TECHNOLOGICAL AND SCIENTIFIC DEVELOPMENTS IN THE FIELD OF COMMUNICATIONS AND MILITARY I.T. AND THEIR INFLUENCE ON PLANNING AND PERFORMING MILITARY ACTIONS

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Introduction

Technological and scientific developments in the field of research, design, achievement and implementation of new military communication and IT systems and equipment, especially after 1970, cause major changes in all times of military activities, during peace, crisis situations and war.

In fact, this course is proper to all organized human activity: science, culture, production of goods and services, transportation, communications, media, banking and financial systems, leisure etc.

From the several hundred Internet network users, especially government institutions, universities and research-development institutes, in December 2009[1] a total of 1.802 billion users was reached, representing a penetration rate of 26.6% of the world population (53% in Europe, Romania is holding the 11th place in the top of European countries, with 7.787 million users and a penetration rate of 35.5% - 12th place by this criterion). The explosive growth of such global information systems and of those specialized in certain key areas has brought about and will continue to bring important gains in organization and efficiency, together with significant risks and vulnerabilities (the latter began to be taken into consideration and studied more attentively in various political, military, administrative and academic forums after 1996).

In the period that makes the object of this analysis (1970 - 2010) we find out that in scientific research and in the development of new, often

[1] http://www.internetworldstats.com/stats.htm

revolutionary, technologies for various civil and military purposes, military and civil research have gone hand in hand and have stimulated each other, often leading to the implementation of similar systems and equipment, or in any case to performing with more physical strength in difficult environments for the defense sector.

In what follows we will present developments regarding the military and its related fields in some developed countries, with comparative reference to Romania, in some important aspects.

Technological and Scientific Developments in the Field of Military Communication and IT

Coming back to the military field, in the area of technical systems for command and control forces for use in nearly real time, the optic-electronic sensor system, in order to make weapon systems in outer space based on platform, sea and land, we cannot but observe that the most significant progress has been determined by several factors, such as:

- **Technological developments in the production of communications equipment and information technology** (hardware and software). Note the rapid and substantial developments in expanding radio bands, the types of modulation and coding used, with direct effects on the growth and protection of the information flow from operations of electronic warfare, microwave and communication technology expansion by military and commercial satellites, miniaturization of equipment, while decreasing energy consumption and increasing the protection of information war actions in the broadest possible meaning of the word etc.

- **The stunning increase of computer performance in the last 30-40 years,** based on extensive interdisciplinary research on physical, electrical, electronic and logic phenomena in the construction and operation of these intelligent machines. An important role was played by research and the continuous improvement of the CPU (microprocessor), vital elements present in all computer systems, sensor systems, smart weapons and entities for complex activities called today "information war".

- The history of these microprocessors[2] is fascinating and worth being studied by those concerned, for these small items have changed and continue to change the physiognomy of military conflicts, from the human aspects to the military and technical ones at the highest level (superpowers, regional powers' alliances) and down to the fighter, regardless of where he is forced to act (a text summary is given in Appendix. 1);

[2] http://en.wikipedia.org/wiki/central_processing_unit

•**Conceptual, technological and operational joining** of digital communications equipment and networks, computer equipment and software applications. It is a process that modern leading armies began in the 80s, continued in the 90s, and was reinforced as clearly as possible in the 2000. This has led to highly integrated systems and subsystems such as C4I (+ variants), for all hierarchical levels of categories and types of forces and weapons, and advanced weapon systems (what remains to be scrutinized in Romania in general and the Romanian Armed Forces in particular is the reason why this joining is denied or whether one is working "hard" to prevent it from happening.)

