CHAPTER 3

BOSNIA AND HERCEGOVINA

Executive Summary

Internet connectivity was introduced in Bosnia during the 1992-1995 war, first as bulletin board services (BBS) with electronic mail gateways in 1993 and then as full-fledged IP connections the following year, principally for humanitarian purposes. War-time use was limited to electronic mail between a small group of Bosnians who remained in Sarajevo and friends and relatives who fled the country, and between non-government organizations (NGO) to coordinate their relief efforts. Use of Internet e-mail served as a morale-boosting adjunct to international telephone calls, which were beyond the reach of most Sarajevans. Although there have been some recent developments in the infrastructure, there has been little additional Internet diffusion since the end of the war.

- **Wartime use and impact**
  - There is no evidence that use of the Internet by any of the parties to the conflict had any effect on the course or outcome of the war. This is principally due to the difficulties inherent in establishing a network under wartime conditions. Internet connectivity was limited to a single site in the capital, Sarajevo, and the number of users was limited both by the lack of geographic dispersion but also by a lack of electricity, telephone lines, computers, and potential users.
  - Although the use of Internet search engines, such as Yahoo or Alta Vista, for sites related to Bosnia using such key words as “bosnia*,” “serb*,” “croat*,” and “yugoslav*” yields a list of thousands of Web sites, in fact less than two hundred directly pertain to Bosnia and the recent war. Most are personal Web sites and the majority of the remainder belong to humanitarian organizations. The little propagandizing or lobbying that was conducted on the Web was limited to persons and groups outside Bosnia attempting to influence the Bosnia-related policies of the United States and European countries. No evidence has been found that these efforts had a meaningful impact on policy.
- **Post-war developments**
  - The network that was started during the war has grown only slightly, although its user base has surged. Sarajevo University’s University TeleInformatic Center (UTIC) is the sole Internet site open to the public. It is inadequate to meet the current demand. Although there are plans to build a nationwide academic intranet, the initiative is stalled due to continued ethnic animosity, lack of funds, and a lack of support from the national telephone company.
  - The Soros Foundation, which introduced the wartime connections, is similarly stymied in its efforts to expand its network, currently limited to several sites in Sarajevo. Soros offers free e-mail accounts to all comers, but does not offer public Internet access.
  - The Joint Stock Company for PTT Operations (PTT), the state-owned telecommunications monopoly, installed servers to establish nationwide Internet access and brought one server on-line in December 1997, but the service is apparently not yet open to the public. A temporary Web page is being hosted by UUNet, the provider of the network equipment, on one of their servers in the United States.

- Efforts to establish nationwide Internet service are hampered by the current lack of a nationwide telephone network. Several operators provide Internet connectivity via Belgrade in the Serbian entity (Republika Srpska). The Croatian telephone company offers Internet connections in the Croatian-majority areas of the Muslim-Croat entity (Federation).
- Several Web sites have been established by Bosnian companies on servers located outside of Bosnia, principally in the United States. These sites provide information about Bosnia and current events in the country; some commercial information (e.g., hotel, rental car, and airline information) is also provided.

The Internet has mainly been used as an alternative communications medium, which is natural given the poor state of the domestic telephone network and corresponding difficulties and expense in making international telephone calls. Foreign nationals may be the principal users of the Internet in Bosnia, which is used mainly for e-mail. In addition to the limited Internet service, it is also possible from some locations to direct-dial a network service, such as America OnLine, in a foreign country. Table 16 summarizes the current state of the Internet dimensions in Bosnia, which are depicted in Figure 3.

Dimension	Level	Explanation
Pervasiveness	(1) *Experimental*	Less than 0.1 percent of the population has Internet access. The network is used primarily by students, networking professionals, and foreigners.
Geographic Dispersion	(1) *Single Location*	The Internet network in Bosnia and its international connection are concentrated in one building. Some geographic dispersion will result from the commissioning of the PTT's network.
Sectoral Absorption	(1) *Rare*	The very small Bosnian user community comprises students and other computing professionals.
Connectivity Infrastructure	(1)	There is only a minimal infrastructure supporting the Internet in Bosnia. This situation will be only slightly improved when the PTT's network is commissioned.
Organizational Infrastructure	(2) *Controlled*	The PTT will be the only authorized purveyor of public Internet access, while the UTIC will offer connections to the academic community.
Sophistication of Use	(1) *Minimal*	There is only a small user community with inadequate assets at its disposal. Internet use is haphazard.

