7 Information and Communication Technology

Information and Communication Technology

I. History and Background

Given the effects of Information and Communication Technology (ICT) on various economic and social sectors in the country, policymaking and coordination charter of several supreme councils were established within different periods. The High Council of Informatics affiliated to the Plan and Budget Organization (PBO) was the first one established in 1980. Ministry of Industry, Mine and Trade as the stakeholder of manufacturing sector and Ministry of Post, Telegraph and Telephone as stakeholder of infrastructure were two original actors in Information, Communications and Electro-electronic Sector.

With ICT development and increase in its effects on different sectors, tasks and responsibilities were apportioned nationwide and in process, the Council for Information, Communications and Microelectronic Technology affiliated to the Vice-Presidency for Science and Technology was established in 2000 in an attempt to develop and promote the related technologies, help knowledge-based businesses and promote knowledge.

The council contributes to commercialization of domestic science and technologies, alongside science production in the universities and businesses involved in the sector.

In addition to developing ICT infrastructure and applications, development of this technology can increase productivity in all economic and manufacturing sectors focusing on production development in this sector as a dynamic and effective industry in the country progress.

II. Policies and Strategies

Major ICT policies and strategies are stipulated in the following upstream documents:

- Fifth Development Plan: Articles 46, 47, 48, and 49;
- 20-Year Vision Document: Policy No. 9;
- Strategic Plan for Modern Industry Development (Ministry of Industry, Mine &Trade, 2001);
- Development and Use of Information and Communication Technology Plan- TAKFA (High Council of Informatics- 2002);
- Information Cyberspace Security Document- AFTAA (High Council of AFTAA -2005);
- E-Commerce Document- META (Ministry of Industry, Mine &Trade, 2005).
- Comprehensive IT System (2007).

III. Capacities and Capabilities

A. Current Status

The following tables and figures show the current status of information and communications technology in Iran and its comparison with neighboring countries.

Table 1

ICT Indicators– Public Access to ICT

Indicator	Unit	2010 status (5th plan)	Last Status	Reference Date	NSO[1]	Reference Period
International Internet Bandwidth Used	Gbps	64.3	187	March 20, 2015	Communications Regulatory Authority (CRA)	3-month
International Internet Bandwidth per Internet User	Kbps per user	1091 b/s	10.32 kb/s	September 23, 2015	Information Technology Organization of Iran	12-month
Domestic Internet Bandwidth	Mbps	–	2400520	September 21, 2015	CRA	3-month
Percentage of the Population Covered by Cellular Network	%	–	94.2	September 21, 2015	CRA	3-month
Mobile Cellular Telephone Subscribers per 100 Population	%	73.7	91.46	September 21, 2015	CRA	3-month
The Proportion of Households with Access to Computer by Urban and Rural	%	22.3 PCs of household	52.47	March 20, 2015	Information Technology	12-month
The Proportion of Households with Access to Internet by Urban/Rural and Type of Service	%	26.5	Urban:44.73 Rural: 17.5	March 20, 2015	Information Technology	12-month

1. National Statistics Organizations: All the public agencies collecting official statistics

Table 2

ICT Indicators - Development of ICT Infrastructures

Indicator	Unit	Expected Status at the End of the 5th Plan	Performance Status at the End of 2013	NSO	Realization Rate (%)
Proportion of Households with access to National Information Networks and Broadband Internet (minimum speed: 512 Kbps)	%	60	38	Statistical Center of Iran	63
International Internet Bandwidth	Gbps	500	124	Telecommunications Infrastructure Company (TIC)	25
Domestic Internet Bandwidth	Gbps	2000	844	TIC	42
Per Capita Shared Capacity	Kbps per Individual	832	260	Communications Regulatory Authority	31
The Number of Active Domestic Data Centers	Center	40	18	Information Technology Organization	45

Table 3

ICT Indicators – IT Economy

Indicator	Unit	Expected Status at the End of the 5th Plan	2013 Performance	NSOs	Realization Rate (%)
Ratio of Exports of IT Products and Services to Total Non-Oil Exports	%	1.5	0.146	Ministry of Industry, Mine and Trade	10
Ratio of Imports of IT Products and Services to Total Imports	%	10.4	6.304	Ministry of Industry, Mine and Trade	61
Share of CT Value-added in Total Value-added	%	–	1.58	Statistical Center of Iran	–
Share of IT Value-added in Total Value-added	%	–	0.54	Statistical Center of Iran	–

