The Beginning of Network Technology in COMECOM

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Frank Dittmann, Deutsches Museum Munich

1 History of the Internet

In the last few years a lot of studies on the history of Internet appeared.[1] This story is well known and therefore it is not necessary to report it here: All of you know the heroes Douglas Engelbart, J.C.R. Licklider, Tim Berners-Lee. You know the roll of ARPA, the Advanced Research Projects Agency, in financing related projects. It is well known that in 1971 when Intel presented the first microprocessor, the ARPANET consisted of 15 network nodes. Three years later, in 1974, the first Computers outside the USA (Hawaii, Norway, and U.K.) were connected at the ARPANET. Everybody knows that 1989 was an important mile stone because Tim Berners-Lee presented at the CERN (the European Council for Nuclear Research) a prototype of the World Wide Web. I could continue these facts with the foundation of the World Wide Web Consortium (W3C) at the MIT Computer Science Lab or the launching of the Netscape company, both in 1994.

However what strikes me reporting these facts is the following:

First: Although most of the prehistory of World Wide Web happened during the Cold War but in the story there is no reference on the East except that the start of Sputnik 1 in 1957 initiated the foundation of ARPA. It might be unbelievable today: This organization had been established in the US to catch up the technological gap over USSR.

Additionally it is surprisingly, that the end of Cold War, which determined international policy after Word War II of about 40 years – that the end of block confrontation had apparently no influences at the development of the Internet. Exactly in that year, when Berners-Lee invented the World Wide Web the break of iron curtain finished the Cold War period. Afterwards the East European users were integrated apparently without problems. It seems to be that the computer scientists from the East had no difficulties with hardware, operating systems and Western software at all.

This leads to the question: What was the state of data transmission and computer networking in the East? This question makes clear another deficit in the history of Internet: There are a lot of studies on the early development on computers, software

or principles, and as well on social effects. However, we have only less information about computer communications and data networks. The reason for this lack seems to be a result of the intermediate position between telecommunication and computer technology.[2]

2 Phases on Computer Communications in the West

Considering the Western development of computer communications I propose to distinguish four different periods.

The **first period** from 1950 until mid 1960s was determined by centrally controlled wide area networks designed for special military purposes, transport companies, or major banks. The leading concept was provided by SAGE system built up between about 1950 and 1963.[3] SAGE, the Semi Automatic Ground Environment, was an semi-automated control system in the US for detecting, tracking and intercepting Soviet bomber aircraft used from the late 1950s into the 1980s. Additionally, SAGE was enormously important for the development of computing. It led to huge advances in online systems and interactive computing, real-time computing, and data communications by using modems. Last but not least, SAGE was an important factor leading to IBM's domination of the computer industry in the following years. Big Blue and the Cambridge Research Laboratory developed the computers for SAGE which was a modified Whirlwind computer. In 1961 IBM suggested the concept of tele-processing aiming to feed data transported over long distances directly into the computer. For the data transition on the telephone system were used modems. This devices for amplitude modulation on one side of the transition line and demodulation on the other side were developed by the Bell Labs. The word "modem" is a coinage based on the terms "<u>mo</u>dulation" and "<u>dem</u>odulation".

The **second period** from the mid 1960s until the second half of the 1970s is characterized by introducing of time-sharing systems for connecting central computers with decentralized I/O systems or other computers. Two basic technologies were promoted for using in the early computer networks: It was pulse code modulation (PCM) – a more reliable modulation thus the amplitude modulation, and – much more important for the internet – **packet switching** technology,[4] developed between 1961 and 1967. In contrast to traditional circuit switching systems, packet switching no longer reserved an entire channel for duration on communication. The new idea was to split up messages into standardized data packets and sending them together with addresses and control data on line. Initially, this data transfer technique was developed for public long distance data communications systems, but it was soon integrated into the in company network

architecture. In the 1970s appeared some experimental computer networks. Some of that one can find on the following schema.