Table 16. Internet Dimensions for Bosnia

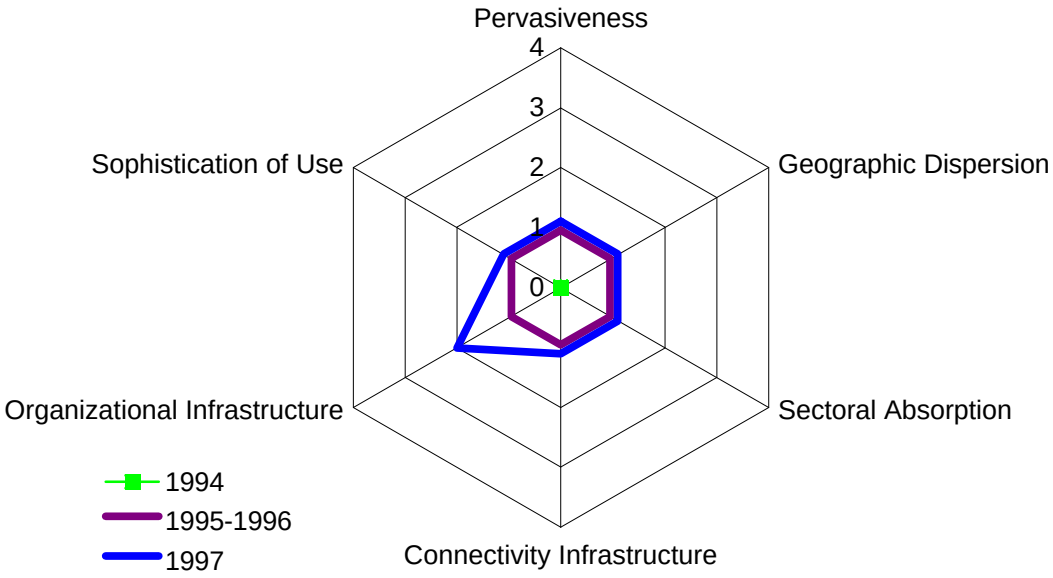

Figure 3. Internet Dimensions for Bosnia

Introduction

Figure 4. Bosnia in Europe

Bosnia is a mountainous country comprising about 51,129 km^2 east of the Adriatic Sea (Figure 4). The Dinaric Alps run parallel to the Adriatic coast and continue into central Bosnia. In the northeast, there are plains along the Sava River which separates Bosnia from Croatia. The country has approximately 20 km of coastline on the Adriatic Sea at the mouth of the Neretva River, but no sea ports. The issue of access to international trade routes has been of importance in the history of the Balkan region, and is critical today to the post-war reconstruction of Bosnia. Prior to the re-opening of the airport at Sarajevo to commercial traffic, Bosnia was dependent upon assistance from neighboring Croatia for transshipment of supplies and equipment.

The very irregular geography of Bosnia, with high mountains and deep river valleys (Figure 5), coupled with the harsh winters, makes the establishment and maintenance of long-haul cable and microwave networks difficult. Geography has had a pronounced effect not only on the dispersion of the population, but on the proliferation of the IT infrastructure.

The pre-war population was about 4.36 million, of which 44 percent were Bosniak (Muslim), 31 percent Serb, 17 percent Croat, and 7 percent people of other ethnic groups, including Jews and Ruthenians. The average population density was 85.2 people/km^2, a figure that varied widely between the urban areas and the higher elevations. Approximately one-quarter of the population was under 15 years old and about 11 percent of the population was older than 60.

Figure 5. Map of Bosnia and Hercegovina

Due to refugee flows, estimates of the population today vary. Approximately 3.5 million people reside in the Republic today (Table 16); of these, about 2.1 million people live in the Federation. Almost 1 million Bosnians are internally-displaced persons (IDP), having been forced out of their homes by the war and attendant “ethnic

cleansing" campaigns. There are almost another 1 million refugees living in various European and Asian countries and the United States.[30] As the majority of refugees are Muslim, the Muslim Bosniaks residing in Bosnia may no longer be the most predominant ethnic group, a situation that has prompted Bosniak nationalist leaders to give a high priority to repatriation.

Table 17.
Bosnia and Hercegovina in Statistics

Metric	Value[31]	Remarks
Population	3.5[32]	millions, 1997 estimate
Population density	68[2]	per km^2, 1997 estimate
GDP	1.0[33]	US$billions, 1996 estimate
GDP per capita	300[34]	US$, 1996 estimate
Telephones	237.8	thousands, 1995
Teledensity	5.43	per 100 inhabitants, 1995
Teledensity in largest city	42.86	per 100 inhabitants, 1995
Cellular subscribers	1.5	thousands, 1997
Cellular density	< 0.01[35]	per 100 inhabitants, 1997 estimate
PCs	na[36]	
PC density	na	
Television sets (receivers)	385	thousands, 1995 estimate
Television density	9.4	per 100 inhabitants, 1995 estimate
Literacy rate	na	
Infant mortality	43.2[37]	per 1000 inhabitants, 1996 estimate

Since the end of the war, the country has been occupied by multi-national armed forces, first the Dayton Peace Agreement (DPA) Implementation Force (IFOR), followed by the Stabilization Force (SFOR), both led and commanded by NATO. The forces achieved the basic military requirements of the DPA, having secured the cessation of the war, the partial demobilization and disarming of the three armies, and the physical separation of the three armies in their respective zones of control. Although some NGOs were active in Bosnia during the war, the end of hostilities created a safe environment for their operations, and their numbers grew dramatically, especially in the Federation areas.

