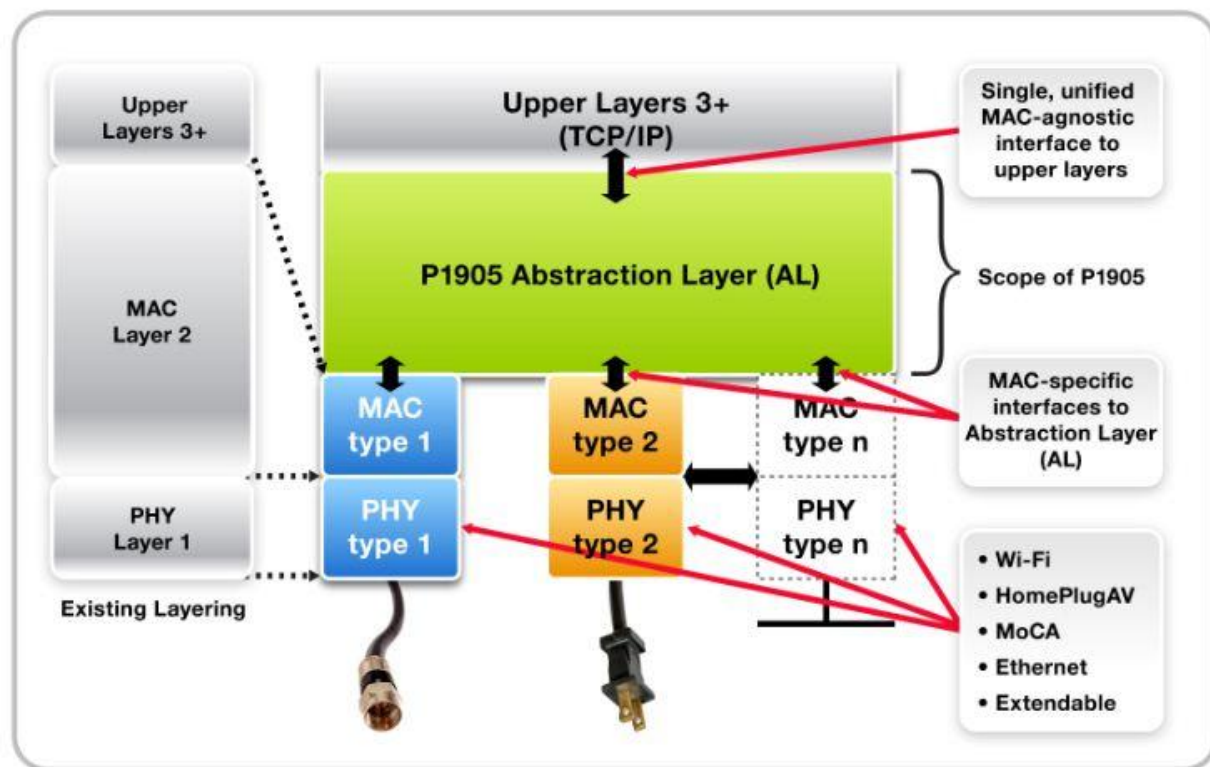


Fig.3: P1905.1 brings seamless bridging to the home network by introducing a software layer between layers 2 and 3 that abstracts the particular operating details of each interface in use. P1905.1 thus provides quality of service (QoS), device configuration, secure connections, among other advanced network management features

The standard enables the next-generation of home networks to provide many key functions and benefits. At this time, no other single technology is available for uniting the vast array of wired and wireless technologies, media, platforms, and devices. The P1905 features can be summarized as:

**Ease of Use:** As a consumer-oriented technology, it is critical that the procedures for setting up a home network be transparent to users. P1905.1 specifies common setup procedures for adding devices to the network, establishing secure links, implementing QoS, and intelligently managing network resources.

**Reliable Service:** Common network issues such as congestion or the temporary loss of connection can result in degradation of quality. By implementing path selection mechanisms (see Figure 4), devices can use alternative routes to lessen interruption of service, thereby ensuring a positive user experience and reducing the number of support calls service providers must manage.

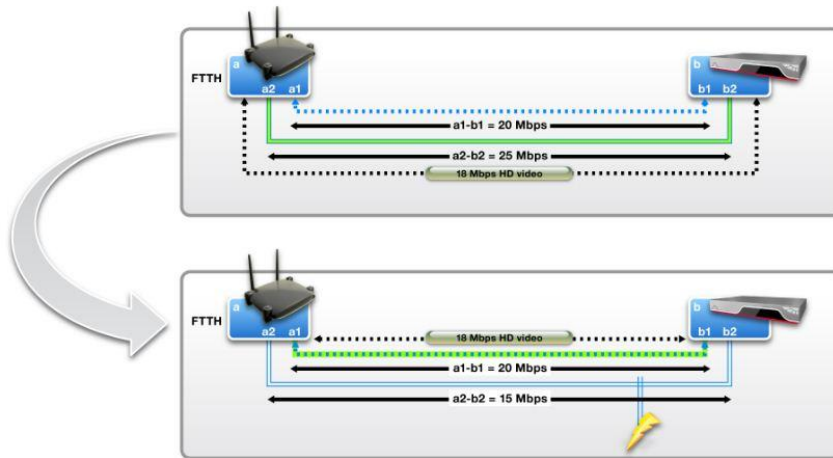


Fig. 4: P1905.1 maintains content quality and reliable service through the use of path selection to resolve common network issues such as congestion and interference.

**Greater Network Capacity:** Hybrid networks provide maximum throughput through the ability to aggregate bandwidth across all of their different interfaces.

**Multiple Simultaneous Streams:** With applications such as interactive TV where even a single user may watch multiple streams simultaneously, next-generation networks must have the capacity to handle several HD streams at the same time.

**Congestion Management:** P1905.1 enables features such as load sharing and QoS to limit network congestion to maintain network reliability and content quality.

**Complete Interoperability:** Next-generation home networks must support any existing infrastructure the service providers have already installed. P1905.1 is the only specification that supports full backward-interoperability with HomePlug, Wi-Fi, Ethernet, and MoCA.

**Transparent Security:** Service providers and content owners want robust security mechanisms for protecting their content. However, to avoid costly truck rolls and/or support calls, these mechanisms must be simple enough for consumers to perform. P1905.1 devices may be configured with a single button-press to avoid the complexity of password entry (see Figure 5). P1905.1 also enables consistent password and authentication procedures to support legacy devices.

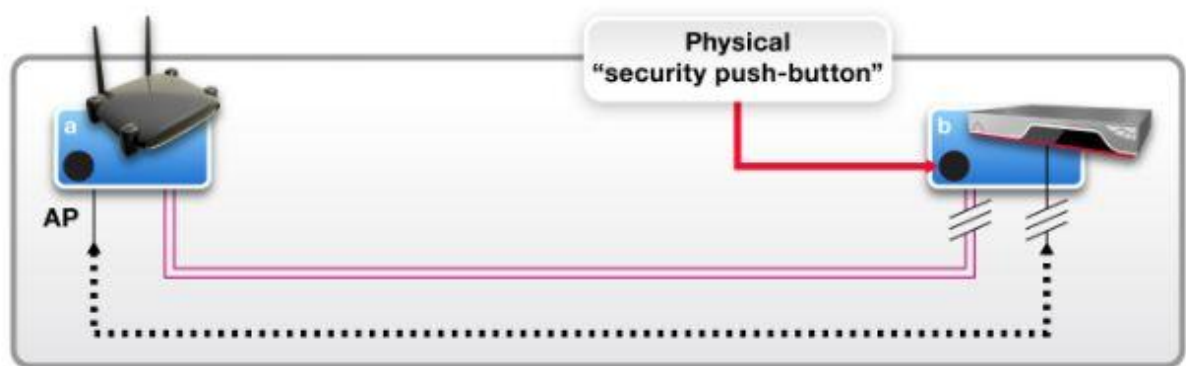


Fig. 5: P1905.1-compatible devices are configured with a single button-press to avoid the complexity of password entry. P1905.1 also enables consistent password and authentication procedures to support legacy devices.

**Higher Reliability through Advanced Monitoring and Diagnostics:** P1905.1-based networks are able to provide uniform diagnostics. In addition, service providers are able to remotely monitor networks and preemptively address potential impairments before they impact the user experience.

**Self-Install:** Avoiding service and installation calls is critical to controlling network deployment and operational costs. The next-generation home network must support simple installation, discovery, and self-configuration. For example, when a user connects a second P1905.1 Wi-Fi Access Point to the network, regardless of which interface is used, the primary access point will automatically configure the second access point with the network name and password.