•**High pressure** on the military command and control structures to shorten the cycle favours the fair and expeditious conduct of a multi-criterion analysis of a huge volume of data and information necessary for planning and carrying out operations (battles). This single aspect requires a systematic and thorough approach, especially in the command and control structures of the Romanian Armed Forces, where the time necessary for decision-making and sending decisions to the performers is 8-10 times longer than in the U.S. military (the main cause being the lack of integrated C4ISR systems and insufficient training of soldiers of all ranks);

•**Improvement of the optic-electronic sensors** and issue of new types of high performance on different platforms - land, air, naval and cosmic. It is expected that progress in this area, especially after 2000 (mainly through the efforts of large U.S. companies, supported by the U.S. Government and the Pentagon) is crucial in modern military confrontations, where a competitor can see 2-3 times farther away and with an accuracy of inches better than another. We are talking about different types of radars, infrared sensors, acoustic sensors, environmental sensors (temperature, wind, precipitation, storms, hurricanes, radiation etc.). Spectacular new development is expected over the next 5-10 years in this sensitive area, aspects that will be making a difference substantial enough to be taken into account in assessing the real military power of a State;

•**The emergence and development of digital maps** has meant and means a giant step forward in the planning of all military actions, the correct view of all physical and geographical aspects of the field in providing vital support for the troops, especially when merged with digital topographic support technology, GPS software and sophisticated command and control, as well as the intended use of various weapons systems. Basically the land, the geographic area of warfare, becomes friendlier and more accessible to whoever possesses the technology. Finally, it is about saving the lives of thousands, perhaps tens of thousands of fighters and, why not, about obtaining the victory if all we talk about is war (which places Romania and its armed forces in an area hard to define). However, in the

next five years some progress should be made, otherwise we will be back to traditional maps, with pens and the famous canopy. Before we plan an operation, we will find out that the war has ended);

•**Development of new concepts of warfare** such as "network-based war", "network and information infrastructure in the network-based war," military aspects of the asymmetric conflict, "the fight against terrorism," cyber war " etc, require a greater effort of thought and analysis from politicians, military leaders and political-military analysts (those who deserve that name) to determine the" way", a way of reasoned action, in accordance with the specifics of each geographical area - political-military, economic - without copying the U.S. and its armed forces model entirely and uncritically. A country like Romania cannot have the absurd pretention to set up committees, agencies, forces, headquarters and other structures with the same name and functions as the U.S. ally. For once, there are no resources and even if there were, Romania is not prepared to commit any euro; on the other hand, the state, statehood and military power no longer have an interest in the Romanian present-day political "leaders"' short and medium term. Maybe in the future. As a direct and natural consequence of progress (briefly mentioned above) but also as a necessity in the exercise of leadership and control, all the NATO armies (and beyond), since the late 70s, have started a consistent and strongly supported financial process of modernizing communications and IT systems (CIS), and later, since the early 80s, complex integrated systems such as C3i (C4I, C4ISR variants).

•Political and military leaders of the major Western countries have understood that these developments can be an important differentiating factor in the assessment and possible expression of military power trying to deter potential aggressors and in promoting political, economic and military states. Last but not least, they gave an important boost to the military-industrial complex and to the expansion of powerful high-tech companies in the field, an action accompanied by employment benefits and individual and collective profits.

Thus, having the benefit of the technological and scientific achievements of the time, in the '70s significant progress was made in the field of CIS:

•Development of permanent military communications (local), originally analog and mixed analog-digital, and finally (in the '80s) digital (particularly in the U.S., France, Germany, Italy and Britain);

•Increased data transport capacity, by global networks (the Internet), specialized in the military field;

•Research, development and implementation of CIS systems, high technology, with a high degree of integration and complexity, automated, for all

hierarchical levels, types of forces and weapons. We illustrate the system: MSE - U.S. AUTOKO - Germany SOTRIN - Italy, RITA – France. The explosive growth of the role of military radio communications based on HF, VHF and UHF, of land, air and naval forces' performant systems and equipment, as well as of radio communications, voice, data and video through military and commercial satellites;

Since the '80s (particularly after 1985) and the 90s there have been important qualitative and quantitative developments in the CIS (C4I + variants); the pace accelerated as the U.S. administration and the Pentagon required:

- Develop and implement all kinds of forces, weapons and echelons of highly integrated systems such C3i (C4I + variants). Technologic and decision promoters: U.S., Britain, Italy, France, Germany;
- The emergence, development and use of digital map troops, which has allowed and allows a higher precision of movement and an increasing integration of forces of various optic-electronic sensors with CIS systems and impact vectors;
- Research, development and implementation of optic-electronic sensor classes to be integrated into weapon systems, leading to greater accuracy and (hitting) reaction in nearly real time;
- Applying lessons learned from the conflicts that took place in the world (particularly the U.S. Army);
- Developing new concepts and advanced technology solutions in C4ISR (+ variants) in the U.S. and NATO, based on a close collaboration between industry and the military (in Romania, this aspect is entirely absent; moreover, all cooperation is discouraged from the beginning by typically "Dâmbovița" suspicions).