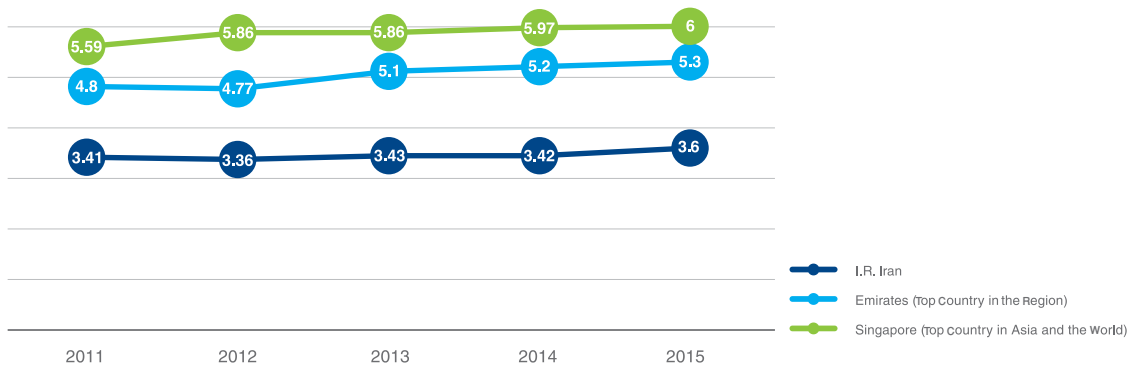


Figure 1: *Network Readiness Index; Comparison of Iran's Growth Trends and Top Countries in 2011-2015*

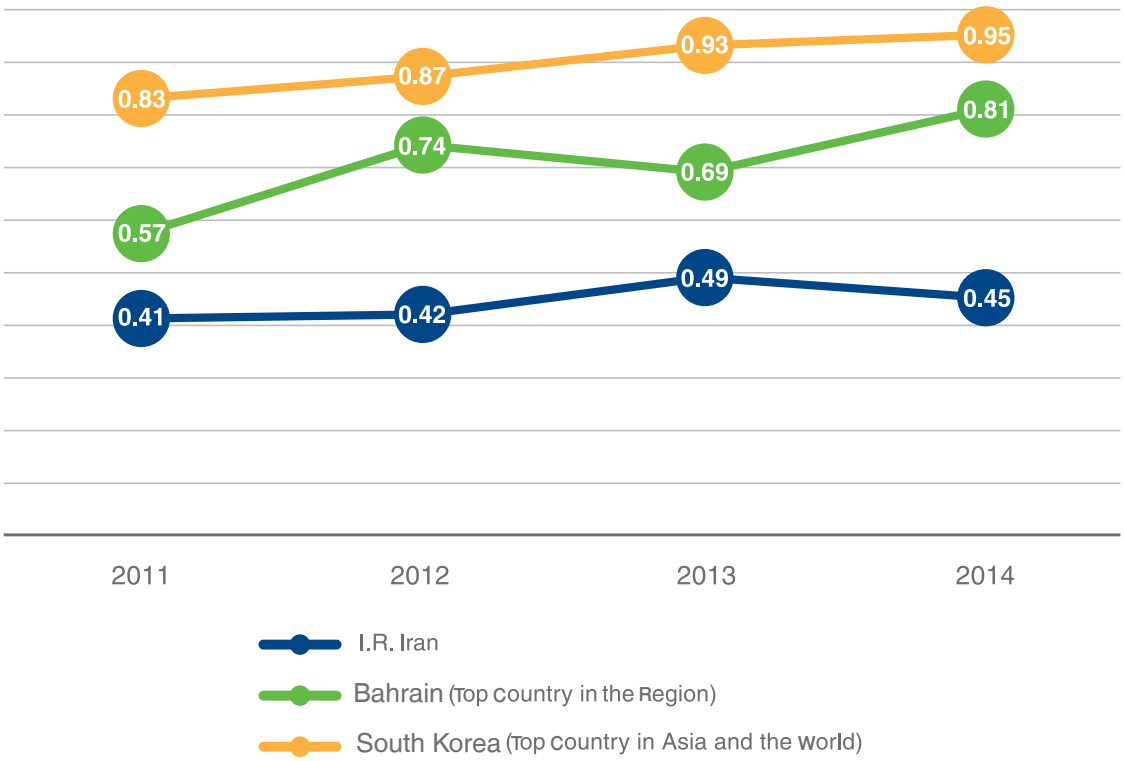


Figure 2: *E-Government Index; Comparison of Iran's Growth Trends and the Top Countries in 2011-2014*

B. Human Resources

According to student statistics in 2014-2015, about 17 percent of students, namely 740,000 students (except for students in universities affiliated to Ministry of Health and Medical Education), are studying ICT related fields.