Humanitarian relief, principally food and medical supplies, received the highest priority during and immediately following the war. Repair and construction of housing and basic infrastructure (especially gas and water) received a high priority early in the reconstruction program, followed by transportation and the electrical system. Essential telecommunications services were repaired, but the reconstruction of the telephone network was not a high-priority project.

"Bosnia and Hercegovina" is today a somewhat ambiguous term. In this chapter, we refer to the Bosniak-Croat *Federation* of Bosnia and Hercegovina, as the "Federation." The Serb-held sector of the former Yugoslavian republic of Bosnia-Hercegovina has chosen the designation "Republika Srpska," which we use. The *Republic* of Bosnia and Hercegovina, comprising the Federation and the Republika Srpska, we refer to as "Bosnia."

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[30] At the end of 1995, the United Nations High Commissioner for Refugees (UNHCR) estimated that there were 1 million refugees living outside of Bosnia and another 1 million internally displaced persons. UNHCR estimates that 250,000 people, comprising both refugess and IDPs, returned home in 1996, and expects another 200,000 to return to their homes by the end of 1997.

[31] Source: *World Telecommunication Development Report*, 3rd ed., 1996/97 (Geneva: International Telecommunications Union, March 1997), unless otherwise noted.

[32] Embassy of the State of Bosnia and Hercegovina to the United States, data for 1991, adjusted for United Nations High Commissioner for Refugees estimates of population losses. The CIA estimated the population to be 2.66 million in 1996 (<http://www.odci.gov/cia/publications/nsolo/factbook/bk.htm>).

[33] *The World Factbook 1996*, <http://www.odci.gov/cia/publications/nsolo/factbook/bk.htm> (9 February 1998).

[34] *ibid.*

[35] MOSAIC Group estimate.

[36] Not available or not applicable.

[37] *The World Factbook …* /bk.htm, *op. cit.*

The term "Bosnians" is used to refer to the government and/or people of the Republic. The terms Croat and Serb are generally used to denote people of those ethnic groups residing in, or refugees from, the Republic. The Muslim population of the Republic, and certain people of mixed heritage, are referred to in the DPA as "Bosniak."

Networks in Bosnia

An information technology infrastructure had been developed throughout Bosnia and Hercegovina prior to the 1992-1995 war, but much of the technology in use was obsolescent. Modernization was underway, however, and some newer technologies, such as limited fiber optic communications links, had been deployed. The war destroyed a large portion of the existing infrastructure and assets while both the war and the preceding and ensuing instability prevented the absorption of new technologies during the first half of this decade. Although significant infrastructure elements remain intact, they are of marginal utility as the basis for reconstruction due to their generally poor material condition. This gives Bosnia the opportunity to use the most modern technologies to "leapfrog" the development process; however, this can be accomplished only at great cost. The international community has decided that the reconstruction and further development of the IT infrastructure in Bosnia is to be conducted largely on a commercial basis, rather than on the basis of relief grants. Consequently, the lack of indigenous and donor funds, coupled with a confused environment that is discouraging international investment,[38] has significantly hampered the pace of reconstruction.

The current environment is a significant impediment to reconstruction and development. The country is partitioned into two entities in accordance with the Dayton Peace Agreement (DPA): the Bosniak-Croat Federation of Bosnia and Hercegovina and the Republika Srpska (RS). Furthermore, the Federation areas under the control of the Croatian Defense Council (HVO) have not been completely relinquished by the HVO in accordance with the Federation's implementing agreement, resulting in yet a third governing entity in the Republic. Many civil and social structures, and the entire IT infrastructure, have been similarly partitioned into three uncooperative entities.

Computers were in common use in Bosnia prior to the war, there was an established computer science curriculum for secondary and university education, and software development companies were common. However, computer literacy was common only in the more developed (i.e., urban) areas, and the available hardware by obsolete by Western standards, due largely to the cost of new equipment and restrictions on imports that had been in place for almost a decade.

Most of the computers in Bosnian combat zones were destroyed or stolen during the course of the war, and many computer industry professionals emigrated. The achievements of those who remained behind, however, are impressive, and the software industry is picking up again. Computers remain very expensive in Bosnia, however, especially relative to the depressed levels of post-war incomes.

One of the most sophisticated computer centers in the country is the Management Information Technology Center (MITC) funded by the Soros Foundation and installed at the Faculty of

[38] In the case of basic telecommunications services, private investment is prohibited by law. Although the case for privatization of telecommunications seems clear to Westerners, the Bosnian government—like the rest of the former Yugoslavian republics—has no plans to privatize certain strategic assets in the near term.

Economics of Sarajevo University, in downtown Sarajevo. This center was installed during the war, roughly coincident with the Soros BBS project. The intention of the MITC was to create a forum for collaborative decision-making and negotiation support.