**Freedom through Mobility:** Support for wireless devices is essential so that users can connect their smart phones, handsets, laptops, and tablets.

**Universal Connectivity:** For complete transparency, users need to be able to connect to the next-generation network from every room in a house without having to be aware of the interface they are communicating with. Furthermore, link handoff must be seamless when moving from one room (and the interface) to another.

**Power Efficiency:** P1905.1 supports more efficient and greener operation through power management capabilities that balance energy consumption with connection reliability and responsiveness. For example, routing can take into account the most power-friendly path through the network by considering which nodes are already awake and active.


In the past, attempts were made to connect devices within a home using a single connectivity technology. It was found in practice that none of the available standards for individual technologies provided reliable, whole-home coverage nor easily interfaced with every type of consumer device. To reach a higher level of ubiquitous connectivity, a hybrid network topology is recommended. The P1905.1 has been designed not to solve hypothetical problems but to provide a working technology for the real home networking issues that must be addressed so that service providers can deploy hybrid networks with confidence. By seamlessly bridging the existing connectivity technologies deployed today, the P1905.1 provides the final piece required for building a truly robust home network.

The work of the IEEE P1905.1 committee is on schedule to complete the draft standard by the end of 2011. Version 1.0 of the draft will provide the foundation of the next-generation home network and will serve as a platform for introducing advanced features and capabilities in the future. P1905.1 has broad industry support and companies like Broadcom are at the heart of delivering the key technologies and standards that will enable consumers to enjoy video, apps, photos, and any other content they desire in the room of and on the screen of their own choosing. For example, Broadcom's Xtendnet™ technology is an intelligent, decision-making software architecture that enables a hybrid homeplug-coax-Wi-Fi network to dynamically switch streams between the different media.

For service providers, the P1905 represents an opportunity to enhance profitability through new premium services that would attract new customers and the ability to deliver quality content in a reliable manner. For consumers, the P1905 will serve as the bridge between the wired and wireless technologies to connect homes and lead to a connected lifestyle.

For more information on the P1905.1, visit <http://grouper.ieee.org/groups/1905/1/>.

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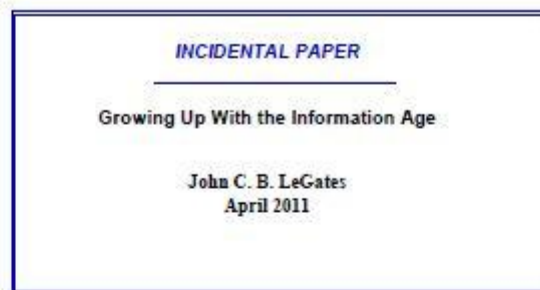
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## Growing up with the Information Age

### John LeGates

In the following we publish the Part II the article by Harvard University PIRP's John LeGates. (The copy of the article reproduced here is *as it appears at PIRP* and was not edited by us.) It is fascinating to read his encounters with the legendary figures' of the Internet and his involvement in the process. The URL of Harvard University is [www.harvard.edu](http://www.harvard.edu) and that of the Program for Information Resources Policy: [www.pirp.harvard.edu](http://www.pirp.harvard.edu) - Editor



## ***Program on Information Resources Policy***



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John C. B. LeGates

John LeGates began his career as an entrepreneur in the earliest days of computer communications and networking. He was the first to put computers in schools and later in hospitals. He built the first academic computer-resource-sharing network and was a member of the Arpanet NWG, the original Internet design team. Since 1973 he has been a member of the Harvard faculty, where he co-founded the Program on Information Resources Policy.

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## **GROWING UP WITH THE INFORMATION AGE**

### **PART II**

**John C. B. LeGates**

**EDUCOM, ARPANET and Internet 1969-1972**

#### **EDUCOM**

I was being courted by an organization called EDUCOM, or the Interuniversity Communications Council. It was an association of about 100 universities, established to explore the development and sharing of modern technology for teaching, administration and research. Jordan Baruch, one of the original BBN'ers was the CEO. Of his upbringing on the border between Italian and Jewish neighborhoods in Brooklyn, he claimed: "my favorite meal was spaghetti mit gefilte fish". The EDUCOM Bulletin is still among the magazines in the "take one" rack for the airline shuttles between New York and Boston. Until I joined, EDUCOM had mostly sponsored conferences and publications. It was basically sharing information about what the individual members were doing. Now it wanted to become an operating entity. I was asked to be in charge.

I had some qualms about running an operation the non-profit sector – it can be inefficient and pay poorly. By way of mollification, they included two conditions in my contract. I could continue to found and operate for-profit companies on the side, as long as there was no conflict-of-interest. And it was very likely that EDUCOM would produce for-profit network spinoffs. I would be in charge of that as well, and could be a shareholder, board member or CEO.

My part of EDUCOM was called "The Educational Information Network" or EIN. Its mission was to gather and document computer programs from the member universities, and make them available to the whole group. The plan was to start with a paper-and-mail-based exchange of software, move forward as the technology became ripe into dial-up computer access, and eventually graduate to high-speed data networking - the EDUNET. Once again I was doing something that had never been done before – there was no template.

My new EDUCOM circle was academic computer science departments and computer centers. They were all very security conscious - almost all had had bomb threats from leftists who suspected them of military connections. One member of the EIN steering committee was known to the public from the national news. He was seen quelling a student riot wearing a helmet and shouting through a bullhorn. If these people were doing anything with the military, they were cagy about admitting it. If there were admissions, they were inevitably accompanied by circumlocutions like "Yes, the money comes from the Office of Naval Research, but it's only used to pay for high-minded things like my academic studies."

Computing everywhere was centrally controlled. In most universities a mainframe was operated by the computer science department. It not only served for computer science research, but also for teaching about computers, and was available as a kind of service bureau for the administration and for other departments. This looked like a structure that could not sustain growth.

Computers behaved like a scarce resource. They required so much esoteric knowledge that they were run by a priesthood of anointed computerniks. The machine ran twenty-four hours a day. It was expensive and permanently being upgraded. The priesthood were technical types with little appreciation of other people's needs and inadequacies. They were viewed with ambivalence by the users, who loved them for the help they might provide and loathed them for their total control and insistence that you "do it our way". In some cases a department (often administrative) would acquire its own computer, usually a mini, and escape the central priesthood. Then it would develop its own priesthood, complete with the same ambivalence in miniature. This ambivalence has become a permanent feature of organizational computer usage. (note from 2011: Now of course, the personal computer has eliminated the middleman for most small applications.)

While I was at EDUCOM, Harvard abolished its computer service center altogether, remitted the fees to the departments, and told them to go buy services on the open market. Oettinger chaired that decision. Very few years later, Harvard re-established the "Office of Information Technology" to supply those services more efficiently provided by the university to itself. Relations between OIT and its users had a heavy dose of the usual loving, tolerating, and loathing. It was abolished again in 1996.

Centralization may have been a yoke from which the users struggled to be free, but it was an environmental blessing for EIN. It provided an easy mechanism for programs to be transferred among universities. Working originally through the computer guys, we created a way for disciplinary departments to talk about computing to similar departments in other universities, rather than to their own computer geeks. Control began to shift from computing supplier to user. Almost every major program developed somewhere in the EDUCOM membership turned out to be useful to the other members. Science areas provided most of the major applications: Statistical packages were our "best seller".

EIN did very well. It grew to be most of EDUCOM. After a year it was triple its expected size. Our documentation won awards as the best around. Our funding was renewed and increased.

By then something was becoming apparent. Like most successful computing developments, we had become a success by solving a problem. But we had created new needs, and were now a problem looking for a new solution. Our most conspicuous problem was speed. Our programs traveled (electronically) on tape, which in turn traveled (mechanically) by mail. Once they arrived, there would be a flurry of correspondence between the sender and the user over how to run and debug them. Feedback started coming in from our members that program sharing was great, but could we do it on-line? Could the programs be catalogued on-line? Could they be moved over wires? Could they even be operated by a remote user on the site that had developed them? Could the inevitable interaction between the originator and the new user be done on-line?

With the technology of the times, “no”. Remote computing was possible, but only for tiny applications. Electronic transmission was far too slow - slower than a tape going through the mail. 2400 bits-per-second was the best modem speed over a non-dedicated wire, and it was very unreliable as well. We started looking around for better all-electrical transmission. We found it hiding in one of the early-adopter communities of the day - the military/industrial/academic complex. We had discovered the Jurassic Internet.