The number and proportion of students in different levels of ICT are presented in Table 4 and Figure 3.

Table 4

The Number of ICT Students in the Academic Year 2014-2015

Level	Number
A.S.	203.291
B.S.	488.454
M.S.	46.199
Ph.D.	3144
Total	741.088

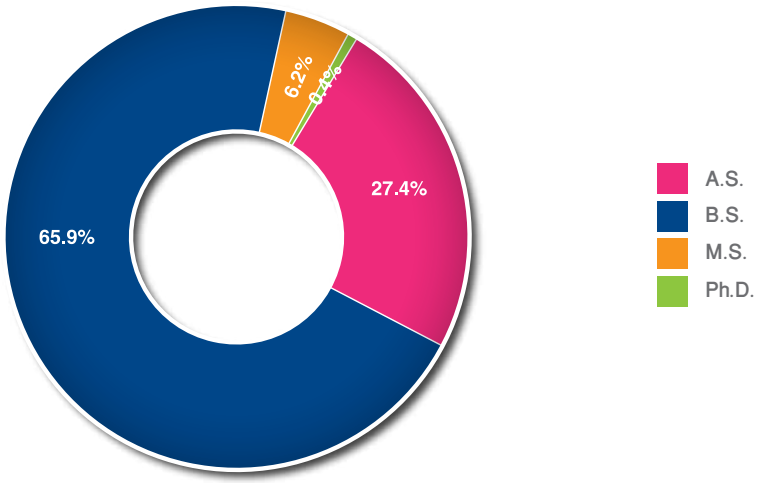


Figure 3: *Proportions of ICT Students in the Academic Year 2014-2015*

In 2015, the number of ICT graduates was about 1,870,000 out of a total of 6,900,000 graduates looking for job (Figure 4).

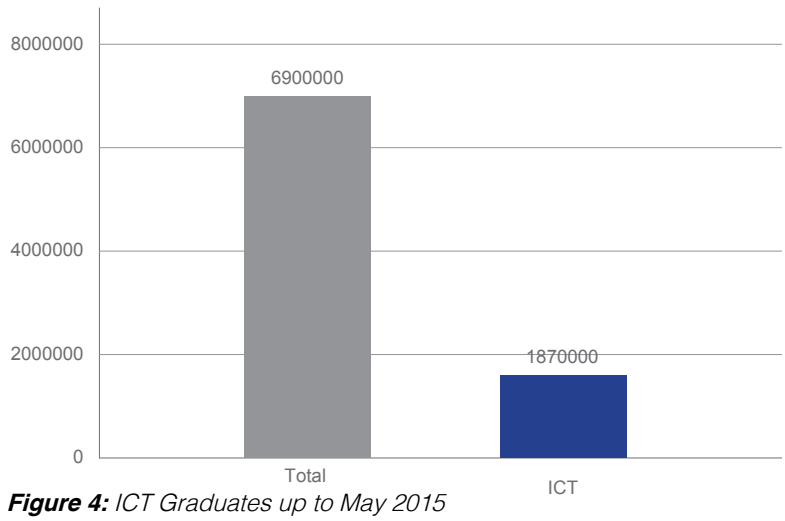


Figure 4: *ICT Graduates up to May 2015*

In 2014, 20% of ICT workforces were working in the public sector and 80% in the private sector which totally amounted to about 117,000.