There has also been some foreign assistance for computer training. The Construction Jihad Ministry of the Islamic Republic of Iran sponsored a computer training course in Mostar. The first 30 students graduated from the course on 23 September 1997. Neither the content nor the duration of the course were publicized. It is the Iranian Embassy's intention that these courses be offered regularly.[39]

Electronic Mail

Electronic mail services were introduced to the region by the Soros Foundation's Open Society Institute (OSI) Network Media Program in 1993, with bulletin boards established in Bosnia (Sarajevo), Croatia (Zagreb), Macedonia (Pri{tina), Slovenia (Ljubljana), and Yugoslavia (Belgrade). The bulletin boards were turned over to the OSI Internet Program in 1994 and were serving about 2,000 individuals and 450 NGOs by 1995. In April 1995, another node was opened in Tuzla, Bosnia. In 1996, the bulletin boards were connected to the main server of the ZaMir ("For Peace") Transnational Network (ZTN) in Bielefeld, Germany, providing UUCP connectivity for exchange of "conference" (bulletin board topics) postings and e-mail.

The Automail system operated by the Directorate of Telecommunications still had about 300 subscribers in October 1997. It is run on a 40 MHz 486 no-name PC running OS-2. Connections are via a pair of Xycel U-1496E V.32b 19.2 Kbps modems. E-mail is stored on a 540 MB hard drive. The administrator would like to up-grade the hardware, but hasn't needed to do so, since the current configuration is adequate for the number of users.

The Automail software was written by Edusoft and distributed by Automail in Switzerland. The software permits batch e-mailing and limited database access through the Automail host in Geneva. E-mail between Sarajevo and Geneva is exchanged via a dial-up UUCP link twice daily. The Geneva end of the link uses U.S. Robotics modems.

The first 1,000 characters costs ChF 0.20 (about ($0.14). Each 1,000 thereafter costs ChF 0.10 ($0.07). Internet transport (i.e., e-mail sent to an Internet address from an Automail originator) costs ChF 0.15-0.25 (US$0.10-0.17) per 1,000 characters, depending upon the size and content (e.g., binary vs. ASCII).

The system was hacked once by a couple of teenagers in Tuzla. They used a feature of Automail that allows any user to get at the system level prompt, and then guessed the administrator's simple password. The system administrator discovered that the hackers were monitoring his actions when he changed his password, so he had to take the system off-line and change it again without being observed. The hackers destroyed about 40 e-mail messages that were stored on the disk, but the messages were recovered. The directorate gave the hackers accounts in trade for promised of future good behavior and possible help with security problems.

[39] "Iran-Bosnia-Computer," thr 021, Islamic Republic News Agency at 1045 GMT (23 September 1997).

Internet Overview

While competitive Internet ventures have been created in Croatia, Slovenia, and even Serbia, there still are no commercial Internet Service Providers (ISP) in Bosnia. The PTT recently completed installation of an intranet within the Federation, and intends to offer public access to the Internet via this network in the near future.

There is somewhat limited public access in the Federation, through the servers at the University (of Sarajevo) TeleInformatic Center (UTIC) and the Soros Foundation's offices in Sarajevo. The Croatian national telephone company, HPT, installed a server in west Mostar, offering public Internet access via Zagreb. The ZaMir nodes in Sarajevo and Tuzla also remain operational.

In the Republika Srpska, RS Telecom has established RSNet and is offering public access to the Internet in several cities, including Banja Luka and Prijedor. RSNet is connected to the Internet via the Serbian national telephone company in Belgrade.

Some people in Bosnia subscribe to Internet or other computer networking services (e.g., ZaMir) outside of Bosnia. Users physically located in Bosnia have been noted on America Online (aol.com), USA Network (usa.net), and Bosnia Online (bosnia-online.com). All of these ISPs have servers (access nodes) located in Europe. Users located in Srpska have also been noted using the ZaMir node in Belgrade.

The only indigenous web pages are on the UTIC, Soros, and RSTel servers:

www.utic.net.ba (vrbas.utic.net.ba)
www.soros.org.ba (futura.soros.org.ba)
www.rstel.net (ns2.rstel.net)

The Office of the High Representative (OHR) maintains a Web site in Finland, while the OSCE's site is in Austria. There are also many Bosnia-related Web sites located worldwide. Arguably the most creative is that of the New Technologies Group (NTG), a Sarajevo-based computer software house and consulting firm. The site provides local Sarajevo news and services information (automobile rentals, hotels, airline schedules, etc.) along with an e-mail directory and community service information. The server is actually located in Beaumont, Texas, largely because NTG was able to find a Bosnian expatriate there who was willing and able to maintain the server. Web pages are created and tested in Sarajevo, then transferred to Texas via ftp. The site is aimed at an international audience.

