

Emerging Trends in ICT Development: A 5-10 year view

A Discussant's Perspective

Presented at:

5th Global Forum on Reinventing Government
Innovation and Quality in the Government of the 21st Century
Workshop on New ICT and E-government
Mexico City, 5 - 6 November 2003

By Dr. Raymond Khoury
Director, Technical Cooperation Unit
Office of the Minister of State for Administrative Reform (OMSAR)
Beirut, Lebanon
rnkhoury@OMSAR.gov.lb

Presentation Overview

- 📄 Overview of Mr. Doug McGowan's paper
- 📄 The 7Cs ICT Development Framework
- 📄 Chronology of ICT Developments till date
- 📄 Issues with such Developments
- 📄 Projection of ICT Developments over next 5-10 years
- 📄 2010 ICT World Outlook

Overview of Mr. Doug McGowan's paper

- ☞ Focuses on technologies that impact how people communicate, work and learn.
- ☞ Restriction to only Cellular Cell phones, Personal Computer, Networks, Wireless networks, Interactive Television, PDAs and the like.
- ☞ Presents issues with today's technology covering:
 - ☞ PCs: user interface, security, data accessibility, upgradeability, and usability; laptop travel and theft problems.
 - ☞ Wireless networks: voice over cellular phones with limited data usage; WI-FI with only data communication and no voice and limited usage due to high cost.
 - ☞ PDAs: limited functionality PCs; small to display pages; limited data entry means; being morphed closer to cellular phones. RIM pager is like a mini-PDA, can exchange email yet cannot open attachments.

Overview of Mr. Doug McGowan's paper

Discusses Guaranteed Trends

- ☞ Pervasive wireless networks (cellular and Wi-Fi) will develop; dual voice and data support will improve; cell phones will subsume PDAs.
- ☞ Devices like Cell phones, PCs, laptops, and PDAs will continue to improve in terms of power, weight, cost and portability (battery life).

5-10 year predictions for ICT Developments

- ☞ Revolution in the computer industry over next 5 years leading to a paradigm shift in how computers are understood and used.
- ☞ Shift from 'device-centric' to 'information-centric' computing.
- ☞ Technologies will provide an individual with a personal library that is secure and accessible through the right credentials from anywhere,
- ☞ Central storage of individual data in the electronic equivalent of a safety deposit box; avails anywhere, anytime access, better security and more storage.
- ☞ Issues with safeguarding credentials and trust in central storage

Overview of Mr. Doug McGowan's paper

- Accessing of centrally stored data assessed using new devices: own devices and those just used.
- 'Day in your life' examples are given for these 2 classes of devices: in the pocket, in the car, at the airport, in the office, in the store and in the shopping store showing how one can access personal information from anywhere and at anytime.
- Interactive TV is addressed with examples of how such units can be used for information exchange with business case for advertisers to receive more reflective data on viewers patterns & preferences. Wink system is an example.
- Impact on community and government presented with some associated challenges; problem of limited Internet access.
- Concludes by envisioning a world where technology will be used to improve everyone's life.

The 7Cs ICT Development Framework

1. Communication Channel and Bandwidth
2. Computer Processing Power
3. Capacity for Digital Storage
4. Critical Software Facilities
5. Capability of Benefiting Parties
6. Content Production for Digital Assets
7. Compliance to Evolving Standards

Chronology of ICT Developments till date

Communication Channel and Bandwidth:

Wired networks (data):

- ☞ On-demand dial-up has evolved from simple bandwidth speeds of 1.2 Kbps to over 2 Mbps through ISDN.
- ☞ Always-on leased lines have scaled up from speeds of 9.2 Kbps for X.25 connections to 4Mbps for ADSL connections.
- ☞ LAN bandwidth speeds have evolved from 4 Mbps for token ring, to 10/100/1000 Mbps for Ethernet, to 622 Mbps for ATM, and to 6.4 Gbps for HIPPI.
- ☞ WAN and MAN setups have advanced along similar steps.
- ☞ A mix and match of such data networks is underpinning the Internet that became mainstream in the mid 1990s.