Table 5

Total Number of Human Resources Working in ICT by the End of 2014

Sector	Number
Public Sector	23591
CT Private Sector	45550
IT Private Sector	48000
Total	117,141

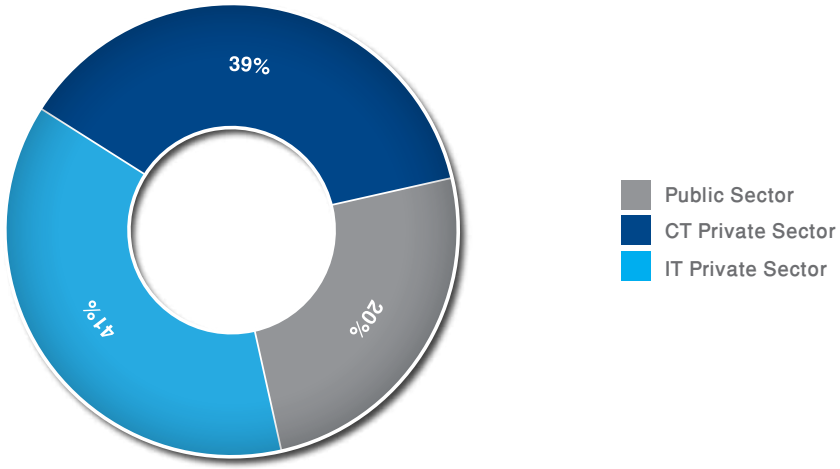


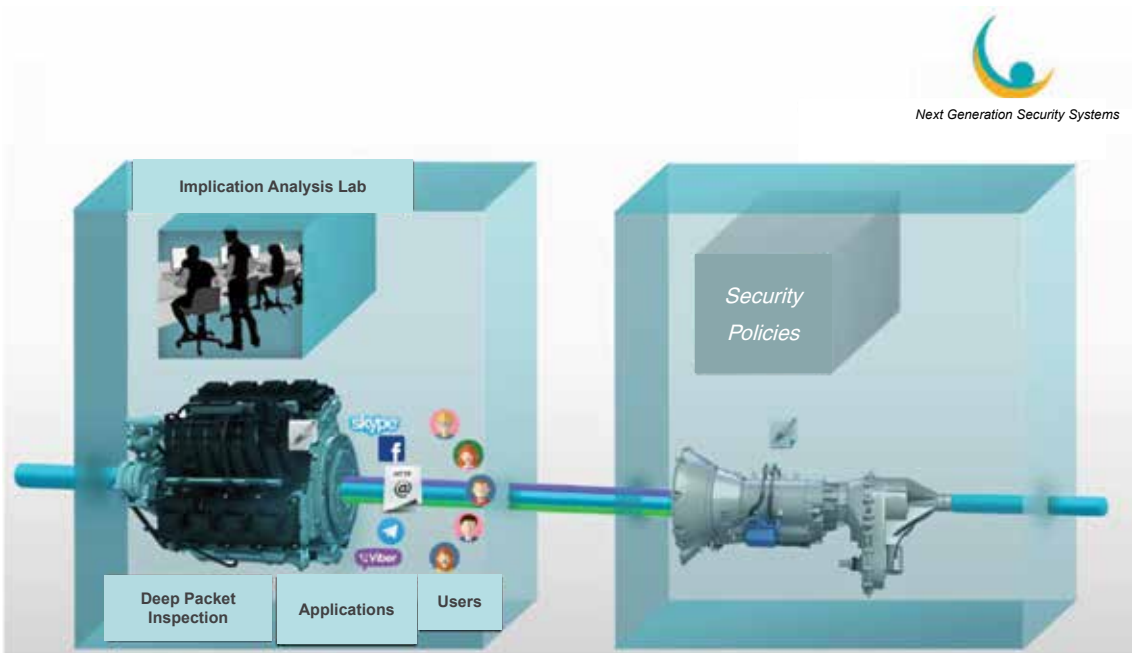
Figure 5: *Proportion of Human Resources Working in ICT Sector by the End of 2014*

C. Some Achievements

• Next Generation Security Systems Technology-SANA

This plan aims to develop the infrastructures required to produce next generation security products such as firewalls. Precision-inspection packages and processing with high quality are necessary in such technologies. SANA provides these capabilities in the form of a complete set of hardware and software products. This plan includes the following themes:

- SANA-PA: Next generation security systems for filtering (NG Filtering)
- SANA-TN: Next generation security systems for intrusion detection (NG IDPS)
- SANA-HEFAZ: Next generation security systems for firewall (NG FW)