## **ARPANET and Internet**

Was I there at the creation of the Internet? Was anyone? That depends on what you mean by the Internet, and by its creation.

I was almost immediately part of (and helping to create) the small community that was everybody in the world involved with computer networking. BBN was there (Frank Heart, Alex McKenzie, Robert Kahn) as well as MIT (J.C.R. Licklider), ARPA (Larry Roberts, Steve Crocker), Carnegie-Mellon (Harry Rowell), Dartmouth (Tom Kurtz), Network Analysis Corporation (Howard Frank), UCLA (Leonard Kleinrock) SRI (Doug Engelbart, Vinton Cerf), and others. Now that the Internet is in the limelight, these names have become legendary as the pioneers. I worked with them all, and became personal friends with many.

The Internet, like most major technological developments, happened in small stages, each taking the mix of technologies, administrative structure and problems of its time, and making an incremental change. The change, in turn, creates a new mix of technologies, administrative structures and problems. The question of when the mix of things that fed into it turned into what we mean by “the Internet” is a little like that old question “Is it soup yet?”

There are several histories of the Internet around, most carefully claiming not to be “definitive”. One is available from The Internet Society, and written by some of the principals who made most of the major advances. You’ll find it on the web at <http://www.isoc.org/internet-history/>. Even it claims to be “cursory and incomplete”. Its style as a history gives a pretty clear picture of how complex it is to reconstruct what happened. The document describes itself thus: “In this paper, several of us involved in the development and evolution of the Internet share our views of its origins and history”. The fact that the net didn’t all crystallize at once is reflected in the statement, “The Internet represents one of the most successful examples of the benefits of sustained investment and commitment to research and development of information infrastructure.”

Perhaps a useful analogy to the Internet development can be had by looking at the genealogy of your grandparents. Each of them had two parents, four grandparents, eight great-grandparents and so on back. Each of those ancestors could be considered “the origin” of your grandparents. Perhaps the first to settle in your town is even referred to as the “origin” or “beginning” of the family. Your grandparents also had descendants. Each of those descendants had additional ancestors. The Internet came from many generations or lines of development. Each of those fathered (“parented”, to be fair) many developments in addition to the Internet. Many of those developments could be referred to as “cousins”. Alternatively you could think of Internet development as a tapestry, with many independent

strands interwoven to create a coherent whole. But while “Unified” in this analogy is OK for the tapestry, it goes too far for the Internet.

I won’t go over the history again. However let me highlight a number of moments that can be thought of as “the beginning of the Internet”, with notes about what you therefore think the Internet to be.

Circa 3500 B.C.: Babylonian clay tablets and papyrus scrolls appear that refer to earlier ones - the logical basis of hypertext (later called “linking”).

Circa 300 B.C.: The Library at Alexandria introduces cross-references and annotations. If the Internet is freedom to move around linked ideas for you, these could be the beginning.

1945: Vannevar Bush proposes MEMEX, a thinking machine that lets users create trails among related pictures and stored information. His article in Atlantic Monthly of July 1945 is considered the beginning of modern hypertext theory. (54)

April 1962: Leonard Kleinrock at UCLA published the first paper describing some aspects of packet-switching theory. If you believe that the Internet is packet switching, a departure from circuit switching as in telephone networks, this is it. His first book on the subject appeared in 1964.

August 1962: In a series of memos, J.C.R. Licklider (then at BBN, I believe) laid out the concept of a “Galactic Network”. He envisioned a globally interconnected set of computers through which everyone could access information from any site. It provided a vision. Very few predictions come anywhere near close to what actually happened, but this one did. It was also the first serious appearance of the term “information superhighway”. If by the Internet you mean a model or vision, towards which it could grow, this is it. There was little idea, however, of how it could be done or at what cost. In October 1962 Licklider became the first head of ARPA’s computing organization.

1963: Douglas Engelbart published “A Conceptual Framework” for the machine implementation of hypertext. It is built as the “Augment/HLS hypertext system” in 1968.

1964: Paul Baran at RAND published a paper on packet switching networks for secure voice for the military. In England, NPL (National Physics Laboratory) independently began work on packet switching. It’s the underlying transport technology of the Internet. Disputes continue to this day on the relative significance of Baran’s and Kleinrock’s primacy.

1965: Larry Roberts, then at MIT Lincoln Laboratories, and Thomas Merrill linked two computers in Massachusetts and California. It was the first distant computer linkup, or wide-area computer network. That is unless you believe that a network of telephone switches is a computer network, even if the computer is unionized telephone operators plugging cables into switchboards - in which case step back about a century.

1967: Roberts, now in Licklider’s old job at ARPA published a plan for the ARPANET. It is presented at a conference in which the ARPA, RAND, and NPL people find out about each other.

1968: ARPA issued an RFQ based on the plan, which was won in December by a group at BBN, headed by Frank Heart. The central job was to devise computers that will attach (“snuggle up” in Heart’s words) to computers and then communicate among each other using packet-switching technology.

September 1969: BBN installed the first Interface Message Processor (IMP) at UCLA. Three other sites are added in October. In that month, the first ARPANET message is sent from UCLA to Stanford Research Institute. If the Internet isn’t the Internet without content, this was the beginning - the analogue of the Wright brothers’ first flight.

According to Kleinrock, it went something like this: “We set up a telephone call to SRI. We wanted to send the word “login” We typed the ‘L’ and asked on the phone, ‘did you see an L?’ ‘yes, we see an L.’ Then the ‘O’. Did you see an ‘O?’ ‘We’ve got an ‘O.’ When we typed ‘G’, the system crashed”. It was the dawn of an era.

Connected to the SRI node was Douglas Engelbart’s project on “Augmentation of the Human Intellect”, including his NLS hypertext system.

March 1972: Ray Tomlinson (BBN) wrote the basic email send-and-read software. Roberts wrote the first email utility programs. Email is by far the most widespread application on the Internet, and for a respectable percentage of Internet users, the only one they ever see. If you’re one of those, perhaps March 1972 is the beginning of the Internet.

October 1972: Robert Kahn presented the ARPANET to the (narrower) public at the third International Computer Communication Conference. (I had been the U.S. delegate to the first conference, held in Amsterdam in 1970). This event is usually considered to be the first appearance of the net outside of its priesthood, and the point at which the net started to grow. I disagree – keep posted.

June 1973: TCP/IP protocols are developed by the Internetwork Working Group (INWG) and formally presented by Vinton Cerf (Stanford) and Robert Kahn (BBN) in September. These protocols allowed the ARPANET to link to other networks with different architectures. They turned a packet-switched network into a network of networks - or internet (with a small “i”). This net could accommodate the diversity of user types we see today. If the germ of a working network of networks is your idea of the Internet, this is your date.

January 1, 1983: After years of planning, all computers connected to the ARPANET switched over to TCP/IP simultaneously. Lapel buttons and bumper stickers proclaimed “I survived the TCP/IP transition”. If an operational network of networks is the Internet for you, 1/1/83 is your milestone.

1989/90: Tim Berners-Lee at CERN devises the World Wide Web. It’s a format that can be used for diverse applications. A user knowing only one “language” (HTTP) could use any program built in it. If you think the Internet is a bunch of stuff all in one accessible language, this is the beginning.

1993: Marc Andreessen at the University of Illinois creates Mosaic, the first successful web browser, which he gives away for free. It can let a non-technical person use the web. He then takes it commercial

as the Netscape navigator. The Internet takes off as a consumer phenomenon. Before this, if you weren't a researcher, you probably hadn't heard of it.

Even in this cursory history, you will note that there is no clear beginning, or even definition, of the Internet. Many different threads (genealogies, technological lines of development) are interwoven, such as computer-to-computer communication, packet-switching, internetworking, universal user language, and applications such as email, and hypertext.

So where do I fit into this picture?

There are two ways my role could be characterized. One is as the principal denizen of one of the Internet's major blind alleys. Even I would agree. The other is as the key person causing one of the key evolutionary moments; the real introduction of the Internet to the world outside itself. Here is the story - the reader can decide.

I entered the picture in early 1969. "Computer networking" still meant linking terminals to mainframes. However on the frontier, it was about to mean what the words sound like - the linking of one computer or network to another. One place more than any other was the center of computer linking: The Advanced Research Projects Agency of the Department of Defense (ARPA).

ARPA had sponsored a number of frontier-pushing advanced computer applications at several sites around the country. Now some of those places wanted to use the resources of some of the other places. The cost of duplication was prohibitive. But could they be accessed remotely?