Chronology of ICT Developments till date

Communication Channel and Bandwidth:

Wireless networks (data):

- ☞ Different levels of IR and RF data communications have developed with 4Mbps and 400 Mbps speeds to date
- ☞ Wi-Fi networks (or 802.11 type) based on LAN design have evolved with from 11 Mbps for 802.11b networks at 2.4 GHz to 54 Mbps for 802.11a networks at 5 GHz.
- ☞ Bluetooth has developed as a universal radio link that can connect portable as well as fixed electronic devices at 720 Kbps speeds at 2.4 GHz.
- ☞ Data communication over cellular phones has advanced from rates of 9.6 kbps for basic phones (WAP) to 171.2 Kbps for GPRS to the ultimate of 384 Kbps for 3G.

Chronology of ICT Developments till date

Communication Channel and Bandwidth:

Wired and Wireless networks (voice):

- ❏ PSTN have advanced from an analog to a digital foundation.
- ❏ Digital convergence has allowed voice to be transmitted over Internet-Protocol (IP) data networks – VoIP.
- ❏ Cordless phones have evolved from a 10 MHz limited range to a 5.2 GHz extended range, with the option of having multiple hand sets for the same base unit.
- ❏ Cellular phones have advanced from the 900 MHz range to the 1900 MHz range in the dial-up spectrum and most recently to the always-on GPRS range of 900-960 MHz.
- ❏ VoIP over Wi-Fi networks or Wireless LANs (VoWLAN) has recently been introduced.

Chronology of ICT Developments till date

Communication Channel and Bandwidth:

Other channels:

- ☞ Satellite technologies have also evolved over the last 20 years and today constitute an effective means of delivering broadcast as well as interactive data and voice assets to globally dispersed regions.
- ☞ TV broadcast has evolved from the analog domain to the digital domain with intelligent processing capabilities embedded (US FCC requiring all TV tuners to be digital by 2007).

Chronology of ICT Developments till date

Computer Processing Power:

- ☞ In 1970s/80s main frame computers with processor speeds between 250 to 1000 (MIPS) with application access through display terminals were mainstream.
- ☞ In early 1980s, the silicon microprocessor gave way to the PC that has been doubling in capability every 18 months at a constant price – ‘Moore’s Law’. (3.2 GHz by end of 2003).
- ☞ Servers, enhanced PCs, with processing and storage enhancements and redundancies form nucleus for any network information infrastructure. Servers have also evolved from single to dual to quad to multiple processor based units.
- ☞ ‘Blade servers’ are recent server entrants yet with heat problems. Server processor speeds are dependent on both processing power and onboard cache.

Chronology of ICT Developments till date

Computer Processing Power:

- ❏ Clustering of servers is gaining momentum reaching the computing paradigm of “grid computing”.
- ❏ Notebook designs have evolved since early 1990s. Tablet PC is a recent variation of a notebook that can be swiveled into a digital notepad with data entry using touch stencils.
- ❏ Electric powered laptops existed for some 5 years (1989-94).
- ❏ In late 90s, PDAs became a viable processing tool for the mobile user. They synchronize with PC applications (calendar, contacts, word, excel, etc.). Over the last 2 years, cellular capability has been added to PDAs (smart phones).
- ❏ Pagers have evolved over the years from simple telephone number receivers to more sophisticated devices. RIM pagers (Blackberry model) are lead examples.

Chronology of ICT Developments till date

Capacity for Digital Storage (4KB / full page):

Type of Storage	Unit Capacity (KB/MB/GB)	No. of pages that can be stored
5.25" floppy diskette	1.2 MB	300
3.5" floppy diskette	2.88 MB	750
USB Memory Stick	512 MB	128,000
CD-ROM disc	640 MB	160,000
DVD disc	4 GB	1,000,000
PC Hard Drive	40 GB	10,000,000
Server Hard Drive	400 GB	100,000,000
Backup tapes	40 GB	10,000,000
Optical Jukeboxes	1 TB	250,000,000
NAS setup	40 TB	10,000,000,000
SAN setup	160 TB	40,000,000,000

Chronology of ICT Developments till date

Critical Software Facilities:

☞ PC/Server/PDA operating systems:

- ☞ PC OS → DOS to Win 3.x / 9x / 2000 / XP / longhorn; Linux; MAC.
- ☞ Server OS → Win NT / 2000 / 2003; Unix; Linux; Solaris.
- ☞ PDA OS → Palm, Win CE, Nokia/Ericsson OS.

☞ Hardware specific firmware:

- ☞ Routers, network switches/hubs, scanners, printers, modems, etc.