1969	EIN (European Informatics Network) France, Italy, Norway, Portugal, Sweden, Switzerland, U.K., Yugoslavia, and Euroatom	
1970	SITA (Societe International de Telecommunication Aeronautique)	airlines
1970	NPL (Network of National Research Laboratory, U.K.)	science
1972	CYCLADE (network of Institut de Recherche d'Informatique et d'Automatique)	science
1973	S.W.I.F.T.(Society for World Wide Interbanking Financial Telecommunications)	banking
1975	ECNET (network of European Centre for Medium-Range Weather Forecasts)	meteorology
1975	IIASA Data Communication Network (Laxenburg, Vienna, Bratislava, Budapest, Kiev, Moscow)	science
1975	GMDNET (network of GMD, Gesellschaft für Mathematik und Datenverarbeitung)	science
mid 1970s	Hahn-Meitner-Institut Computer Network	science
mid 1970s	ALOHANET (a packet broadcasting computer network at the University of Hawaii using UHF radio communication)	science
1977	EURONET	PTT, European Commission
1978	TRANSPAC	French PTT
1978	Datapac (Trans-Canadian Telephone Systems)	Canadian PPT
1979	UNINETT (network of the Norwegian universities and research institutions)	science
end 1970s	JANET (connection of British Universities)	science
1980	Datex-P (Deutsche Bundespost)	West German PTT
1980	EURONET (European Economic Committee)	commercial

During the **third period** – beginning at the end of the 1970s – Local Area Networks appeared on the market. This period also saw a wide differentiation of network architectures and a growing divergence between military packet switching systems and manufacture standards and additionally between the civil CCITT norms and the standards for "open systems" (OSI – Open System Interconnection).[5] The CCITT is the French abbreviation of the International Committee for Telephone and Telegraph Systems. That organization had been established in 1865 to compile international communications standards.

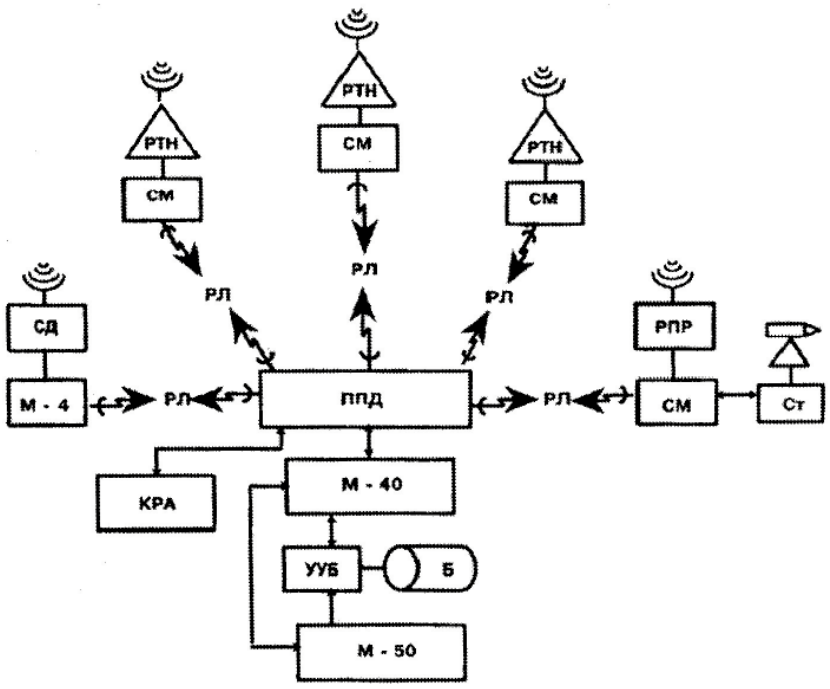
At the end of the 1980s a **new phase** had started in which heterogeneous network architectures had to be integrated and raised to higher speed levels. At that time the modem became a standard peripheral device of Personal Computers. However this period is after 1990 and therefore I will leave it out of consideration in this presentation.

Now I like to use these time period on Western technology as background for consideration activities in the Eastern.