As I have said, electronic data communication was slow, unreliable and costly; worse than sending tapes through the mail. ARPA launched a new research initiative to solve just that problem: high speed, reliable, affordable electronic communication.

Once I started looking for electronic solutions to EIN's needs, I found myself immediately in the ARPA inner circle. The connection was originally made through J. C. R. Licklider, then at MIT.

Of all the ARPANET principles, he was physically the closest. His office was ten minutes walk from mine. MIT was both a member of EIN and one of the early ARPANET sites. We liked each other on sight, spent a lot of time together and became close friends.

Licklider (always known as "Lick") would have been a hard person to dislike. He combined a bright and active mind, a complete lack of egoism, a permanently sunny disposition (though not aggressively so), and an irrepressible non-threatening sense of humor. His puns would disarm the most self-serious conversation. If no pun was handy, he would invent slogans that made fun of his own liberal politics ("Clean for Gene - clean again for Phnom Penh"). As a manager, he was non-directive. Instead he created an atmosphere in which good people could do their thing. The room with the copier had the name plate "Z. Rocks". A sign sticking out of the back of one mainframe proclaimed, "Absolutely no hardware changes without notifying the management."

One winter night he and I were trying to get to Newark airport in a dreadful snowstorm. The Eastern shuttle put us on a 727 in the front row. "Good," says Lick, "in these seats we'll get there first." After an hour on the ground they switch us to an Electra (better anti-icing), this time in the back row. "Good," says Lick, "if the plane crashes, we'll be the last to go."

The match between EIN and ARPANET seemed made in heaven. For starters most of the ARPANET advanced computing sites were at EIN member universities. Those that weren't (RAND, BBN) were at non-profit think tanks or places that were highly acceptable centers-of-thought by academic standards.

From EIN's point of view, ARPA had the only solution going for our resource-sharing problem. Furthermore the ARPA sites were in the part of the universities that we related to - the computer scientists: they were already engaged with and often committed to us. Once Lick and I started talking, the idea of EIN using the ARPANET to communicate among its members rapidly escalated to (at least the possibility of) EDUCOM taking over the ARPANET. This idea was not necessarily as far-fetched as it sounded.

EDUCOM also looked good to ARPA. To see why, we need to reconstruct where they were at the time. What were they trying to do and where was the frontier?

As I traveled around to the various sites, I found isolated pieces of advanced computing research. They all seemed to combine three elements in various mixes:

- First, to develop some branch of science that required an advance in computing in order for the branch to advance.
- Second, to push forward some aspects of high-performance computing.
- Third, to make these new advances available to researchers not located on site.

These goals are both separate and interrelated. In that sense they were proving mutually stimulating. Just as it took World War Two to provide the incentive and environment for major advances in aerodynamics, so were these developments providing the stimulation and environment for each other to grow?

You will note something that I did not report, and that is because I didn't see it. What about the famous origin of the Internet: "The military wanted to develop a network that could survive nuclear attack?" The closest I ever heard to such a thing was one of the IMP performance requirements - and a necessary one at that. The net needed to be able to identify either a line or an IMP that was out of service, reprogram the net so that it worked anyway, and restart the dead element when and if possible.

Was there a conspiracy of silence about military purposes for the academic work? I don't believe so.

The nuclear-survivable network idea was indeed present among the threads in the Internet historical tapestry. The 1964 study by Paul Baran at RAND had been funded to address that feature (among many) for a secure *voice* military network. In doing so, it had become one of the three unrelated streams that began to develop packet-switching as a networking technology. But that study had not been funded by

ARPA. By 1968/69 the mantle of packet-switched networking had passed to ARPA, which took the lead with its BBN/IMP contract. The original Baran mission was no longer among the goals.

In the Internet-history-by-the-participants this question merits only a footnote. Here it is: "It was from the RAND study that the false rumor started claiming that the ARPANET was somehow related to building a network resistant to nuclear war. This was never true of the ARPANET, only the unrelated RAND study on secure voice considered nuclear war. However the later work on Internetting did emphasize robustness and survivability, including the capability to withstand losses of large portions of the underlying networks."

No doubt the "false rumor" was reinforced by another later development. After the 1972 presentation, many specialized, and sometimes separately owned networks began to sprout using the ARPANET technology. Most of the early military uses, however developed on the ARPANET itself. In 1983, the military uses split off. Thus MILNET became an operational network for the Department of Defense, leaving ARPANET to continue serving research needs.

It seems that in every era there is some segment of society that Americans want to despise. Over the years, I remember big business, Madison Avenue, the CIA, big oil, big government, unions, suburbia, welfare recipients, etc. In the late sixties it was "defense". Vietnam war veterans would hide that piece of their biographies. Campus newspapers were doing exposes on intelligence activities. Academe, with its traditionally liberal attitudes, and defense were particularly uneasy with each other.

The question: "what are we wonderful academic scientists doing taking money from the nasty military?" did come up from time to time. The response, as might be expected, depended on who was talking. I would say that the spectrum ran like this:

- (Right end) This is work that I want to do anyway. It benefits knowledge and the human race. If they're willing to fund it, I'm willing to accept the money.
- (Left end) I'm taking money that might otherwise be spent killing people and putting it to humanitarian purposes - a double benefit for humanity.

Oddly enough I didn't meet anyone who thought of him-or-her-self as a bad guy.

ARPA had some other pressures as well. The bad military image was no help at budget time. Turning part of the operation over to academia would have provided direct relief by getting some of the operation off ARPA's budget. It would have also provided an applicant for further research money (academia, EDUCOM), which would have a better image, and perhaps therefore a better chance of getting funded - the perfect image laundry, as it were.

There were also rumblings here and there about incest. You have no doubt noticed the small number of institutions - MIT, BBN, Stanford etc; and the movement of the small number of key persons among them. I picked up just-below-the-surface concerns, especially in Congress, about self-dealing. ARPA would give a grant to some institution, then hire the key player, then the key player would go administer the grant. Licklider went from BBN to found the computer interest at ARPA, which then gave a grant to

MIT. He then went to MIT to administer the grant and found project MAC (Multiple Access Computer). Lick wasn't a crook; he was at worst an innocent. Roberts, Crocker and Cerf all went from ARPA contractors to ARPA itself. Eyebrows went even higher when Ivan Sutherland went from ARPA (as Roberts' immediate predecessor), after a stint at Harvard, to found Evans and Sutherland. The for-profit company's principal income was from an ARPA grant. Robert Metcalfe took the Ethernet concept private as 3COM, and made a great personal fortune. This kind of closed community may be OK if everyone is competent and honest. Otherwise, and maybe anyway, it begins to look like your basic political-machine abuse. Again, turning it over to a consortium of universities could be an excellent cure for the image.

The initiative came from our side, specifically from Lick and me. If we were going to get anywhere, we had a lot of selling to do - to both EDUCOM and ARPA.

EDUCOM seemed like the harder sell. How unified can a consortium of 100 universities ever get? We would have to convince each one, and probably dozens of people in each school. However we had a stroke of good luck.

Jordan Baruch left. I mean him no disrespect. He was a good man, but he was an outsider to the world of education, and therefore limited in his clout within the group. We were very fortunate in his replacement.

Henry Chauncey, the President of Educational Testing Service (ETS), was a man whose name commanded instant recognition and respect. He was almost so perfect an example of the old-money/upper class/high-culture Yankee as to be a caricature - all the way to the accent. His ancestors had come over on the Mayflower, and his remoter ancestor, Chauncey de Chauncey, had been with William the Conqueror's army in 1066 (as had my own forbears). He was a graduate and Fellow (trustee) of Harvard. His career had included educational and public-service positions of the highest rank. His integrity was beyond question, his intelligence and grasp splendid, and his judgement sound. He could understand and wrestle with subtleties, and his mind was open to change. He was not quite so disarmingly open as Lick; Henry always kept a professional distance. But he was always accessible and never threatening. People not only respected him, they liked him.

Fortunately he and I were also a good match, and quickly became friends. We stayed at each others' homes and visited each other on summer vacations. Unfortunately he moved EDUCOM headquarters to Princeton (he was still head of ETS), and I entered the weekly-commute-through-Newark-Airport phase of my career, spending a day or two each week in New Jersey.