After 1999 and until now (2010) (same traditional promoters)

- **Development of integration**, miniaturization and resistance to heavy C4ISR systems and equipment (+ variants);
- **Appearance, theoretical foundations** and practical experimentation of new concepts in NATO Network, in what means now "ENABLED NATO Capabilities (NNEC)
- The launching and theoretical consolidation and experimentation in the theater of operations and applications of the concept "network-based War" (U.S. Army since 1999);
- Increased NATO and U.S. efforts to improve the level of the NATO European armies in the field of C4I (+ variants). However, some of them cannot perform improvements, while others cannot or will not (it is the typical case of Romania);
- Developing the concept of "network of networks", "system of systems" or "federation of systems", meaning a higher degree of compatibility

(interoperability) between different systems within the same country and between systems and allied forces under a single shared command;

- Increase commercial VoIP network model (Internet), including field tactical radio support performance;
- Improve physical and electronic means of protection of voice and data communications;
- More widespread use of GPS both in the C4ISR planning systems as well as in the operations planning (fighting) and the various smart weapon systems.

Some influences of the new scientific and technological development of systems and data communication equipment on planning and carrying out military actions

Military experts and analysts[3] are unanimous in determining that the unprecedented development of techniques and technologies, the emergence of new products and services with increasingly higher performances - I am referring in particular to information technology, special technology, digital communication systems, software applications dedicated to planning and carrying out operations (battle) as well as those deployed in weapon systems - have a major impact on all categories of forces, weapons, weapon systems, hence the expected results of actions in crisis situations or war.

It is understandable that, in the reserved space, we will not be able to identify and present all possible influences (they are very numerous and evolving). I will try to draw the attention of the few interested to those which seem more important and more visible today.

- **Thus, in the military and civil human resources field, one can identify:**
  - **New and tough requirements** in professional and psychological training, as well as in the development of the moral qualities necessary in order to cope with systems that are increasingly complex and more difficult to manage;
  - **Necessity to understand,** from general to soldier, the new "tools" of the IT era in all their technical and operational complexity, with a view to using them in a natural way, without gaps caused by technological stress (by all fighters, regardless their rank, position or weapon);

[3] The works of the AFCEA Jubilee Symposium, Washington DC, June 18-19, 2006, with the interventions of Admiral Edmund P. Giambastini Jr., Vice President (at the time being) of the Joint Staff and U.S. Army General (ret.) Colin L. Powell (former Secretary of State).

- **A fair assessment** of the limits of C4ISR systems (+ variants) under a tough information war carried out by using all modern means. For this purpose, if needed, the military must remain able to act without these means, which may collapse (this was already understood even by the most hi-tech armies, like the U.S.);
- **Testing, applications and exercises** in conditions as close to the reality of the modern battlefield: how to relate to fighters with advanced weapon systems, computer-assisted or integrated in such complex technical and operational C4ISR; **Specific training; taking the necessary measures** to protect fighters from psychological war actions used by the enemy in time of peace, crisis and war;

- **In exercising command and control from a strategic level and to the soldier:**
  - **Increasing opportunities for commanders**, staffs and fighters to know the enemy and its intentions in real time (nearly real) through the use of the facilities of C4ISR systems (where they exist);
  - **Rapid, multi-criterion analysis of complex situations**, using computers and specific software programs, thereby shortening the necessary time for all command and staff activities (management cycle);
  - **Detailed data and storage of information** about all aspects of an operation (battle); timing their implementation; learning, by analysis, lessons for the future;
  - **Automatic** replication and storage of data and information from the point of basic control (master) to other control points 1-2 control points of their own, in some command and control points of subordinate echelons and in the command and control points of the upper echelon;
  - Appointment of senior commanders according to criteria as tough as possible in point of professionalism, moral and psychological training, resistance to stress, bearing in mind that they exercise management of human and complex technical systems with wide deployment space (it goes without saying that appointments under political patronage are meant from the very beginning to destroy the cohesion and effectiveness of any modern military structure);
  - **The contribution of new technology** made it possible to reduce the number and size of communication and IT means, as well as of

control cells - in some cases, almost ten times. This fact has led to increased mobility and protection of all control points;