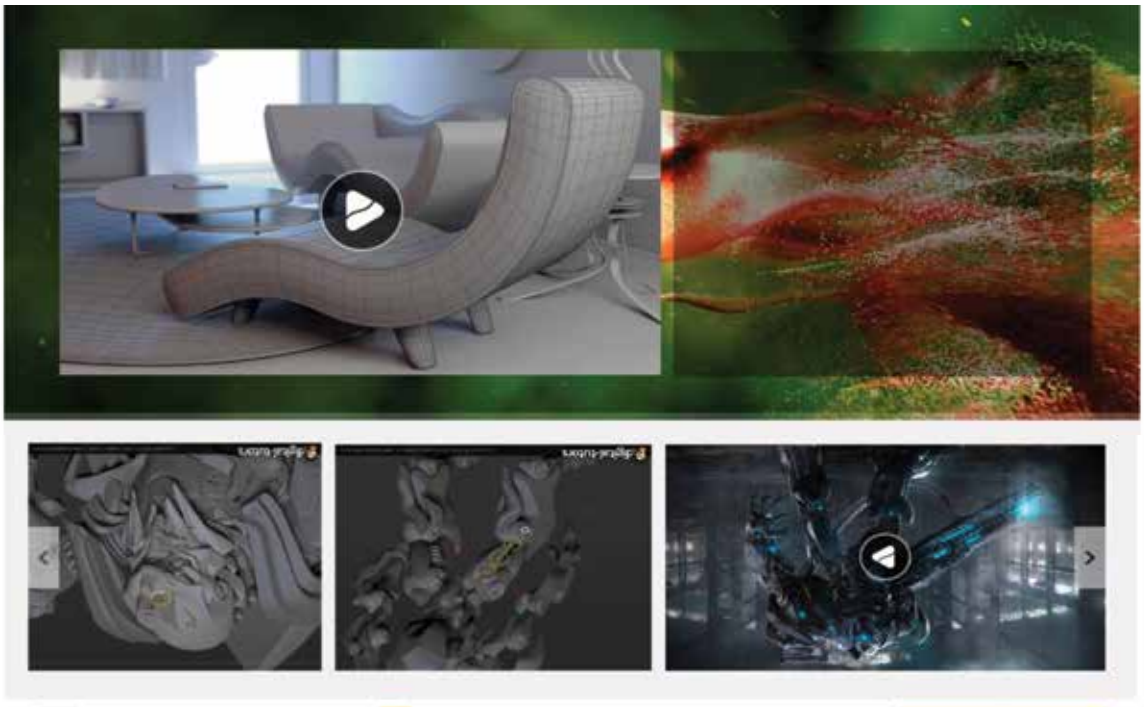


Schematic Design of Next Generation Security Systems

• The Package for Promoting National Computer Games Industry

This package includes several projects to promote and develop national computer games industry focusing on the following topics:

- Digital distribution network of games;
- Cloud gaming;
- Quality control lab and computer games testing;
- Specialized virtual training for game development;
- Developing three games by a large company through supporting 9 startups;
- Developing 8 small casual and mobile games in cities of Tehran, Saqez, and Kashan;
- Developing a big mythology-based game for PCs and mobile phones.



Some Examples of Computer Games Software in Production Stage

• Supporting Big-Data Plans

Analysis of rapidly growing and diverse data involves employing new tools and methods. Organizations should benefit from experts, appropriate infrastructures and the required tools for data storage, extraction, processing and analysis, so that they could elicit appropriate information from these data.

These plans include the following parts:

- Training data science experts who are familiar with businesses and concepts of big data. These experts help to analyze and implement big data systems;
- Preparing hardware infrastructures including data centers, storage equipment, servers and communication networks;
- Identifying software infrastructures to implement the functional big data software;
- Producing the functional software given the wide range of applications in this area.

• Manufacturing and Calibration of DNA Microarray Systems

Application of microarray in breast cancer diagnosis and treatment is a simple example of microarray's capabilities widely used in the country. Currently, a large number of genes and their control agents for breast cancer have been detected. Given the fact that diagnosis and drug prescription for this disease involves accurate detection of all gene expression patterns, detection of these genes helps to design the markers showing a direct relation with breast cancer and put the associated oligonucleotides on the microarray. This way, patients who do not need chemotherapy can be identified in an attempt to reduce their treatment costs and avoid chemotherapy risks. DNA microarray system may help to:

- Diagnose the disease before its acute phase and help its treatment or control;
- Classify patients with special cancers and help to determine the appropriate drugs and treatments;
- Perform genetic testing on newborns and treat inhibited disorders;
- Identify bacteria and viruses in animals and food contamination;
- Find genetic map of biological species including humans;
- Design new drugs and treatment methods consistent with genetic conditions in the country.