The only virtue to this routine was my weekly dinner at the Newark Airport restaurant. The Newarker provided the best food in Newark and interesting service. It was reputedly run by the Cosa Nostra. There were about two waiters per customer, and they were all (waiters and customers, except me) well-dressed beefy Sicilian-looking characters with bulges under their left armpits. Someone must have pointed out to the local mafia that they were creating an image problem. One week they made a permanent switch. The waiters were now all well-dressed trim Englishmen with bulges under their left armpits. I always wondered if the Sicilians were now waiting table in London.

I presented Henry with our EDUCOM/ARPA notions, and he quickly decided that checking it out should be a top priority. It was becoming clear to everyone that EIN, the success story of EDUCOM, needed direct high-speed electronic access to continue growing - perhaps even to survive.

It is not quite fair to say that we became a "three musketeers" trio. I was personally closer to each of Henry and Lick than they were to each other. But we were of one mind, and worked very effectively together. And when Henry spoke, the EDUCOM member schools listened.

How about ARPA? At ARPA there was no question who was in charge. It was Lawrence G. (Larry) Roberts.

Roberts was intense and decisive. His subordinates found him distant and even a bit frightening. He led by example and not by intimidation, but his example was forceful.

On at least three different occasions I witnessed this leadership in the same unusual shape: A team of senior researchers would have been working on some tough technical problem for weeks or months, and had gotten stuck. The people were not dummies - they would be, for example, MIT faculty or postdocs. They would come to Larry, outline the problem and ask for more time or resources. In two or three sentences he would hand them the solution and walk away. They would stand there amazed.

Although I spent considerable time with Larry, we never met outside of work, and I can't claim to be among his friends. The task of getting him interested fell to Lick. Apparently it wasn't easy. The ARPANET people had plenty to do without being bothered by academic administrators. Getting Roberts' attention would require a major event. We created one.

As I said, every Internet history I have read counts the October 1972 appearance of the ARPANET at the International Conference on Computer Communications as a major milestone. It is credited as the ARPANET's coming-out party, its introduction to society, its first encounter with potential users outside the ARPA community, the point at which it opened up to the world and vice versa, the moment when it stopped being force-fed and started to grow on its own.

In fact the 1972 presentation was not the turning point. It was an aggressive promotion that grew out of the real turning point.

Namely, the EDUCOM Fall Council of October 14-16, 1970 in Atlanta. I organized and chaired it. Henry mobilized the academic community, and Lick produced Larry Roberts. I offered it to the EDUCOM membership as a look at a technology that could mature along with EIN, and provide EIN with the capability it obviously needed. Larry described the status and plans of the net, and expressed strong interest in EIN as the vehicle that could both use and manage it. Lick closed the session with his vision of the universally-wired future.

Lick began his remarks "Ever since John introduced Larry as 'the horse's mouth on networking', I've been worrying how he would introduce me."

For EDUCOM it was a sensation. Member after member told me it was the best thing EDUCOM had ever done, and that it brought EDUCOM to a new level. As reported in the next EDUCOM Bulletin: "During the Friday forum on the future for EDUCOM, it was noted that once the ARPA network was fully developed, 'if EIN didn't exist, it would have to be invented.' ... The membership voted to have a task force investigate EDUCOM support for the evolution of the ARPA network into a common carrier data communications facility and the possibilities of a comparable educational network ..." I was fingered as the key person in this pursuit.

I am reluctant to speak for ARPA, but it was obviously significant for them as well. I was promptly invited to join the ARPA NWG - the core network design team. I was not one of the tech wizards, whose names I have mentioned already and who are now legends. I was not expected to make technical contributions, except perhaps in the man-machine interface area (which was hopeless anyway in that era). I was instead to feed in information about what academic users might need and keep EDUCOM in the loop.

What I found there was intriguing not only technologically, but also sociologically. The people were top notch. But their universe was limited to the upper echelons of the inner circle of the computing world. Their idea of a "user" would be a research project in advanced computing.

Furthermore they were developing not only a new technology, but also a language that was different from and, at first exposure, incomprehensible to people from both computing and telephony. Their vocabulary had "Interface Message Processors", "switched packets" with "headers" and "cyclic bit error checking". "Connection" meant a random dynamic assortment of "routings". This language sailed past both the computer and telephone people without making contact.

Larry, who had not previously attended to - or appeared to care about - events outside the ARPA community, began to appear "in public" so to speak. EDUCOM and ARPA, together and separately, started exploring management alternatives that could make the net operational to wider communities.

Our panel was reprinted in the EDUCOM Bulletin, and reprinted again in Behavioral Science magazine. A subsequent article (by me) appeared in the Association for Computing Machinery Bulletin in June 1972. Larry and Lick and I became a kind of intermittent road show, appearing together in various public forums.

For example we were the centerpiece of another EDUCOM event on April 29, 1972 also organized by myself. The conference was called "The Financing and Organization of Computing in Higher Education". Along with the three of us, there was Richard Nichols, Vice President for Marketing of AT&T Long Lines. The conference proceedings summarized the progress since Atlanta:

"ARPA started the network but has no interest in managing it. Its interest will continue to be in funding new research facilities and promoting new ideas; it is anxious to get out of the position of administering either the communications or the use by universities. AT&T may provide communications, but it will not take on the responsibility of building a management superstructure. Some organization will have to take on this function. EDUCOM has been mentioned as a possibility. ... Henry Chauncey, President of EDUCOM, wrote to the presidents of all EDUCOM members and some other large institutions, informing

them about the network and asking for an expression of interest. All of the institutions responded, about 90% favorably.

If the network is to be successful, there must be good standardized documentation. Thus some organization must develop standards and examine and test the documents before they are distributed to users. EDUCOM has offered to assume this responsibility.... The problem of getting people onto the network is more one of organization than of money."

The person to do all this was, of course, me.

I became active and visible in wider circles. I was constantly addressing conferences and workshops, including meetings of college presidents. At the same time I was immersed in the ARPA community and other networking frontier groups. EIN continued and even accelerated its explosive growth. I recollect feeling that I was spared having to write about what I was doing, simply because I was being so often quoted and cited.

I also began to get unsolicited job offers in the academic realm. These included, for example, Vice Chancellor of SUNY - the largest university in the world, Dean of the Medical School at Stony Brook, and tenure at Illinois Institute of Technology with my choice of departments. I was asked if I "would be considered for President of New York University."

EDUCOM, and I in particular, became promoters of the ARPANET as an operating entity beyond the community of ARPA research sites. Our goals were mixed. One was to explore whether we wanted to run it. The other was to make sure it became available, in order that EIN could use it. One of our methods was simply to make the wider world aware that there was something here that could and should become available.

One of my talks, at Princeton in June 1971, was taped and transcribed. I updated it in January 1972, and it was published by EDUCOM as "The ARPA Network - Technical Aspects in Nontechnical Language." EDUCOM aggressively distributed this paper, and it became the standard document in all forums for demonstrating the technology and its benefits to the layman.

Meanwhile Henry was using his connections in Washington. One of the places where my paper became influential was the United States Congress, especially the senate. We were told - via the informal feedback that emanates from such places - that it had transformed several key committees from unawareness to pushers of the technology.

It is most likely the item that prompted the involvement of Senator Albert Gore, Jr. Though the unfortunate remark (if he ever really made it) that he invented the Internet is an overstatement, he deserves credit for adopting it early and vigorously promoting its development and its Federal budgets. It's probably fair to say that he invented it as a Federal priority.

We were hearing things like:

"With all the flak we take around here for military spending, we wanted to show some civilian payoff."

“We made it clear to them that this thing should be visible by the election.”

“It helped them a lot with their budget.”

I cannot document these claims, save the usual “they came from reliable inside sources”.

Most of the INTERNET histories simply list the October 1972 presentation to the world as a fact. One, however, adds a few more lines. In The Roads and Crossroads of Internet’s History, by Gregory Gromov we read:

**1972: Public** demonstration of the ARPANET.

In late 1971, Larry Roberts at DARPA decided that people needed *serious motivation* to get things going. In October 1972 there was to be an *International Conference on Computer Communications*, so Larry asked **Bob Kahn** at BBN to organize a public demonstration of the ARPANET.

It took Bob about a year to get everybody far enough along to demonstrate a bunch of *applications* on the **ARPANET**. The idea was that we would install a **packet switch** and a *Terminal interface Processor* on **TIP** in the basement of the *Washington Hilton Hotel*, and actually let the public come in and use the **ARPANET**, running applications **all over the U.S....**

The demo was a roaring success, much to the **surprise** of the people at **AT&T** who were *skeptical* about whether it would work.