- **The ISR sensor subsystems integration in the complex C4ISR systems:**
  - It is obvious that communications and IT systems cannot be a **strong differentiator** in military action without a complex technical and operational integration of a large class of optical-electronic sensors (radar, infrared sensors, optical sensors, acoustic sensors, marking systems and laser sights, etc..) into what we understand as present-day highly integrated systems such as C4ISR (+ variants);
  - **Create, based on all information** and data collected by modern technology (including satellite) and humans, a common image of the space to conduct joint military action, making them available to those with the right knowledge, in real or nearly real time;
  - **Create technical and operational capabilities** to "see" further and faster than the enemy through the joint performance of sensors, people and computers;
  - **Take technical and organizational measures** to protect sensors against possible enemy countermeasures;
  - **Real possibility for each fighter** to become an integrated sensor himself within the system by means of communications, microcomputers and sensors that he wears in battle, regardless of the environment and his location at a certain moment.

As a conclusion to this chapter, it can be said that the new technical means (communications, computers, software, sensors) directly determine an increased efficiency and speed of command and control instruments, while bringing new internal and external risks and vulnerabilities that need to be known and counteracted.

Evolution of communication and information systems in the Romanian Armed Forces

I appreciate that the development of the Romanian Armed Forces broadcasts after the Second World War is well summarized in the chapter on communications and computing (p. 408-441) in the Encyclopedia of the Romanian Army, published in 2009, a chapter republished by C. TRS and by the Communications & IT Magazine issue 2(10), 2009.

It is, I think, necessary to bring back the focus on some important aspects and possible positive or negative effects in time (some of them extending until today):

- **From 1950 to 1968** we can speak about the lower limit transmission level of an European army, with exclusively analog technique, mostly imported from the US, usually at least 10 years behind the armed forces of the allies at that time;
- **The August 1968 events** awakened to reality the Romanian political and military decision-makers (not for long, though) who became aware of the quantitative and qualitative scarcity of structures and technical means for exercising troop leadership in those days. Emphasis was laid on the design and manufacture in the country of some types of technique and equipment with acceptable performance, tailored to the needs of troop management on the national territory.
- **In 1978, Forces Command Communications (FCC)** drafted the "Study on Transmission Weapon Development" which basically suggested measures for improving military transmissions to avoid stagnation, moral and material wearing-out of assets and to decrease responsiveness management in special situations. There was some progress, particularly in the producing technique for tactical echelons, but the enthusiasm melted in the mid-80s. Excessive saving measures imposed by the political leadership of the army have since made the encouraging efforts to improve the dynamics of transmission means and forces not lead to obvious improvements. 1989 found the broadcasting system at the level of an analog army, equipped with outdated heterogeneous technique, with many elements of technical risk in the absence of obvious forms of transit to digitalization, computerization and automation.
- **Since 1990,** a new process of modernizing military broadcasting in all its aspects has been started (human resources, organizational structures, systems and technical equipment), a process that has proved to have long and difficult turns, often conducted under conditions of hostility, especially on behalf of those who have a legal obligation to allocate a minimum of financial resources:
  - By early February a 1993, the Transmission, Computer and Electronics Command (TCEC) completed the final form of the **"Concept of organization and achievement of the Romanian Armed Forces Communications System - STAR";**
  - The above mentioned concept has been reviewed and approved by the CSAT meeting on 06/09/1993;
- **It is necessary to mention** that the basis for a uniform design approved by Decision no. 0031/09.06.1993 relied on:

- The experience gained by the Romanian army over the years in the design, implementation and use of military transmission systems;
- Experience and advanced technologies in some NATO armies (U.S., Britain, France, Italy, Germany, and Belgium), which helped our army with publications, books, studies, surveys, direct meetings, etc.
- The designed structure of our armed forces for the years 2005 - 2010;
- The organization of a hierarchical leadership throughout the Army in peacetime, crisis and war;
- Ensuring safe and accurate technical information relations based on rules set in agreement with other state institutions with responsibilities in security, public order or national defense, using the existing resources and those that will be gradually implemented (the concept of "network of networks" based on organizational and technical solutions for interoperability);