Regional Services: ZTN

The ZaMir Transnational Network is affiliated with the PeaceNet network run by the Association for Progressive Communications (APC) in San Francisco, California. Figure 6 depicts the logical layout of the network (less the Tuzla node, which was not operational at the time the ZaMir topology was published). The main server is located in Bielefeld, Germany, and is connected to the Internet with a full-time IP link. During the course of 24 hours, it initiates eight telephone calls (every two hours during 8.00 to 18.00 and twice during 18.00-8.00) to the Belgrade and Zagreb nodes, and four telephone calls to the Ljubljana node. The Belgrade node in turn calls the Pri{tina node four times a day, and the PeaceNet node in Vienna once a day as an alternate route to the Internet and to provide the Yugoslavian conferences (bulletin board contents) to other PeaceNet bulletin boards. The Zagreb node calls the Sarajevo node four times a day. During these telephone

links, waiting bulletin board postings and e-mail are transmitted in from the remote node toward the direction of Bielefeld, and up-dated bulletin boards and waiting e-mail is transmitted down-stream to the remote nodes. The ZTN servers are generally old model PCs (e.g., 40 MHz 80386) that communicate using "Trailblazer PEP" modems.

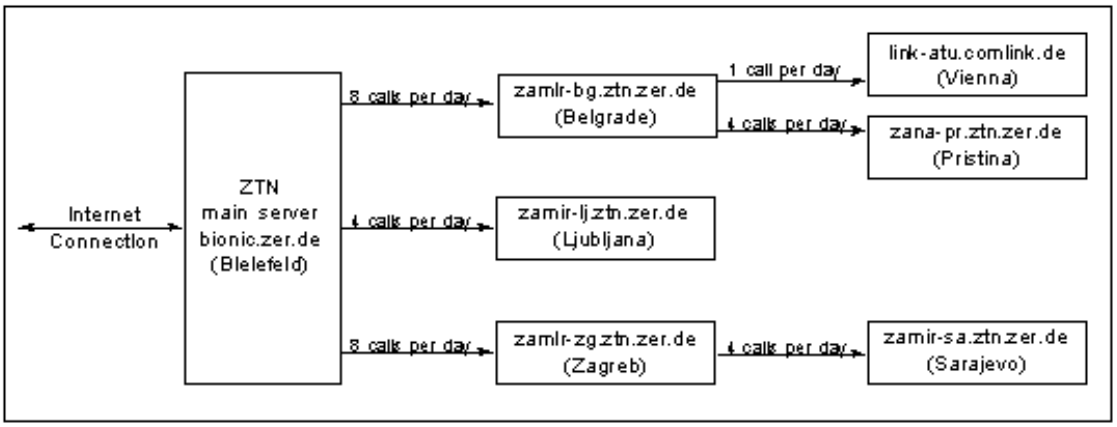

Figure 6. The ZaMir Bulletin Board Network

Federation Internet: UTIC

To the extent that existing laws can be interpreted as being applicable to the Internet, the Director of Telecommunications has the overall authority and responsibility for the Internet in Bosnia. As such, the Director is officially the manager of the *.ba* top-level domain (TLD). In fact, the University of Sarajevo TeleInformatic Center (UTIC) performs the actual administrative functions associated with management of the TLD. The University of Sarajevo/UTIC is registered with the InterNIC as the TLD manager, with Haris Had`iali} listed as the Administrative Contact.

The Director of Telecommunications has delegated authority for management of the *.edu* domain to the UTIC, while the PTT is responsible for the *.com* domain. There presently are no *.net*, *.gov*, or *.mil* domains registered in Bosnia and plans for their possible use are not known. Several NGOs have *.org* domain names (e.g., soros.org.ba) which were assigned by the UTIC, although we are not aware of who is officially responsible for managing this domain.

The only public Internet access in Bosnia is via a non-commercial system operated by the University TeleInformatic Center (UTIC) in Skenderija, Sarajevo. It has been operating since July 1996, and was established with grant funds from the Soros Foundation, equipment donated by Silicon Graphics (SGI), and assistance provided by students/staff of the Free University in Amsterdam, Netherlands, which also provides the Internet connections to UTIC. UTIC operates six servers: two SGI Challenge servers and four SGI "Indigo" workstations (Figure 7) that use the IRIX 6.2 operating system. UTIC has registered

Figure 7. The smaller of two Internet systems rooms, with two Indigo workstations.

an additional 23 servers, listed in Table 18, but there were no new computers at UTIC in late 1997; the IP numbers apparently refer back to various of the six original servers.