Source: Vinton Cerf

The words “Larry Roberts decided” and “serious motivation to get things going” are the keys to evaluating my role. They did not come out of the blue. They were the product of Roberts’ exposure to an aggressive eager user (EIN), beginning at my Atlanta conference; and very possibly also the product of pressure from Congress triggered by my paper.

And it seems that AT&T hadn’t read my paper, which would have showed them that the technology did indeed work. Remember my remark that the new language was incomprehensible to the old technologists.

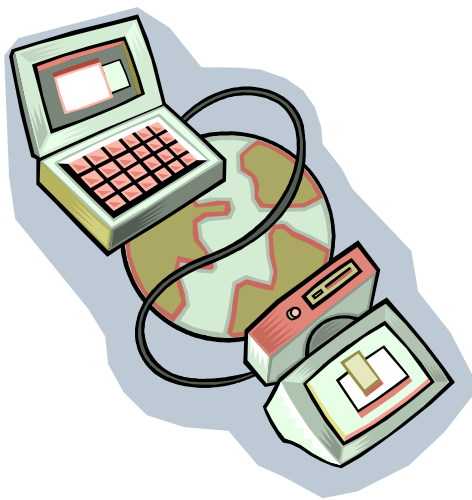
Philosophers will argue forever about the role of personalities versus forces as the cause of human history. There is little doubt that without me, the Internet would have happened anyway. But the 1972 debut may not have happened, and the shape of the development curve may have been different - even significantly different. When I started, the ARPANET community talked to and was known only to itself, and showed no interest in other communities. When I was finished, it was well known, especially in key circles in business, academia and Congress. It was actively courting visibility and interest, and trying to

promote development by outside users. There was no turning back to insularity. By this reckoning, I did play a central role at one of the pivotal points of Internet development.

In the end EDUCOM did not become an on-line network operator. In that sense, our efforts were a dead end. We were not the foundation for the cathedral, we were the scaffolding. Perhaps a better image is that we were not the chemicals but the catalyst. In any case, we began a success story that was eventually someone else's success, and our role is largely overlooked.s

Most of the major players, Kahn, Cerf, Heart, Engelbart, Kleinrock, have ridden the Internet to visible and illustrious careers. Licklider remained at MIT as the beloved founding father of the now-famous Laboratory for Computer Science. He retired and is now deceased. Roberts moved to GTE, where one publication said "Their next success will be whatever Larry Roberts thinks up next". He progressed from there to be founder/CEO of several related companies. Metcalfe is a major player in the Boston hi-tech venture scene. McKenzie became head of network activities for BBN. Henry Chauncey remained head of EDUCOM and ETS until his own retirement. I am told that around age ninety he still visits ETS, and offers cogent and heeded advice (year-old information in 1998).

In March, 1972, pressed by both EIN's exploding significance and his wife's diagnosis of cancer, Henry decided to relocate EIN to the Princeton headquarters. Exactly zero of us chose to go. I closed down the office and disbanded the Boston group at the end of June. ██████████



## **iTwin, a remote access tool**

### **A product review**

**Amitava Dutta-Roy**

I wonder if there is any law similar to Moore's law for the evolution of semiconductor chips that would apply to perceived human needs. We needed an electrical typewriter, then a calculating machine, a

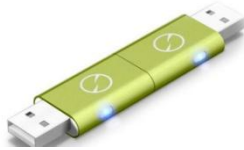
computer, more memory, faster processors, local networks, the Internet, laptops, tablets, smart phones and now remote access to our home computers, all in a span of less than thirty years! Do our needs double every two years?

Seriously, those of us who deposit the fruits of our labor — be they from counting beans, a life-saving project or a creative piece of literature — on the innards of a computer, know well how important it is to access that work remotely while we are away on business or vacation. You may be at a business meeting where your colleagues or clients may want to see figures that you forgot to take with you. If you are a writer and while sipping your favorite drink an expression or a plot suddenly comes to your mind that you want to integrate with the rest of the text you have been busy with recently? Yes, you could certainly load up your laptop with the data that you may expect to use while away or you could carry them in a flash drive. But your laptop and the invaluable information inside it vulnerable, it may be stolen or you might lose the flash drive in a cab while paying for your ride. There are all sorts of situations that can cause you unexpected pains.

Software such as LogMein can give you a bit of solace. But after a free trial period you have to pay a monthly fee. This software lets you access every feature of your “home” computer. For some telecommuters it is a great advantage and worth the money. But the danger to most of us is that anybody can access the “home” computer with stolen user’s name and password. In spite of these dangers lurking around there are people who advocate the use of cloud- based remote access. In theory, cloud computing sounds great. But what happens in practice? Do we know where in the cloud the data are stored? How secure they are? Can a hacker suck out the life blood of a honest user? What happens in the event of a disaster? How does one get some urgently wanted data in a hurry if that “cloud” for some reason or the other may not be visible at that moment of need? Are they doing routine maintenance? How is one to know? There are all kinds of issues in this game.

Two Singapore-based young engineer-turned entrepreneurs Lux Anantharaman and Kal Takru thought of an elegant solution to the problem of remote access. They probably asked themselves what if we could access the home computer without entering a user id and the password, and do that without any need of downloading special software. Could they develop a system that would it be difficult, well nigh impossible, to hack into such a scheme, since nobody would be able to see the identifying data?

The result of those two entrepreneurs’ curiosity, business acumen and bold risk-taking is a little device known as the iTwin. (I saw it for the first time at Consumer Electronics Association’s Line Show in New



York a few weeks ago.) The device acts like an invisible but secure cable connecting two computers that may be half a world apart. It looks like two identical USB flash drives — hence, the name iTwin — connected back-to-back. The mechanical construction is robust that gives you confidence. You plug in one side of the dual combination to a USB port of a “home computer.” The software built into the devices automatically places into the computer and the progress bar of the transfer of data is displayed on the screen. After a few seconds a green icon appears on the bottom right corner of the Windows Explorer (WE) pane. You are then asked to type in your e-mail address. (More about that later!) The iTwin is now ready for remote access operation. The user (you?) then brings up another copy of the WE (start>>computer>>WE) and drags & drops the files that might be accessed remotely on the first WE pane with the iTwin icon. Sure, if you should want you could open more than one filse.



Note that if you already have the WE up on your screen when you install the iTwin you do not need to bring up a second copy of the WE. The iTWin will show up in a WE pane all by itself and you will have two WEs side by side.

For my testing I pulled out the outer half of the twin devices leaving the inner half still connected to the “home” computer that belongs to my wife Cristina. I then plugged the outer half into the USB port of *my* laptop (simulating a remote computer). Within a few seconds a replica of the home computer screen appeared on the remote computer screen. At this instance the iTwin icon changed its color to dark orange. The file I dragged and dropped on the iTwin page on the home computer also appeared on the remote machine. I could open the file and modify it in any way I liked. Once I saved that modified remote file, magically the file on the home computer got updated as well. Now I asked for help from my wife Cristina. She was sitting at her computer, the home machine for this experiment. I requested her to modify her side of the file by adding some texts and *save* it. I then opened the file on my side, i.e., the remote computer. Golly, the file on my side was also updated.

While using the iTwin things to remember are:

- After the iTwin icon comes up on a Windows Explorer pane at the home computer the files expected to be used at a remote location must be dragged from a separate copy of the