•**Since 1994** the conceptual and technical foundation of the STAR Project (RTP and program HF and VHF radio station frequency hopping) has been founded, based on building knowledge, experience and access to information technologies and modern Western armies from lessons learned during the participation of Romanian experts in the range of applications "Combined Endeavor" and activities organized by NATO Headquarters (after January 1995) and some armed alliances (U.S., UK, Germany, Italy, Belgium, etc). Special emphasis was laid on the effort to fulfill the goals of interoperability in communications and computer set with NATO to prepare for accession (1995-2002). The implementation of these goals depended on clear and unambiguous requirements, inviting our country in October 2002 to join the alliance, with rights and obligations;

• **Without going into too much detail**[4] it can be said that until now (2010) important steps have been made in strengthening modern communications and information systems, without reaching yet the level of highly integrated systems such as C4ISR (+ variants), particularly due to the lack of financial resources, as follows:

- **Permanent Communications Network** (RCT), now having 253 different development centers, located throughout the country;
- **Communication Network Support Company (CNSC);**

[4] Communications & IT Journal 2nd issue (10)/2009, page 30-36.

- **Radio Integrated Services Network** (R.I. S.N.);
- **Encrypted Video Conference System (E.V.C)**
- **Satellite Communications System (S.C.S)**
- **System Communications and pursued IT (SCPIT);**
- **Tetra - Dimetra Mobile Communication Systems;**
- **Development of the first INTRAMAN data network** in order to implement, step by step (depending on resources), the Integrated Information System of the Ministry of Defense (SIIMAN)

• **Note** the important role of positive developments in military communication and information systems for achieving and commissioning the first type of C4I systems for the Air and Naval Forces:

- **NACCS - "The National Air Command and Control System";**
- **IROSBS - "Integrated Research and Observation System in the Black Sea;**

•**There remain, unfortunately, significant failures, such as C4ISR systems** for large units and units of the Army (for Battalion echelons, Brigade and Division). These projects have been shifted as procurement plans from one year to another, since 1999. Due to budget adjustments, totally negative for the MoD, the resources for these vital systems for operating and fighting in the Army (including forces deployed in foreign theaters of operations) are the first to be canceled.

Some Conclusions

1. I would start with General (ret.) Colin L. Powell's (AFCEA, 2006, Washington DC) statements:

- Civilian and military high officials bear high political and moral responsibilities towards the fighters sent in operation theatres;
- Soldiers (in the extended sense of fighters) cannot be the object of political action and propaganda, of crocodile tears, expressed in the media, after disasters have occurred, resulting in loss of young lives;
- Endowment with arms, IT & C equipment and means of protection for the military must be a top priority of U.S. Army (NA - and any other forces);
- Modern wars and conflicts have proven, without any doubt that the importance of C4ISR systems has grown exponentially, from strategic level to soldier. This means viewing in real time the area of operations (combat), information relevant to the fighters, aspects saving more lives than the thickness of armors;

2. Developments in the field (CIS, C4ISR, etc.) are continued at a high pace in the armies of NATO and non-NATO countries (Russia, China, India, etc..), competing hard to win and maintain information superiority.

3. The rapidity of change is obvious in the field of computers and software applications in space technology development, in the miniaturization of components and equipment, which directly contributes to increased mobility and troop protection.

4. The Romanian Armed Forces moved accordingly (under conditions of severe financial limitations) between 1994 and 2006, but after that date, virtually abandoned programs and projects in the field of C4ISR modernization, which affected the main structure, that of the Army Staff, large units and their subordinated units.