3 Development in the East

3.1 First Phase (1950 until mid 1960s)

The fist period in the West is characterized by using computer networks for military purposes. Unfortunately, we have only less information about activities in the soviet military complex because of very strong secret protections and as well because of languages barriers. However, it is known that already in 1953 a group of specialists at the Moscow Institute of Precision Mechanics and Computing Machinery started to create a computer-based missile defense system.[6] The mentioned Moscow Institute and its director Sergey Alekseevich Lebedev played an important role in the history of Soviet computing.[7] In 1956 first experiments followed. Radar stations sent information to a computer center by remote data transmission on about 100 until 200 km. There a special computer – tagged with "M - 40" in the scheme – selected and digitized the data to plot the trajectories of the flying object and a second computer generated control signals. This equipment made it possible to aim the anti-rocket on the moving ballistic missile automatically. At the end of 1950ies the experimental anti-aircraft system was replaced by an improved one. The total length of the computer network reached now several hundred kilometers. In 1969 the system had been replaced by an advanced anti-aircraft-complex.



Computer network of an experimental missile defense system 1955/56

Source: Burtsev, V. S.: Distributed Systems: The Origins of Computer Networks in the USSR. In: Trogemann, G. et al. (Eds.): Computing in Russia. Braunschweig 2001, pp. 215-220

Data transmission technology was also used for information transfer from the stations automatically observing Soviet space ships and satellites. Already, in 1962 Viktor M. Glushkov, director of the Institute of Cybernetics of the National Academy of Science of Ukraine had the idea of a computer network for a nationwide economics control system called OGAS[8] which was not realised because of political barriers.[9]

Surely, we expected that Soviet Union and the US had a similar technological level, at least for military purposes, because of strategic balance between the super powers during the Cold War. But, what happened in the civil area?

3.2 Second Phase (mid 1960s until end 1970s)

In the 1960s as well in the East increasingly computer systems were used for civil purposes. Between mid 1660s until end 1970s in COMECON countries[10] engineers experimented on data transmission and computer networks, in particular in large scientific institutes e.g. the Joint Institute for Nuclear Research in Dubna or the Institute for High Energies in Moscow.[11] Similar to the West those local networks were connected by public telephone systems.

In other countries of the Soviet block we can find similar activities. For example, since 1967 the Hungarian PTT offered data transmission services.[12] In 1969 the East German PTT provided a high quality data network for maximal 600 users. The central bureau for statistic in GDR used data transmission services since about 1971.[13]

The political background for developing data transmission technology was the liberation during the thawing period in Soviet Union. It started about 1956, after the 20th Congress of Communist Party of USSR. There Nikita Khrushchev attacked Josef Stalin for his crimes and opened a period of liberation. However, in the 1960s a group of conservatives led by Leonid Brezhnev ousted Khrushchev, and in October 1964 Brezhnev became First Party Secretary and in the following years changes partly were taken back.

One idea of liberation in COMECON countries had been the wish to improve the Central Planning System by using data processing machines on two different levels. In state-owned companies computers should help to establish an automated management system, production control, statistics, stock keeping, documentation, and other tasks.[14] Additionally, the political leadership had seen computers as a tool to improve the national planning system by using macroeconomic models.[15] Because in the years before computers had not been in the focus of economic policy now there was a lack of production capacity.

	Typ	Country	Main storage	Operation per sec.
Ryad-1	EC 1010	Hungary	8 - 64 KB	10.000 Op/s
	EC 1020-A	Czechoslovakia	16 - 64 KB	40.000 Op/s
	EC 1020	Bulgaria, U.S.S.R	64 - 256 KB	20.000 Op/s
	EC 1030	Poland, U.S.S.R	128 - 512 KB	100.000 Op/s
	EC 1040	GDR	128 - 1024 KB	320.000 Op/s
	EC 1050	U.S.S.R	128 - 1024 KB	500.000 Op/s
Ryad-2	EC 1025	Czechoslovakia	128 - 256 KB	30 - 40.000 Op/s
	EC 1035	Bulgaria, U.S.S.R	256 - 512 KB	100 - 140.000 Op/s
	EC 1045	Poland	256 - 3072 KB	400 -500.000 Op/s
	EC 1055	GDR	256 - 4096 KB	750.000 Op/s
	EC 1065	U.S.S.R	1 - 16 MB	4 - 5.000.000 Op/s