• Securing Electronic Transactions Using Modern Cryptographic Protocols

Today, given rapid expansion of computer networks and internet, people wish to do their daily activities electronically and remotely via the internet in order to speed up their daily routine and save time. The emergence of concepts such as e-commerce, e-business and e-government as well as the rapid expansion of their applications shows their increasing importance in routine life. Any transaction involves providing information security, correct performance, and privacy.
The main point to ensure security of electronic processes is that it is not possible to cover all security metrics by using traditional encryption tools (such as encoding information, digital signature and etc.). To do so, new encryption protocols should be used which ordinary protocols (such as SSL, IPSec, PGP, etc.) lack them.
This plan provides the conditions for production of secure systems of electronic voting, electronic bidding system, exchanging, and digital money in the country. The above-mentioned applications lead to increasing interest in these initiatives, their prosperity and dynamism, and as a result their economic benefits.

• Implementing Internet of Things

Internet of things includes connecting embedded processors through the existing internet platform. This technology offers advanced connection of devices, systems, and services beyond machine to machine connection and covers a wide range of protocols, domains, and applications. It has the capacity of sending data for everything including objects via communication networks such as internet and intranet, and consequently collects a plenty of information considering their status. Such data can serve as a basis to analyze condition of things and how their performance is related. Also, they can help to provide tailored services and information for things. Moreover, home automation appliances such as light switches, HVAC, and security systems are among important applications of internet of things.

• Techno-Medicine

Design and fabrication of microfluidic chips based on micro-machining to detect circulating tumor cells (CTCs) was made possible through employing silicon nanostructures. With development of cancer cells in a tumor inside the body, these cells can be isolated from the tumor and enter the bloodstream. When they reach a suitable place to grow and accumulate, they form a secondary

tumor in another location. These cells, which are the main factor in the spread and proliferation of tumors, are called circulating tumor cells and the process of tumor proliferation is called metastasis. Most deaths from cancer have been attributed to this process.
Through implementing this system, the circulating cancer cells can be detected in the blood. For this purpose, by simultaneous use of two properties including different size of CTCs and blood cells as well as electrical impedance difference of CTCs with blood cells, one can detect CTCs from white blood cells. This would be possible using a new microfluidic system on silicon chips equipped with an active electrical structure. This device makes prevention and early detection of CTCs possible. Being user-friendly is the characteristic feature of this sensor.

• Comprehensive Package of Persian Script and Language in Computer Environment

This initiative tries to provide the conditions for investment and participation of the private sector and support for research and development (R&D) focusing on increasing quality of the current products and developing market for Persian script and language-based products and services.
This package includes several initiatives for studying, promoting and developing software and hardware programs related to Persian script and language in the following parts:

- Developing and improving infrastructures and databases;
- Supporting initiatives in three fields of text, sound, and image;
- Increasing quality and reducing errors in the current software programs;
- Encouraging correct use of Persian language in computer and mobile environment;
- Developing training software for Persian script and language;
- Developing software for disabled people (deaf people, blinds, etc.);
- Developing programs to find similarities and fraud detection.

• Design and Construction of 3D Millimeter Wave Imaging System

Millimeter wave imaging technology is one of the newest technologies for full-body screening in security restricted areas to detect prohibited articles carried by individuals. Now, it has several applications including medical systems. This device is designed for optimal performance across frequency range of 30-40 GHz.

• National Grid Initiative

Today, scientists are faced with complex issues whose solution requires high processing power.

For example, forecasting weather or earthquake, finding cancer drugs, modeling complex economic issues or recognizing elementary particles. On the one hand, today's computers lack the capability of solving these issues. So, scientists try to provoke a new and ideal technology called grid. Developing a new service to share grid computing capacity of a network of computers connected via internet results in a huge computational grid that people can use as easy as urban electric power grids.