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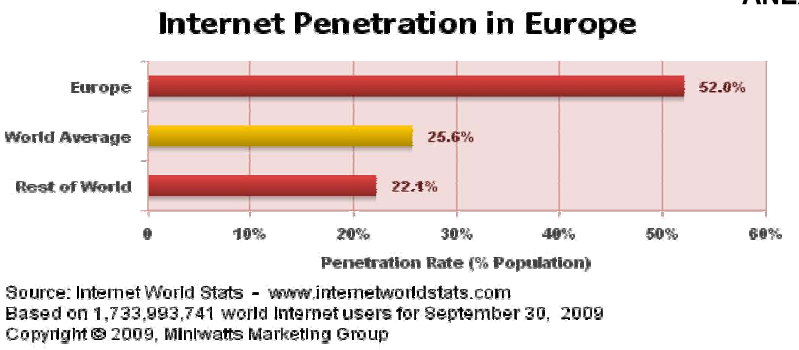
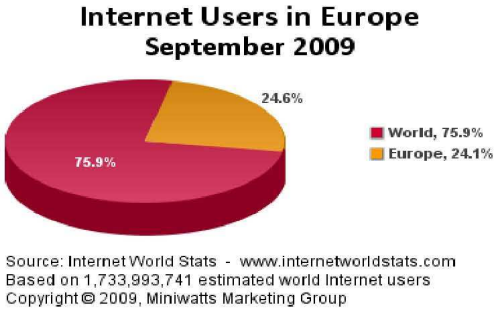
ANEXA NR. 1



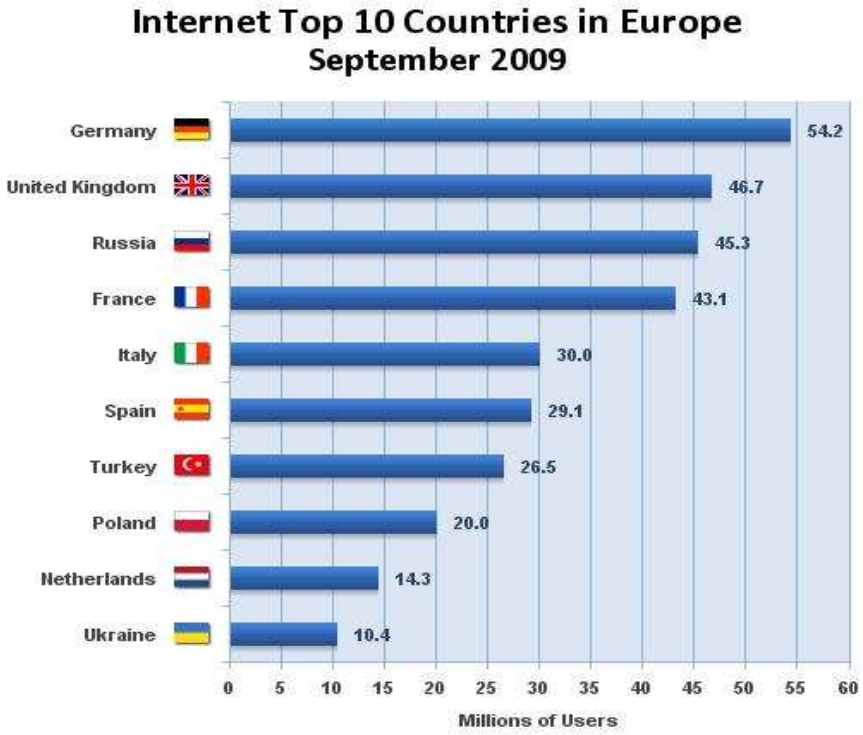


UTILIZAREA INTERNETULUI

Internet Usage in Europe

EUROPE	Population (2010 Est.)	% Pop. of World	Internet Users, Latest Data	Penetration (% Population)	User Growth (2000-2010)	Users % Table
Europe	813,319,511	11.9 %	**475,069,448**	58.4 %	352.0 %	24.2 %
Rest of World	6,032,290,449	88.1 %	**1,491,445,368**	24.7 %	482.8 %	75.8 %
TOTAL WORLD	6,845,609,960	100.0 %	**1,966,514,816**	28.7 %	444.8 %	100.0 %

NOTES: (1) European Internet Statistics were updated for June 30, 2010. (2) Population is based on data from the Census Bureau. (3) The usage numbers come from various qualified sources, mainly from data published by Nielsen Online , ITU, GfK , and other trustworthy sources. (4) Data may be cited, giving due credit and establishing an active link back to Internet World Stats . Copyright © 2010, Miniwatts Marketing Group. All rights reserved worldwide.