Ryad Computer Systems

Source: Davis, N.C.; Goodman, S.E.: The Soviet Bloc's Unified System of Computers. In: ACM Computing Surveys 10, 1978, No. 2, pp. 93-122

Therefore in 1969 COMECON, the Organization for economic co-operation, decided to create a unified computer system, a standard for the all countries of COMECON in Russian called Ryad. In a first step in USSR, GDR, Hungry, Poland, Romania, Bulgaria, and Czechoslovakia 20.000 scientists and 300.000 workers in 70 companies were involved in this huge project.[16] In 1973 first computer of Ryad set had been available. Consequently the Ryad system had been completed with data transmission components. IBM's system 360 later 370 served as model for the standardized set of computer. The decision to construct the Ryad system as improved IBM 360 clones led to a more intensive linking on western technology, although socialist countries could never catch up the time lack of a few years.

One of the leading countries in data transmission technology had been GDR. The modem DFE 550 since 1968 produced by the East German computer company Robotron reached a rate of data transfer on the public telephone system of 1.200 Baud.

The information on Western computer technology mostly had to be obtained legally. During the whole Cold War period never stopped trade relations totally. The COMECON bought Western computers which had been delivered since the 60s by the British ICL, Honeywell-Bull, NCR, CDC, Sperry Univac, Siemens, Ferranti, CII, Data Saab, and other. Additionally, the Eastern companies obtained licenses from Western products. The Czechoslovakian Computer Tesla 200 was a clone of Bull-GE Gamma 140/145. Hungary and Romania produced clones of French Computers. The Polisch Odra-1300-Seria used Software by ICL. In 1973 the US company CDC and the Soviet government subscribed a contract on intensive cooperation.

	Bulgaria		Czechoslovakia		GDR		Hungary		Poland		Romania		USSR	
Bull-General Electric, France			1964-68	10	1967	1	1966	12			1967	4	1967-69	3
CII, Companie Internationale pour l'Informatique, France											1969	1		
Datasaab, Sweden			1969	3										
Elliot, U.K.	1970	1	1960-68	6			1962-67	7	1961-69	24	1963-70	5	1959-70	14
Ferranti, U.K.			1969	2									1969/70	5
Fujitsu, Japan	1969	2									1969	2		
General Precision, U.S,			1963-66	3										
General Electric Information Systems Italia, Italy							1968	1					1969	2
Regencentralen Gier, Denmark	1968	1	1966/67	2			1965	2	1966	1				
Honywell, U.S.			1969-70	2	1967-70	6	1969	4	1970	1				
IBM, U.S.	1965-69	4			1967-70	2	1965-69	3	1966-69	2	1968-69	3		
ICL, International Computer Ltd., U.K.	1968-70	4	1964-69	17	1968-69	3	1966-69	11	1965-69	9	1968-70	4	1966-72	10
Marconi, U.K.			1968	1										
NCR, National Casher Register, U.S.			1967-68	2	1968	1			1967	1				
SEA, Société d'Électronique et d'Automatisme France			1968	1										
Siemens, Germany			1967-69	4	1968	1	1970	2			1968	1	1970	1
Univac, U.S.			1965-70	32	1966-68	7	1964-70	17						
Zuse KG; Germany			1964-65	3										

Computer imported by COMECON 1963-1972

Berenyi, I.: Computer in Eastern Europe. In: Scientific American 223, No. 4, Oct. 1970, pp. 102-108

In 1980 the situation radically changed. After being elected, Ronald Reagan tightened the embargo conditions regarding the East. One reason was the movement of Red Army troops into Afghanistan in December 1979 and the threatening intervention of the Soviet Union in Poland after the sharpening of the political situation there. The Reagan Administration considered high technology as an important competitive field in which the USA and the West could easily outpace the East.