☞ Communication and security software:

- ☞ Software for servers/PCs, modems, routers, network switches, satellites, etc.
- ☞ Functions: data/voice exchange, web surfing, email, synchronization, back-up, de-centralized transactions; secure exchanges (SSL, SET), smart cards, biometrics, digital certificates, PKI, other encryption algorithms, etc.

Chronology of ICT Developments till date

Critical Software Facilities:

Productivity and reference tools:

- Word processing, spreadsheets, presentation, simple databases, publishing, drawing, etc.
- Dictionaries, thesauruses, encyclopedias, educational references, wealth of CD/DVD titles, etc.

Specialized vertical and horizontal applications:

- HR, payroll, accounting, planning, management, banking, tax, etc.
- ERP, WF, DM / CM / KM, BI / DW / DSS, GIS, GPS, archiving, etc.

Web-based applications:

- ISP, ASP, web-sites, portals, etc.
- e-procurement, e-commerce, e-government, e-learning, e-health, e-tourism, e-communities, etc.

Chronology of ICT Developments till date

Capability of Benefiting Parties:

- Benefiting parties cover citizens, businesses, educational institutions, government and others.
- Training on ICT use and administration has evolved with various ICT developments at different levels (beginners, intermediate, advanced) per benefiting party.
- Government and citizens slower to adapt to new ICTs than businesses and educational institutions.
- Developed countries always more advanced in human capability to use and administer the latest ICT (high R&D level); developing countries follow (usually 1 to 2 years later).
- Language barriers have impeded transfer of some ICT products to the developing world.

Chronology of ICT Developments till date

Content Production for Digital Assets:

- Advent of Internet led to an explosion in the amount of online digital content. All benefiting parties became interested to put content online (Metcalfe's law).
- ICT tools have been developed to expedite digital content creation (scanners, OCR, VR/IVR, indexing, CM / KM / BI)
- Businesses and educational institutions have constantly generated content and placed it online within their premises, with some offered to the outside world (MIT's OCW initiative).
- Individual online content has also increased with time as a result of subscriptions to credit cards, magazines and census fulfillments.
- English has by far been the most dominant content language on the Internet (80 to 85%).

Chronology of ICT Developments till date

Compliance to Evolving Standards:

- 📄 ICT standards have evolved with relevant developments in both software and hardware solutions.
- 📄 National, regional and global bodies and SIGs have constantly been formed to form and apply ICT standards.
- 📄 Beyond ICT, sector-specific information standards have evolved (identifier, communication, content and structure, etc) to facilitate harmonized interchanges between different IS.
- 📄 Standards have allowed for broader acceptance of most ICT products (buyers are assured of compliances) and have brought ICT professionals together for a rewarding cause.
- 📄 Standards compliance and certification (CMM) are becoming crucial for winning ICT contracts (case of US government),₈

Issues with ICT Developments till date

- 📄 **Communication:** Fiber capacity always on the raise; Multiple Standards caused non-compliance (wired and wireless); Telecom de-regulation slow in pace; access cost still high; VoIP still banned by many governments; Domain name registration process in limbo; security issues.
- 📄 **Computer Processing:** Pace of advancement too fast; more dis-connected PCs than connected; Schools and community PC needs can be better addressed through recycling; innovative PC assemblies needed for the less privileged.
- 📄 **Digital Storage:** longevity of storage media; practicality of near online storage vs. cost of online storage; scalability always a concern; security protection.

Issues with ICT Developments till date

- 📄 **Software:** Multiplicity of applications causing interoperability concerns; upgrades seldom facilitate seamless migration; proprietary software being challenged by open source; support and maintenance a cost issue; user interface has come a long way with improvements still possible; copyright protection still a global concern.
- 📄 **Capability:** knowledge sharing and transfer evasive; continuous training becoming a must to stay current; cost of training a factor; uneven human capacity building between countries of North and South; brain drain vs. reverse brain drain; participatory process in int'l forums still unbalanced.
- 📄 **Content:** sectoral data standards still evolving; OCR not successful for some international languages; online content production needs a push; online translation lacking; security, copyright and privacy issues; some Internet content outdated.

Issues with ICT Developments till date

- 📄 **Standards:** constantly being enhanced (catch up game); different global standards (case of cellular networks); developed nations more in compliance than developing countries (awareness is needed); participatory process also unbalanced between countries of the North and South.