IV. Authorities

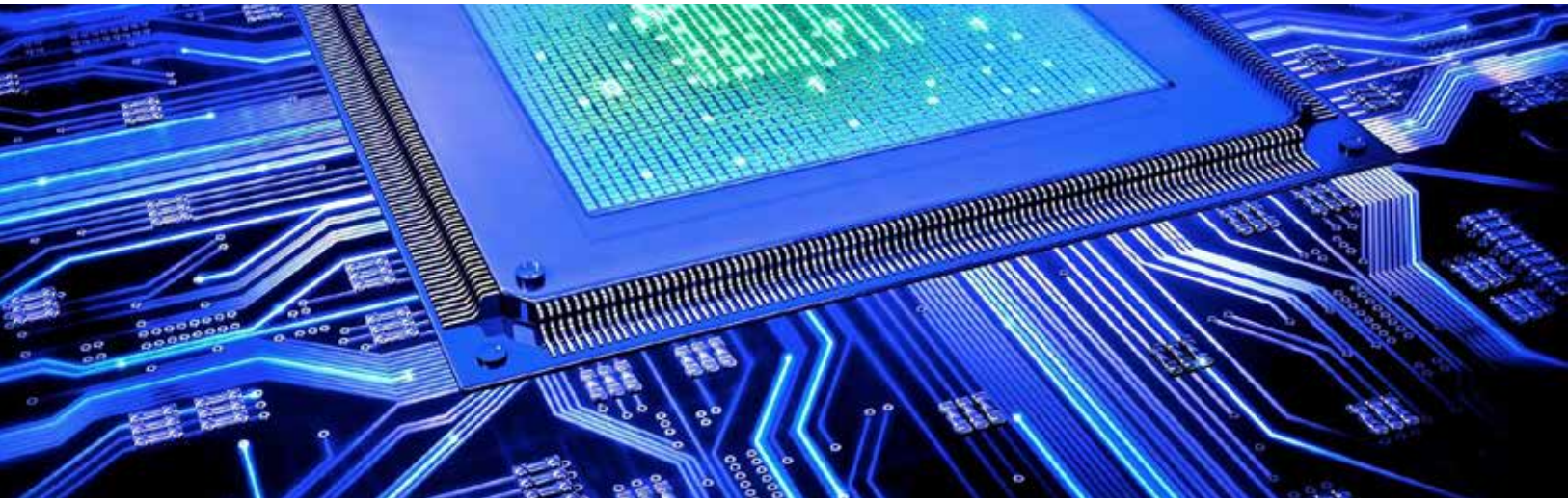
A. Council for Information and Communication Technologies and Microelectronics

The Council for Information and Communication Technologies and Microelectronics has been formed to develop policies, set priorities, coordinate different trustee systems, support knowledge-based companies and commercialization of research results, and develop technological activities in line with the targets stipulated in the 20-year vision. Supporting development of science and technology, empowering knowledge-based businesses, and specializing policymaking system in the related areas are among the high priority measures that the council put on its agenda in order to realize ICT objectives. In this line, the council set its technology priorities in five categories as follows:

IT Priorities: IT priorities include cloud computing, mobile computing, social networks, big data processing, technical infrastructures of software development, location-based systems and geographic information systems (LBS /GIS), e-commerce, etc.

Priorities of Information Exchange Security: Such priorities include modern identification tools (such as OTP & Biometric), hardware security module (HSM), hardware encryption accelerators, penetration testing tools, local product and infrastructures of IDS/IPS, tools for protecting against pornography, fraud detection tools, tools for mobile devices protection and security, and specialized services for modern computing environments: VM, cloud, pervasive computing, grid, web service, etc.

Electronic Content Priorities: Services (content and infrastructure), learning management systems and content management systems (LMS & CMS), big data analysis, applications for mobile devices, computer games, training simulators/virtual labs, data bank, Persian script writing software, content aggregation and distribution, etc.



Telecommunication Priorities: Telecommunication priorities include IP-based secure millimeter radio wave, smart antennas, NFV-based IMS, implementation of the NFV-based EPC, Internet of things, fifth-generation networks, and fifth-generation services such as context aware services, etc.

Microelectronics Priorities: Microelectronic priorities include sensor, MEMS devices integrated circuits (IC), solar cells, automotive electronics, etc.

In addition to the above priorities and in cooperation with experts in other economic and technological areas where ICT may play an important role, the most important products and services in the prioritized areas in the country are studied.

B. Other Authorities

Authorities, associations, and institutions involved in this area are presented in table 6 below.

Table 6

ICT Authorities, Associations, and Institutions

Agency	Establishment Date	Current Activities
Supreme Council of Cyberspace	2011	Running public education and building culture to increase internet literacy and knowledge on the potential risks associated with cyberspace; Prioritizing content over infrastructures and internet services and forms, persisting high investment in content creation according to Islamic culture and the Islamic revolution discourse; Organizing international information exchange; Providing the required platform for maximizing security of the country's cyberspace for all communities of people, cyberspace players, and the regime; Creating high preparedness to protect critical infrastructures against any potential cyber-attacks; and Maximizing use of cyberspace to develop extensive and purposeful cooperation with other nations especially Muslim countries in an attempt to promote and realize the discourse of Islamic revolution.