Table 18. Sarajevo University Internet Host Servers

Server Name	IP Number	Location	Type	Functions
bosna.utic.net.ba	130.37.126.5	UTIC Sarajevo		
~ehotina.utic.net.ba	130.37.126.34			
dobrinja.utic.net.ba	130.37.126.31			
drina.utic.net.ba	130.37.126.9	UTIC Sarajevo	Indigo	
krivaja.utic.net.ba	130.37.126.32			
miljacka.utic.net.ba	130.37.126.40			
mojmilo.utic.net.ba	130.37.126.38			
neretva.utic.net.ba	130.37.126.7	UTIC Sarajevo		
remote1.utic.net.ba	130.37.126.51			
remote2.utic.net.ba	130.37.126.52			
remote3.utic.net.ba	130.37.126.53			
remote4.utic.net.ba	130.37.126.54			
remote5.utic.net.ba	130.37.126.55			
remote6.utic.net.ba	130.37.126.56			
remote7.utic.net.ba	130.37.126.57			
remote8.utic.net.ba	130.37.126.58			
remote9.utic.net.ba	130.37.126.59			
remote10.utic.net.ba	130.37.126.60			
remote11.utic.net.ba	130.37.126.61			
remote12.utic.net.ba	130.37.126.62			
remote13.utic.net.ba	130.37.126.63			
remote14.utic.net.ba	130.37.126.64			
remote15.utic.net.ba	130.37.126.66			
remote16.utic.net.ba	130.37.126.67			
sana.utic.net.ba	130.37.126.37			
sava.utic.net.ba	130.37.126.3	UTIC Sarajevo	Challenge	Radius database, e-mail, ftp
trebi{nica.utic.net.ba	130.37.126.6	UTIC Sarajevo	Aptiva	Network management
una.utic.net.ba	130.37.126.2	UTIC Sarajevo		
vrbas.utic.net.ba	130.37.126.8	UTIC Sarajevo	Indigo	Web server
`eljeznica.utic.net.ba	130.37.126.30			

Routing is via a trio of Cisco 2500 routers (one of which was broken in May 1997). Dial-up links are provided by 16 rack-mounted Telebit 884R modems and a pair of Telebit Octocom PS1802A terminal servers (all in one shelf of a 19" rack). The workstations at UTIC are connected to the terminals, one another, and the servers via a 10base2 (10 Mbps coaxial) Ethernet LAN.

The UTIC has established a set of backbone server names (Table 19), but there is no backbone and no unique backbone servers, due to problems with getting 2 Mbps links from the PTT. Like the Soros Foundation and the PTT, UTIC has plans to establish a nationwide intranet within the next two years, principally connecting academic institutions.

Obtaining an account is trivial for students and staff of the University of Sarajevo and certain government employees (e.g., staff of the Directorate of Telecommunications) and apparently impossible for most others. Internet access costs DM 15 (about $10) for 8 hours (i.e., it is very expensive). There are several thousand registered users. The service is exceptionally busy; it is very difficult to get a dial-up connection, and the eight walk-in terminals at UTIC (Figure 8) are occupied full time (often by more than one student each). There are 16 dial-up lines. It is easier to

get to the UTIC servers by dialing up the Soros site and then linking to UTIC, than by dialing directly.

Table 19. University Backbone Servers	
Host Name	IP Number
bihac.bbone.utic.net.ba	130.37.126.90
mostar.bbone.utic.net.ba	130.37.2.2
tuzla.bbone.utic.net.ba	130.37.126.91
visegrad.bbone.utic.net.ba	130.37.126.65

Figure 8. The public-access Internet terminal room, before and during business hours

The UTIC LAN in Bosnia is connected to the Internet via a 128 Kbps VSAT link to the Free University in Amsterdam. The Sarajevo end of the link is a 1.8 m dish with a 4 W transceiver (Figure 9). The satellite link is via a Kopernikus satellite; the lease cost was donated by Deutsche Telekom (which owns the Kopernikus satellites).

Figure 9. UTIC's VSAT dish in the University courtyard

Some telephone lines in Sarajevo will support 28.8 Kbps connections. It depends on the switch: telephone numbers 2xxxxx and 65xxxx are connected to the new AXE switches and are the best; 67xxxx is the worst (less than 14.4 Kbps). Inter-city lines are variable, but some people have been able to connect by dialing from Sarajevo to Tuzla.

Federation Internet: PTT

The PTT announced a tender in January 1997 for equipment sufficient to build a nationwide network. PTT personnel received Internet training in Germany in early 1997, and installation and commissioning of network components in the Federation was completed on about 1 October 1997. The network, exclusive of inter-city transmission infrastructure (the backbone), was provided on a turn-key basis by UUNet Technologies. There are several servers operational in Bosnia, although the network has not yet been opened to the public. A temporary Web page (www.bih.net.ba) is maintained on an AlterNet server in New York. AlterNet is a wholly-owned subsidiary of UUNet and operates an

international satellite gateway in New York. The equipment that was proposed in the tender specifications is listed in Appendix B. The Bosnian PTT's BiHnet has been assigned the 8.5 Class C networks, IP numbers 195.222.32.0 through 195.222.40.127 (2,176 IP numbers). The servers that were located as of 25 February 1998 are listed in Table 20.