Source: Internet World Stats - www.internetworldstats.com
Basis: 418,029,796 estimated Internet Users in Europe for September 30, 2009
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UTILIZAREA INTERNETULUI ÎN EUROPA

Internet Usage in Europe

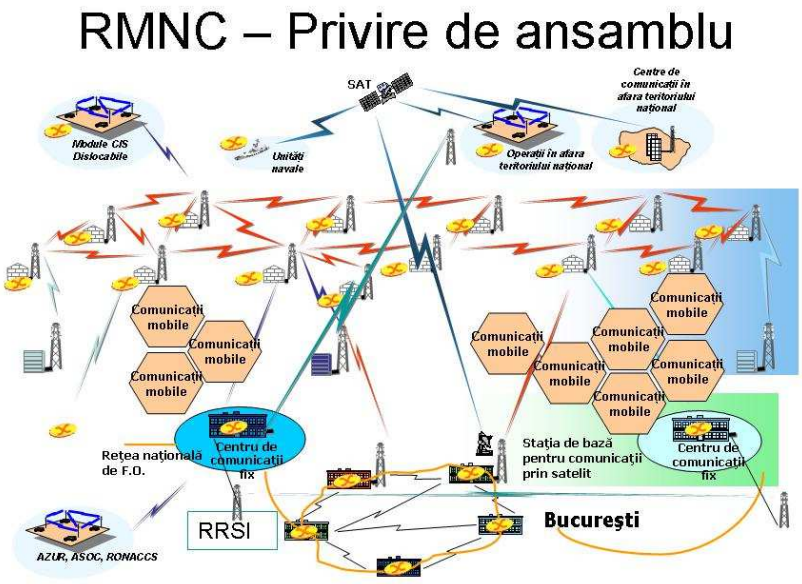
EUROPE	Population (2010 Est.)	Internet Users, Latest Data	Penetration (% Population)	User Growth (2000-2010)	% Users Europe
Albania	2,986,952	**1,300,000**	43.5 %	51,900.0 %	0.3 %
Andorra	84,525	**67,200**	79.5 %	1,244.0 %	0.0 %
Austria	8,214,160	**6,143,600**	74.8 %	192.6 %	1.3 %
Belarus	9,612,632	**4,436,800**	46.2 %	2,364.9 %	0.9 %
Belgium	10,423,493	**8,113,200**	77.8 %	305.7 %	1.7 %
Bosnia-Herzegovina	4,621,598	**1,441,000**	31.2 %	20,485.7 %	0.3 %
Bulgaria	7,148,785	**3,395,000**	47.5 %	689.5 %	0.7 %
Croatia	4,486,881	**2,244,400**	50.0 %	1,022.2 %	0.5 %
Cyprus	1,102,677	**433,800**	39.3 %	261.5 %	0.1 %
Czech Republic	10,201,707	**6,680,800**	65.5 %	568.1 %	1.4 %
Denmark	5,515,575	**4,750,500**	86.1 %	143.6 %	1.0 %
Estonia	1,291,170	**969,700**	75.1 %	164.5 %	0.2 %
Faroe Islands	49,057	**37,500**	76.4 %	1,150.0 %	0.0 %
Finland	5,255,695	**4,480,900**	85.3 %	132.5 %	0.9 %
France	64,768,389	**44,625,300**	68.9 %	425.0 %	9.4 %
Germany	82,282,988	**65,123,800**	79.1 %	171.3 %	13.7 %
Gibraltar	28,877	**20,200**	70.0 %	1,162.5 %	0.0 %
Greece	10,749,943	**4,970,700**	46.2 %	397.1 %	1.0 %
Guernsey & Alderney	64,775	**48,300**	74.6 %	141.5 %	0.0 %
Hungary	9,992,339	**6,176,400**	61.8 %	763.8 %	1.3 %
Iceland	308,910	**301,600**	97.6 %	79.5 %	0.1 %
Ireland	4,622,917	**3,042,600**	65.8 %	288.1 %	0.6 %
Italy	58,090,681	**30,026,400**	51.7 %	127.5 %	6.3 %
Jersey	93,363	**29,500**	31.6 %	268.8 %	0.0 %
Kosovo	1,815,048	**377,000**	20.8 %	0.0 %	0.1 %
Latvia	2,217,969	**1,503,400**	67.8 %	902.3 %	0.3 %
Liechtenstein	35,002	**23,000**	65.7 %	155.6 %	0.0 %
Lithuania	3,545,319	**2,103,471**	59.3 %	834.9 %	0.4 %
Luxembourg	497,538	**424,500**	85.3 %	324.5 %	0.1 %
Macedonia	2,072,086	**1,057,400**	51.0 %	3,424.7 %	0.2 %
Malta	406,771	**240,600**	59.1 %	501.5 %	0.1 %
Man, Isle of	83,859	--	--	--	0.0 %
Moldova	4,317,483	**1,295,000**	30.0 %	5,080.0 %	0.3 %
Monaco	30,586	**23,000**	75.2 %	228.6 %	0.0 %
Montenegro	666,730	**294,000**	44.1 %	0.0 %	0.1 %
Netherlands	16,783,092	**14,872,200**	88.6 %	281.3 %	3.1 %
Norway	4,676,305	**4,431,100**	94.8 %	101.4 %	0.9 %
Poland	38,463,689	**22,450,600**	58.4 %	701.8 %	4.7 %
Portugal	10,735,765	**5,168,800**	48.1 %	106.8 %	1.1 %
Romania	21,959,278	**7,786,700**	35.5 %	873.3 %	1.6 %
Russia	139,390,205	**59,700,000**	42.8 %	1,825.8 %	12.6 %
San Marino	31,477	**17,000**	54.0 %	580.0 %	0.0 %
Serbia	7,344,847	**4,107,000**	55.9 %	926.8 %	0.9 %
Slovakia	5,470,306	**4,063,600**	74.3 %	525.2 %	0.9 %
Slovenia	2,003,136	**1,298,500**	64.8 %	332.8 %	0.3 %
Spain	46,505,963	**29,093,984**	62.6 %	440.0 %	6.1 %
Svalbard & Jan Mayen	2,481	--	--	--	0.0 %
Sweden	9,074,055	**8,397,900**	92.5 %	107.5 %	1.8 %
Switzerland	7,623,438	**5,739,300**	75.3 %	168.9 %	1.2 %
Turkey	77,804,122	**35,000,000**	45.0 %	1,650.0 %	7.4 %
Ukraine	45,415,596	**15,300,000**	33.7 %	7,550.0 %	3.2 %
United Kingdom	62,348,447	**51,442,100**	82.5 %	234.0 %	10.8 %
Vatican City State	829	**93**	11.2 %	0.0 %	0.0 %
TOTAL Europe	**813,319,511**	**475,069,448**	**58.4 %**	**352.0 %**	**100.0 %**