Agency	Establishment Date	Current Activities
Iranian Telecommunication Industry Syndicate	1998	The Iranian Telecommunication Industry Syndicate has been formed with the aim of consolidating manufacturers of telecommunications equipment; creating balanced and competitive conditions in order to increase the effectiveness of investments; organizing activities of the members; improving production quality; creating a data bank in the related fields; providing advisory and legal services; preventing unhealthy competition; cooperating with the relevant organizations; developing standards and By-laws; promoting technical knowledge; and updating the related laws and regulations.
Iranian ICT Guide Organization	2005	In accordance with Article 12 of the Law on Protection of the Rights of the Creators of Computer Software and to practically support the rights asserted by that law, the Iranian ICT Guide Organization began its activities since July 2005 in order to regulate the private sector and public sector relations and also effectively participate in organizing computer business activities by virtue of the above law (passed by the Islamic Consultative Assembly in December 24, 2000) and the By-law ratified by the Council of Ministers (July 14, 2004).
Informatics Society of Iran	1983	Publishing monthly scientific Magazine of PC Report; holding monthly scientific seminars and webinars; holding training workshops; and holding monthly lecture sessions and scientific meetings for members by 7 specialized groups of the society including «network and hardware», «leadership and management of IT services», «Internet and cloud computing», «basic software», «advanced software», «databases and big data», and «analysis, design, and architecture».
Iranian Security Community	2001	Holding annual scientific-research conferences, monthly scientific-research seminars, and workshops on code and information security as case study; and holding scientific- research competitions in the field of code and information security, biannual Journal Monadi for cyberspace security (AFTA), ISeCure, and the ISC International Journal of Information Security.
Association for Information and Communication Technologies	2004	Developing culture of utilizing the capabilities of ICT; collaborating with executive scientific/research institutions in ICT area; holding scientific conferences and specialized workshops (including IKT conference); publishing scientific-research quarterly Journal of ICT; and publishing books on ICT (6 books have already been published).
Computer Society of Iran	1994	Holding the annual national conference of Computer Society of Iran; holding the annual international conference of Computer Society of Iran; publishing the scientific-research Journal of Sciences and Computer Engineering; and forming technical and vocational committees, and education and research committee.
Iranian Association of Electrical and Electronics Engineers	1998	So far, this Association has published numerous publications, of which the Scientific-Research Journal of Electricity is the most important one. To honor the scientists, servants, and advocates of science and industry of electrical engineering in Iran, a group of prominent figures are selected and introduced to the Association every year. At present, Iranian Association of Electrical and Electronics Engineers has scientific cooperation with IEEE-USA, the French institute of CIGRE, and many universities and scientific centers in the country.

C. Companies

According to the exhaustive directory of the Iranian ICT companies (http://ictkey.ir), 2700 companies are registered in this system. These companies are classified as follows:

Table 7

Statistics of the Companies Involved in Various Sectors of ICT (2015)

Sector	Number	Field of Activity	Number
IT	2155	Software Hardware Network Internet	766 679 607 101
CT	68	Mobile Phone Fixed Phone Infrastructure Network Radio and Satellite Communications	14 14 27 13
Information Society	277	E-government E-learning E-commerce	75 103 98
Suppliers and Contractors	52	Telecommunications Contractors EPC Contractors ICT Equipment Manufacturers	26 9 17
Consulting, research and development	176	CT Security IT CEICT Standards	38 19 104 9 6
Business Services	17	Import and Export of Telecommunications Equipment Public Services	6 11

D. Universities

Almost all universities of the country admit students at different levels of ICT. A number of accredited universities have made more contribution to ICT knowledge production and the related technological projects. According to statistics provided by the University News Reference (http://unr.ir), the number of academic and higher education institutes is as follows:

Table 8

Statistics of Academic Units in 2013

Academic Institutes	Number
Universities and institutes affiliated to the Ministry of Science, Research, and Technology	318
Technical and vocational universities affiliated to the Ministry of Education	107
Universities and higher education institutes affiliated to executive organizations	28
Payam-e-Noor University (PNU)	569
University of Applied Sciences and Technology (UAST)	740
Non-governmental and non-profit higher education institutes and universities	344
Islamic Azad University	408
Total	2514