4 Third Phase (end 1970s until end 1980s)

Comparable with the West, in the third period computer networks and data transition lines had been developed, tested, and came really in use. In the Neutron Physics Laboratory of the Joint Institute for Nuclear Research in Dubna about twenty computers of the PDP 11 family were used for data acquisition and measurement control. The measured and preprocessed data must be transferred to the laboratory computer for storing on disk or tape and for further processing. Since 1982 a data file transfer system has been implemented for this aim using standard serial interfaces.[17] In the West CERN played an important role in developing transmission technology because high quantity of data arose from physical experiment pushed development of transmission technology.

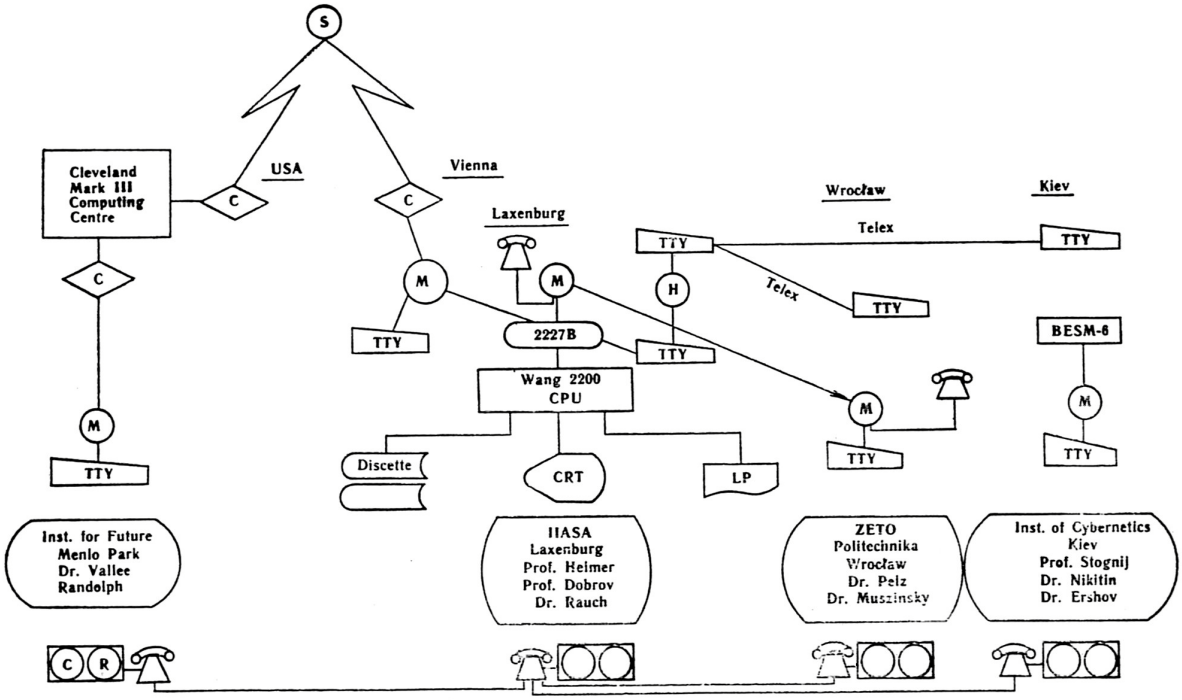
In 1981 the Hungarian PTT put a high speed public data network in operation.[18] In GDR computer scientists worked on the computer network DELTA.[19] The DELTA concept was developed as a model fort he establishment of a national computer network for educational and research institutes in the GDR. In 1982 an experimental data transition between Berlin and Prague had been established. For example it was possible to send and to receive e-mail.