Table 20. BiHnet Servers

Host Name	IP Number
cisco-e0.bih.net.ba	195.222.32.1
ascend-e0.bih.net.ba	195.222.32.2
amazon2-j1.bih.net.ba	195.222.32.3
amazon2-j1.bih.net.ba	195.222.32.4
special.bih.net.ba	195.222.32.6
bond.bih.net.ba	195.222.32.9
ns1.bih.net.ba	195.222.32.10
ns2.bih.net.ba (www.bih.net.ba)	195.222.32.20

The PTT's current plan is to offer dial-up and leased-line services to public and private organizations, companies, and individuals. Table 21 lists the service levels and the proposed pricing; other value-added services, such as web site hosting, are available at additional cost. While basic service is not outrageously expensive, the cost will limit the appeal of the service. Although this method has been used in other countries explicitly to limit Internet access by the lower classes, the Bosnian government indicated that these prices were driven by a need to balance service availability with the PTT's costs.

Other Federation Internet

The Soros Foundation operates several servers (Table 22), reportedly also SGI equipment, at least one of which (azur.soros.org.ba) is connected to UTIC via a 64 Kbps landline. Their Web pages are maintained on futura.soros.org.ba. The Foundation's intranet in Bosnia is connected via 2 Mbps lines leased from the Bosnian PTT. The Foundation desires to build nationwide network to serve its own offices throughout the country, but like UTIC, has been hampered by its inability to lease the required inter-node links. The Soros Foundation offers free e-mail addresses and service to residents of Bosnia.

The OSCE has their LAN connected to the Internet via UTIC, also principally for e-mail. No OSCE servers or nodes (connected computers) have been identified in Bosnia and their Web site is located at OSCE headquarters in Vienna, Austria.

Table 21. BiHnet Services and Proposed Prices[40]	
Service	Proposed Price[41]
"Small User" *(Mali korisnik)* Dial-up access with e-mail address and dynamically-assigned IP address	DM 15/month DM 2/hour (0700-1900) DM 1/hour (1900-0700)
"Medium User" *(Srednjii korisnik)* Dial-up access with multiple e-mail addresses and permanent subdomain, dynamically-assigned IP address	DM 140/month DM 5/month/e-mail address DM 2/hour
"Large User" *(Velikii korisnik)* Leased line access with multiple e-mail addresses, permanent subdomain, and assigned IP numbers	
Modem rental	DM 20/month
E-mail address	DM 5/month/e-mail address
19.2 Kbps line	DM 1,500/month
28.8 Kbps line	DM 2,000/month
64 Kbps (DS-0)	DM 2,260/month
128 Kbps line	DM 3,460/month
256 Kbps line	DM 6,650/month
1.024 Mbps (T-1) line	DM 17,100/month
2.048 Mbps (E-1) line	DM 28,300/month

A French NGO, DIA (expansion unknown) is also reportedly connected to the Internet via a leased line to UTIC. However, no DIA servers or nodes have been identified. Two other organizations, EP and CRPC (expansions unknown) also have servers connected to the Internet via links to UTIC (Table 23). The nature of their activities is not known.

In keeping with its policy of operating autonomously in the Croat-majority regions of the Federation, the HPT is offering Internet access via a server in west Mostar with a direct connection to HPT's main node in Zagreb.

Cyber Café: Sarajevo On-Line To mark the third anniversary of the Serbian attack on Sarajevo, a temporary "cyber café" was set up in the office of the independent Studio 99 radio station in Sarajevo during 29 March - 10 April 1995. Supported by the World Media Network, UNESCO, Radio France, Radio France International, and CAPA and SIPA (photojournalism agencies), two journalists were dispatched from Paris with computers and portable satellite links to set up an Internet connection between Sarajevo and Paris, and thence the Internet in general. Journalists in Sarajevo collected stories that were transmitted twice daily, and personal messages were relayed. The messages exchanged were published daily in nine newspapers Europe, Japan, and South America and archived in France (www.cnam.fr/Sarajevo). Public access to the "cyber café" was coordinated by the staff of the International Peace Center (ipc_sa@zamir-sa.ztn.zer.de) in Sarajevo.

[40] As of 21 October 1997, these prices had neither been approved nor publicized.
[41] Dial-up line prices do not include telephone charges for the access call, if any.

Table 22. Soros Foundation Internet Servers in Bosnia[42]	
Server Name	IP Number
futura.soros.org.ba	130.37.124.130
OSFgate.soros.org.ba	130.37.124.129
pcserver.soros.org.ba	130.37.124.141
remote1.soros.org.ba	130.37.124.133
remote1.soros.org.ba	130.37.124.154
remote2.soros.org.ba	130.37.124.134
remote3.soros.org.ba	130.37.124.135
remote4.soros.org.ba	130.37.124.136
remote5.soros.org.ba	130.37.124.137
remote6.soros.org.ba	130.37.124.138
remote7.soros.org.ba	130.37.124.139
server1.soros.org.ba	130.37.124.140
(unknown)	130.37.124.132
(unknown)	130.37.124.145