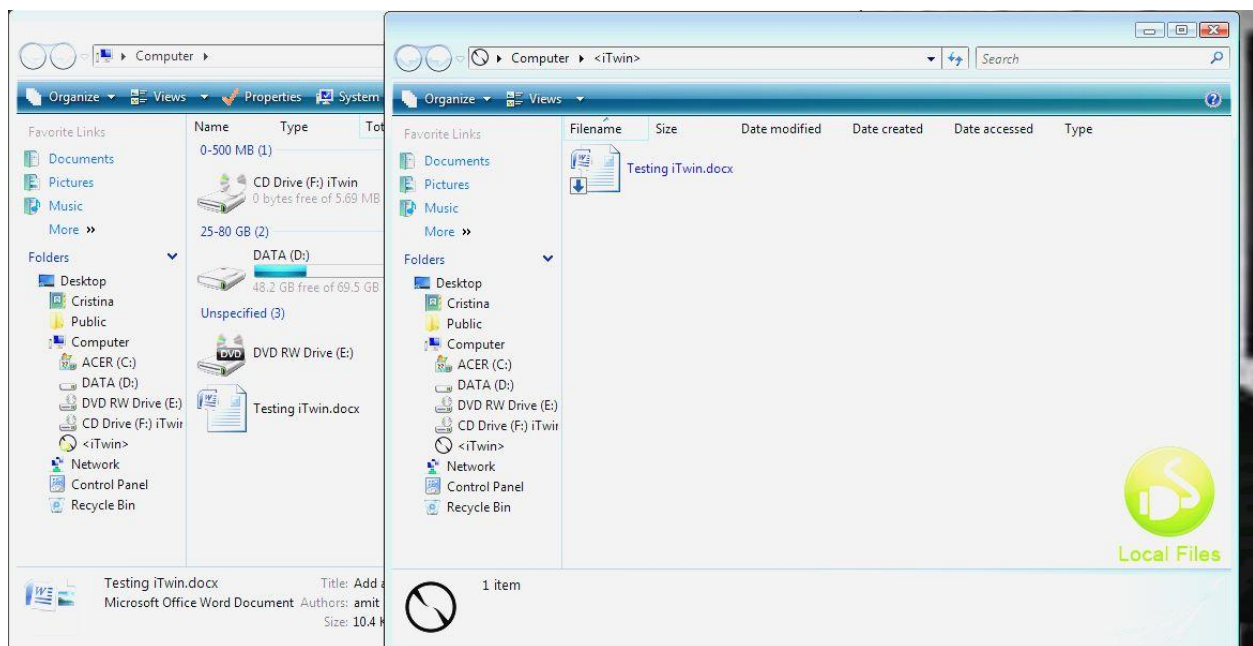
Windows Explorer and dropped into the WE pane containing the green iTwin icon. It is a normal procedure for *any* “drag and drop” operation

- The home computer must be left switched on with the “inner” half of the iTwin pair connected to a USB port for the remote machine to access the home. If for any reason, the home computer is switched off it must again be switched on, with the iTwin half connected to its USB port before it can be remotely accessed
- Files must be *saved* at either end for updating or remote transfer. The technical explanation is that files cannot be sent or received if they still are in their *open* state (i.e., they are in the RAM) but only from hard drives (i.e., after they are saved).

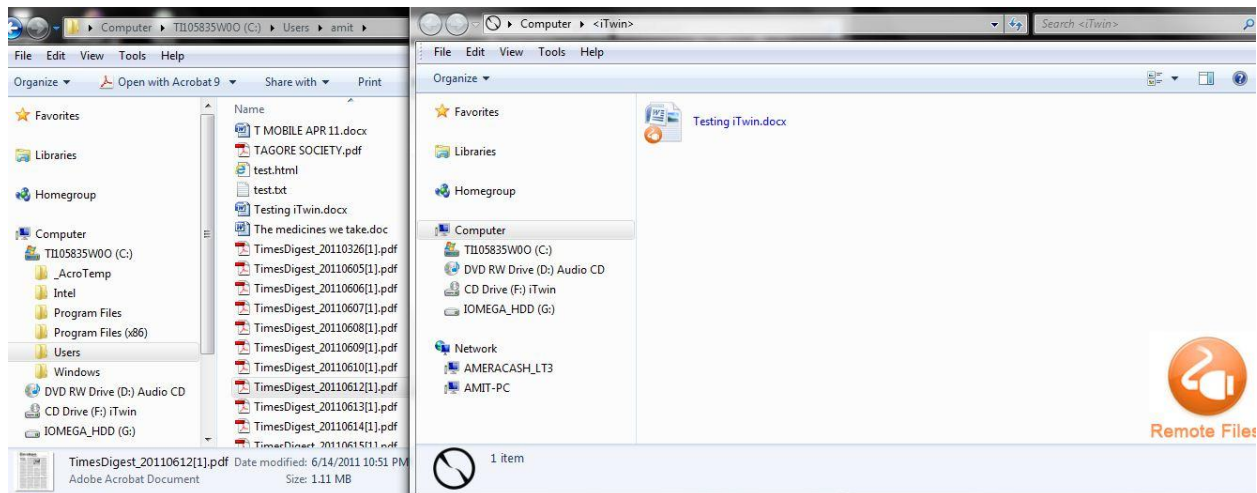
All the procedures mentioned above are very rational. We have prepared the following pages to demonstrate the operations.

## IEEE Monitor Laboratory

### Testing iTwin: August 24, 2011



**A view of the screen of the home computer after the iTwin device is plugged into a USB port. Notice the green iTwin icon and the second copy of the Windows Explorer on the left.**



**A view of the remote computer screen. The color of the iTwin icon in orange . Notice the file “Testing iTwin” both on the right and left panes. It means that the file was accessed by the remote machine has been saved.**

Now, let us look at the pros and cons. The pros first: for most cloud-based remote access the user pays a monthly fee, say, \$10 per month up to 50GB of storage. It may not sound all that bad at the first sight for light users. But on an annual basis you pay \$120. That’s some money. On the other hand, a user pays only a one-time price of less than \$99 for the iTwin. That is the manufacturer’s suggested retail price and I would imagine that it would be possible to get the device from retailers for less money. The user does not pay any monthly charge, since the data at all times reside on the two computers (home and remote) and not on some provider’s network.

I am worried about security anytime I remotely access my home computer. Usually, my entire life’s story and my secrets of staying safe reside on my computers. If I were to use a cloud-based service how would I know that a rogue employee is not prying open my personal documents? All providers would tell you that all their employees are trustworthy. However, newspaper reports show that thousands of files have been hacked from the data vaults of big banks, credit card companies and retailers. With iTwin you are the boss and the security guard rolled into one. I inquired about the security with iTwin. The company told me that the data flying between the two computers are secured via two-factor authentication (password plus crypto keys on the device), AES- 256 military-grade end-to-end encryption of files and remote disable functionality. (Confession: I am not an expert of encryption and that is why I had to swallow iTwin’s claim.)

On the con side, it took me three attempts to get a good handle on the iTwin. Once you apply common rationales of working with computers iTwin becomes a breeze. The company’s Web site looks very pleasing. It offers a nice video and a strip cartoon-like explanatory drawing. But I think that people still tend to rely more on written manuals. I think that there is ample scope for improving the iTwin user manual. But whenever I wrote to the company for explanation they replied promptly. I am told that iTwin currently comes in two colors. This is important. For, if two persons (e.g., husband and wife) work

in the same close physical space and both use iTwins, the devices may get mixed up. However, if they are available in different colors, there is one headache less.

Remember I mentioned above that at the time of its installation iTwin asks you for your e-mail? Well, soon after you have typed your e-mail address you will receive a mail giving you an eight-digit code. Jot down that code somewhere safe and carry it with you. If you lose the remote half of the iTwin the home part can be disabled by entering the Web site [www.itwin.com](http://www.itwin.com). Click on help and the instructions will guide you the place where you can type in the code and that is all; the remote access is disabled. Each time you install the iTwin you will get a new code. In the event of total loss of any of the two halves of an iTwin a new half may be purchased for \$50. The new half will “pair” up with elder sibling without any help from the manufacturers.

I use Windows-based machines and the review above applies to PCs only. I understand that this week the company has launched a version of their twin devices for Mac as well.

Certainly, the iTwin may not serve all purposes for all people. But for \$99 or less it gives a peace of mind to those who do not have the compulsive addiction of accessing the entire contents of their “home” computer. I have read positive reviews about the product in some well known publications.

The reviewer thanks Kal Takru, co-founder & COO and Brian Chamberlain, vice president, marketing and business development at iTwin for their interest and help in this review.