ANEXA NR. 2

SCURTĂ ISTORIE A MICROPROCESOARELOR

- 1971 – Intel lansează INTEL 4004 – primul procesor comercial
- 1977 - Este vândut primul computer comercial – VAX-11/780
- 1978 – Intel introduce procesorul INTEL 8086 – primul din familia x86
- 1981 – Este produs Procesorul Stanford MIPS – printre primele procesoare cu arhitectura RISC
- 1982 - Intel produce procesorul INTEL 80286 – primul procesor Intel care putea sa ruleze tot software-ul scris pentru procesoarele anterioare – 8086 si 8088
- 1985 – Intel introduce procesorul INTEL 80386 – care adaugă un set de instrucțiuni pe 32 de biți procesoarelor cu arhitectura x86
- 1993 - Intel lansează procesorul PENTIUM – primul procesor cu o arhitectură x86 superscalară
- 2000 – AMD anunță extensia x86-64 pentru arhitectura x86
- 2000 – se introduce arhitectura Blackfin pentru dispozitivele analogice
- 2002 - Intel fabrică PENTIUM 4, cu tehnologia Hyper-Threading, primul procesor destinat sistemelor desktop care implementează tehnologia multithreading simultan
- 2005 – AMD fabrică ATHLON 64 X2, primul procesor x86 dual-core
- 2008 – aproape 10 miliarde de procesoare sunt fabricate în acest an
- 2008 – prezent – sunt fabricate procesoare în diverse tehnologii şi arhitecturi şi se explorează utilizarea procesoarelor optice

ANEXA NR. 3



ANEXA NR: 4

Modul de Comunicaţii şi Informatica Desfăşurabil – MCID/RMNC