ICT Developments over next 5-10 years

Communication Channel and Bandwidth:

- Advances in wired and wireless networks: 10Gbps to 1Tbps wired networks possible; UWB, 3G and Wi-Max (802.16) wireless networks to become more mainstream; spectrum allocation and management to improve; cable advancements.
- Co-existence of voice and data on both wired and wireless networks to accelerate with improvement in QoS.
- Liberalization of telecommunication markets to continue and access prices to drop for wired and wireless connections.
- Smarter satellites to be deployed at different orbiting levels.
- NGI or I2 to see broader deployments on global levels and benefiting all sectors.
- Security to improve using biometric and encryption tech.

ICT Developments over next 5-10 years

Computer Processing Power:

- ☞ Moore's law to stay valid for next 5 years at least.
- ☞ Size of computers/servers/notebooks to decrease due to new technologies (nanotechnology).
- ☞ 'Grid computing' to gain momentum with larger bandwidths.
- ☞ Smarter applications to increase load on processors.
- ☞ Support of multiple W & WL networks to become common.
- ☞ PDAs to become smarter with more cellular phone features.
- ☞ Battery time for portables to improve (6 to 8 hour time span).
- ☞ Home appliances to become smarter and proactive.
- ☞ Biometrics enabled security to be added to hardware.

ICT Developments over next 5-10 years

Capacity for Digital Storage:

- 📄 Enterprise storage technologies to advance in terms of capacity, caching, and network speeds.
- 📄 Mobile or portable storage to reach new levels (1G to 5G USB memory sticks)
- 📄 Clustered storage facilities (data centers) to become more common. (ASPs to be more utilized).
- 📄 New types of DVDs with 4x to 6x more storage capacity than current DVDs to reach markets (8.6 GB discs in 10/2003).
- 📄 Digital voice storage technologies to advance (MP3 variations).
- 📄 Storage security technologies to improve.

ICT Developments over next 5-10 years

Critical Software Facilities:

- 📄 Market share of open source to be tested; will drive cost of proprietary software down.
- 📄 User interfaces to become more intuitive / pervasive; voice and video interactive schemas to develop.
- 📄 XML and variations to support more interoperability features.
- 📄 Software upgrades over the Internet to become common.
- 📄 Firmware to become more intelligent (load balancing).
- 📄 Global e-applications to yield new vertical and horizontal application packages.
- 📄 Copyright protection to improve and to be better traced.

ICT Developments over next 5-10 years

Capability of Benefiting Parties:

- Media enriched distance training (CBT) to advance supported by other ICT improvements.
- Customized / adaptive ICT training to become more common.
- Knowledge sharing to be facilitated with broader networks.
- Training-the-trainer modalities to be extensively used.
- More balanced ICT capacity building between countries of the North and South (WSIS process to have an impact here).
- Expatriates to play key role in supporting national KB economies (Forrester Research: 2.5 million overseas ICT jobs to be exported from US and Europe).

ICT Developments over next 5-10 years

Content Production for Digital Assets:

- 📄 Online content to increase with increase in online population.
- 📄 NLP advancements could yield breakthroughs in OCR & online translation.
- 📄 Currency of content to improve using AI / BI technologies.
- 📄 More and more businesses to switch to online interactions with customers and hence more content is to result.
- 📄 e-applications by government to be main catalyst for online content creation.
- 📄 Value add of online content to improve with advances in CM and KM technologies.

ICT Developments over next 5-10 years

Compliance to Evolving Standards:

- ☞ More congruent standards to develop on global scale (standards groups or SIGs could merge).
- ☞ With more digital convergence multiple standards to be morphed into a limited few.
- ☞ Standards to parallel ICT advancements with better dissemination and usage practices.
- ☞ More involvement of countries from the South in international standards committees or forums.
- ☞ e-applications on national, regional and global levels to require better sectoral information standards to be formed.

2010 ICT World Outlook

- ❏ 'Information and service centric' computing to reign in on 'device centric' computing – 'Plug and Play' to be replaced with 'Plug and Process'.
- ❏ A larger global population to reap the benefits of this transformation; structural changes will be required.
- ❏ "leapfrogging" process for countries of the South more possible with advances in the 7Cs of ICT Development.
- ❏ Adaptive security measures will become more warranted.
- ❏ Scientific R&D to exploit ICT advancements for a better quality of living; new learning paradigms to result.
- ❏ WSIS process to spearhead global collaboration and cooperation towards a more equitable 'information and service centric' world harnessing ICT developments for socio-economic prosperity for a larger percentage of society.