**DISCLAIMER: THE ABOVE REVIEW WAS WRITTEN AFTER THOROUGHLY EVALUATING THE DEVICE. IT IS NOT A SPONSORED REVIEW. THE REVIEWER IS NEITHER AN EMPLOYEE OF iTwin NOR DOES HE HAVE ANY FINANCIAL INTEREST IN THE COMPANY.**

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TECHNOLOGY FOR HUMANITY**

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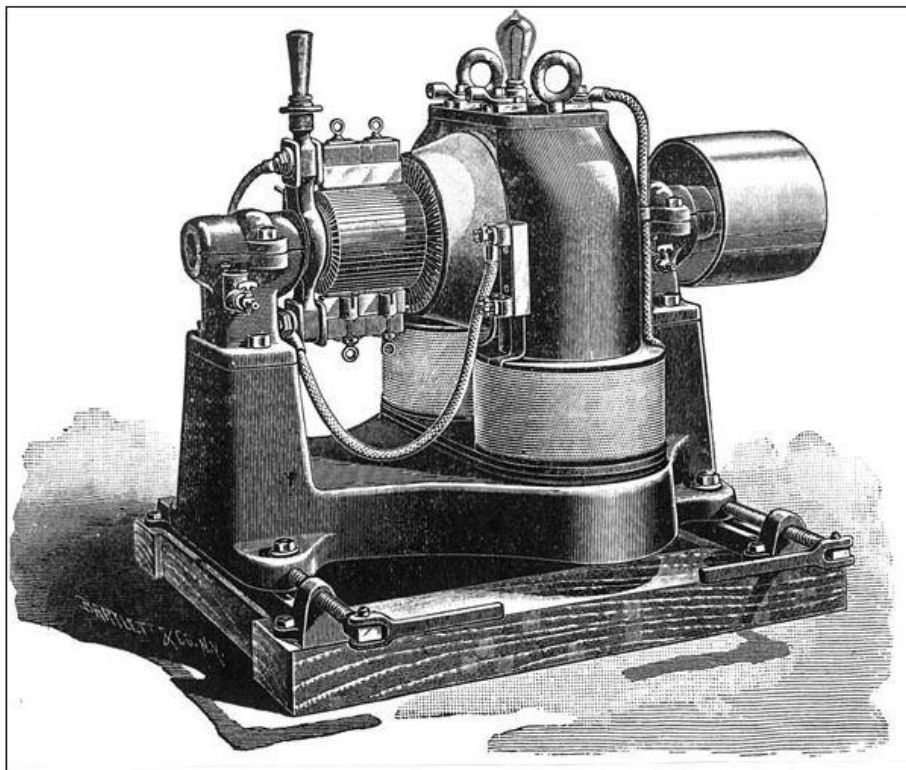
### **Worth reading . . about the electrical industry in early 1900s**

This bit of news may be of interest to the lovers of history of technology. In the May/June 2011 issue of the IEEE Power & Energy Magazine Thomas J. Blalock writes on the history of the Crocker-Wheeler

Company of New Jersey that in early last century manufactured electrical equipment. The associate editor of the magazine Carl Sulzberger adds:

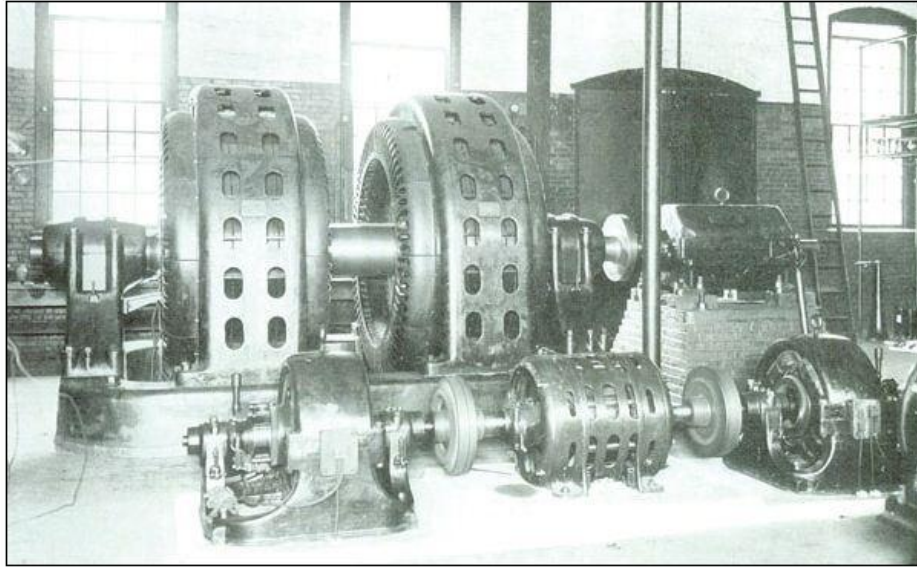
. . . This issue's "History" offering discusses another such Essex County company that was founded and operated by two outstanding engineers, both of whom served as president of the American Institute of Electrical Engineers (AIEE) during their careers. The Crocker-Wheeler Company was a major supplier of high-quality electric power equipment manufactured at a large factory complex in what became known as the Ampere section of the city of East Orange.

The story is fascinating. How such a long ago the engineers designed such machines when sophisticated instruments were not yet available. Irrespective of your specialization in the field of electrical engineering you will find it most interesting. I do not know if the magazine is freely available online to all who are not members of the PES. If you find it difficult to obtain the article try get it from your colleague or from your library. Below we reproduce two photographs that appeared in the article. - Editor



**Figure 8.** Early Crocker-Wheeler bipolar dynamo (from F.B. Crocker, *Electric Lighting*, 1902, p. 324).

**BE A MENTOR TO YOUNG ENGINEERING STUDENTS AND  
HELP THE COMMUNITY**



**Figure 10.** Crocker-Wheeler frequency changer and exciter set (from the *Cyclopedia of Applied Electricity*, 1913, p. 283).

I have no idea if the P&E magazine is freely available to all members of the IEEE. Even if it is not, I recommend that you get a copy from a colleague who is a member of the PES, your company or public library. The article is worth reading. ██████████

## SCIENCE + ART + TECHNOLOGY = CREATIVITY AND AESTHETICS

### Dancing pendulums



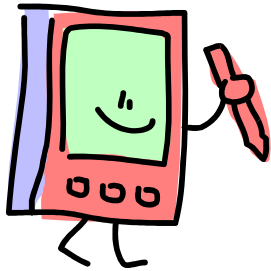
It is indeed possible to mix art with science and technology. Contrary to popular belief they are not mutually exclusive. Both art and technology are fruits of creative minds whereas science is a study of whatever we have around us. All obey immutable laws of physics. The mixture of all these three sometimes may result in things or phenomenon pleasing to the eyes and a practical demonstration of the universal laws of physics. Our life member Bill Coyne who is also chair of the bylaws committee discovered the video clip of one such creation and sent it to us. This example titled “Dance of the pendulums” came from Harvard University. Go to>>

[http://sciencedemonstrations.fas.harvard.edu/icb/icb.do?keyword=k16940&pageid=icb.page80863&pageContentId=icb.pagecontent341734&state=maximize&view=view.do&viewParam\\_name=indepth.html#a\\_icb\\_pagecontent341734](http://sciencedemonstrations.fas.harvard.edu/icb/icb.do?keyword=k16940&pageid=icb.page80863&pageContentId=icb.pagecontent341734&state=maximize&view=view.do&viewParam_name=indepth.html#a_icb_pagecontent341734) or,

click on the link button on the anchor page and where you will find a video clip. - Editor



## Post PC era



We have come a long way from the early days of personal computing in the last thirty years. Thanks to the likes of Steve Jobs (who resigned yesterday from his position of CEO of Apple Computers), Bill Gates and Steve Wozniak. Now many of us cannot even think of living a moment without our PCs. If we could some of us would love to take their machine to the shower; otherwise, what a waste of time it is! But now the next generation is hooked on to netbooks, tablets and other gizmos. Technologists, business leaders and observers of social behavior and trends are voicing their opinions and forecasting the future of personal computing. The other day I came

across a good article on the subject and I thought I would bring that to your attention. You can find that article at:

[http://www.networkworld.com/news/2011/081011-ibm-pc.html?source=NWWNLE\\_nlt\\_daily\\_am\\_2011-08-11](http://www.networkworld.com/news/2011/081011-ibm-pc.html?source=NWWNLE_nlt_daily_am_2011-08-11) \_ Editor



## Folding laptop?

Wouldn't it be good if we could get a folding laptop that we could carry in our backpack? It could a reality one day. Check it out at:

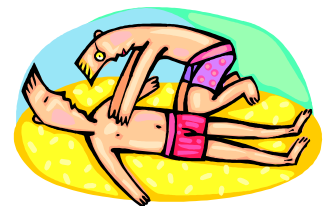
[http://www.youtube.com/watch\\_popup?v=7H0K1k54t6A](http://www.youtube.com/watch_popup?v=7H0K1k54t6A)



## Sarver Heart Center's Continuous Chest Compression CPR

Sometimes we come across situations that need a quick action from folks who know a thing or two about emergency first aids. I wish more of us were aware about these things. Many lives could be saved. Please go to the URL

<http://medicine.arizona.edu/spotlight/learn-sarver-heart-centers-continuous-chest-compression-cpr>



You learn about CPR and you could save a life. - Editor



**This is the end of the August 2011 issue of the New York Monitor  
Thank you for reading. Visit us again in September when we'll again have a  
many exciting stories to tell you. In the meantime, enjoy the rest of the  
summer!**