1974	network of the Hungarian Academy of Science	science
1977	network of the Central Research Institute for Physics, Budapest	science
1977	network of the Polish Scientific Centers	science
1977	public net in Czechoslovakia	PTT
1978	terminal network of the Research Institute for Applied Computer Science, Budapest (SzÁMKI); research for Videoton network	science
1981	DELTA (Academy of Science of GDR)	science
1982	IHDnet (University for Applied Sciences Dresden, GDR)	science
begin '80s	LANCELOT (Humboldt University Berlin)	science
begin '80s	SEKOP (Keldysh Institute of Applied Mathematics, USSR Academy of Science)	science
begin '80s	LOTUNET (University of Technology Dresden, GDR)	science
mid 1980s	LOCHNESS (Local Highspeed Network System of the Central Research Institute for Physics, Budapest)	science
mid 1980s	EXLOC (Videoton, Budapest)	commercial product
1986	ROLANET (Robotron, Nachrichtenelektronik Leipzig, GDR)	commercial product

I mentioned that the situation after 1980 the Cold War declined. Nevertheless the scientific contacts did not break at any time. For example in 1976 the Russian translation of the textbook on Communication Networks by Davies & Barber had been published.[20] Or – to take another example – international conferences gave Eastern computer scientist the opportunity to meet its Western colleagues. Since 1977 about all four years an International Congress on Computer networks took place in Budapest, the capital of Hungary. The following scheme shows the countries coming from the participants on this conferences in Budapest. In general USSR and other COMECON countries had been very active members in international organizations, for example IFAC (International Federation of Automatic Control) and IFIP International Federation for Information Processing).

		COMNET '77	COMNET '81	COMNET '85	COMNET '90
WEST	Austria	●	●	●	
	Belgium	●	●		●
	Brazil			●	
	Canada	●	●	●	●
	Denmark		●		
	France	●	●	●	●
	FRG (West Germany)	●	●	●	●
	Finland		●		●
	Greece			●	
	Ireland		●		
	Italy	●	●	●	●
	Japan		●		●
	Nederland			●	●
	Norway		●		
	Sweden			●	●
	Switzerland	●		●	
	U.K.	●	●	●	
	USA	●		●	●
EAST	Bulgaria		●	●	●
	Czechoslovakia	●	●	●	●
	GDR (East Germany)		●	●	●
	Hungary	●	●	●	●
	Poland	●	●	●	●
	USSR	●	●	●	
	China			●	
	Cameroon		●		

Last but not least I would like to mention a special project on cooperation in Science between East and West: In July 1977, the International Institute for Applied Systems Analysis (IIASA)[21] near Vienna organized a three-week experimental connection between scientists of four countries: Austria, Poland, USSR, and USA.[22] This fact represents an important step in the history of Internet which is neglected until now. Interesting might be the motivation: A group in IIASA led by the Russian science Researcher Gennadij Dobrov considered science as a cumulative team activity. Computer networks could help to support scientific cooperation on scientists of different countries.



Three-week experimental connection between scientific institutions in Austria, Poland, USSR, and U.S. in July 1977

Source: In: International Forum on Information and Documentation 3 (1978) No. 3, p. 10

5 Summery

First: If we are looking into the diffusion of network technology into society we have to pay more attention on the network technology, in particular the telephone system. This, for example, gives us important information why Africa has only less Internet users. In large areas there is neither electricity nor telephone system.

From this point of view one can say: The fact, that after end of Cold War in Eastern countries infrastructure, in particular the telephone system, had been totally renewed by the state of the art technology – of course supported by the West with a lot of

money – this fact made possible the quick implementation of PC technology and the internet in the former socialist countries.

Second: In spite of Cold War the computer scientist in the East knew what happened in the West. In general they could read Western technical journals. Some of them participated on international conferences or were engaged in international organisations. Additionally, the whole Cold War period business relation never stopped. In result surely the end of Cold War had been a big break in the personal life of East European computer scientist. However, it did not mean a totally debasement of their knowledge. The individuals knew Western computer technology form their work before.

Third: One important fact in the history of internet was – beside military interests – the wish of scientists to exchange large quantities of information quickly. This we can find in the East as well. Additionally, one has to add the hope of political leadership to improve the planning system by use of computers as motivation for providing resources in the East.

Fourth: Last but not least the restricted access of individuals to computer technology in the East raised a different view of "user". In the West user was meanly considered as person. In the East during the Cold War period the user was seen primarily as institution not as individual.

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