Table 23. EP and CRPC Internet Servers	
Server Name	IP Number
eprouter.ep.org.ba	130.37.124.33
ado.crpc.org.ba	130.37.124.108
commission.crpc.org.ba	130.37.124.97
commission1.crpc.org.ba	130.37.124.113
dijana.crpc.org.ba	130.37.124.107
james.crpc.org.ba	130.37.124.109
lisa.crpc.org.ba	130.37.124.106
mail_1.crpc.org.ba	130.37.124.98
margit.crpc.org.ba	130.37.124.99
nermina.crpc.org.ba	130.37.124.100
server_1.crpc.org.ba	130.37.124.101
stefan.crpc.org.ba	130.37.124.104
steven.crpc.org.ba	130.37.124.110
todd.crpc.org.ba	130.37.124.102
(unknown)	130.37.124.118
(unknown)	130.37.124.120
(unknown)	130.37.124.122

Srpska Internet

There appear to be at least two commercial ISPs incorporated and operating in Srpska. The Internet in Srpska appears to be under the control of JJP PPT RS in the form of an Internet subsidiary, RSTelnet. RSTelnet's domain is registered in the United States (hence the lack of a national TLD appended to the addresses) and the network is headquartered in the town of Sokolac, 30 km northeast of Sarajevo. A second ISP, HoNet, also registered in the United States, is located in the RS city of Zvornik, about 40 km east of Tuzla. The servers that have been identified are listed in Table 24. Based on the delay times when pinging these servers, it appears that the RS sites are linked to Belgrade via a satellite link (or a very slow landline). Note that the BN.rstel.net server, which is also the name server for HoNet, is the gateway for the other nodes in the RS. Beotel, the Serbian telephone company headquarted in Belgrade, is in turn linked to the Internet via a satellite link to AlterNet, a subsidiary of UUNet Technologies.

The IP numbers assigned to Srpska ISPs come from the Class C networks allocated to Beobanka A.D. in Belgrade (194.106.168-194.106.171).

There are reports of three Belgrade ISPs offering Internet service in the RS, but the numbers and locations of their servers are not known.

[42] There are probably at least four additional servers in the Soros network, whose identities and association with the soros.org.ba domain have not been confirmed.

Table 24. Srpska Internet Servers		
Server Name	IP Number	Location
BN.rstel.net/ns.ho.com	194.106.171.1	
BC.rstel.net	194.106.171.2	
SNJ.rstel.net	194.106.171.3	
mini.ho.com	194.106.171.4	
acu.rstel.net	194.106.171.5	
strider.ho.com	194.106.171.7	
mhal.ho.com	194.106.171.8	
ho.com	194.106.171.17	
jazbina.ho.com	194.106.171.18	
mrakovo.ho.com	194.106.171.19	
ZV.rstel.net	194.106.171.20	Zvornik
eft-bl.rstel.net	194.106.171.29	Banja Luka
baggins-net	194.106.171.32	
frodo.rstel.net	194.106.171.33	
bilbo.rstel.net	194.106.171.34	
alpha.ho.com	194.106.171.35	
beta.ho.com	194.106.171.36	
www.ho.com	194.106.171.44	
www.rstel.net	194.106.171.45	

The assessment of the dimensions of the Internet in Bosnia are summarized in Table 25 and depicted in Figure 10.

Pervasiveness No accurate count of the number of Internet users in Bosnia is possible, but we estimate that there are fewer than 2,000. An Internet e-mail directory posted on the NTG Web site listed about 600 Internet users actually located in Bosnia. Based on projections from earlier estimates, this probably represents most of the UTIC users. There are no users as yet on the PTT network, and the numbers of users in the RS and Croatian areas are unknown but estimated to be small. This equates to a Level 1 (Experimental) pervasiveness, since far fewer than one of every 1,000 Bosnian citizens has Internet access.

Geographic Dispersion Until the PTT's network is fully operational and open to public subscription, the Internet will be concentrated in Sarajevo. The public Internet is concentrated in one building, which is also the hub for other intranets, such as that of the Soros Foundation, and the location of the earth station for the international satellite link. The UTIC is a single point failure node. Bosnia thus is rated at Level 1 (Single Location) for geographic dispersion. Once the PTT's network is commissioned, the rating will increase only to Level 2 (Moderately Dispersed), since the network with not be truly nationwide, since there will be few or no nodes in the RS, and the PTT's satellite link to the Internet is also located in Sarajevo.

Sectoral Absorption Internet use by other than the academic community and foreigners is minimal. The few commercial enterprises that are using the Internet are software and networking specialty houses that do not maintain leased line connections. Due to the poor infrastructure and the requirement to rebuild the potential user communities before they can make use of the Internet, this situation is not likely to improve during the next several years. Individual users will dominate the Internet in Bosnia. The country is rated at Level 1 (Rare) in Sectoral Absorption.

Connectivity Infrastructure in Bosnia is barely at Level 1. There is no IP backbone. Even when the PTT commissions its network, the aggregate bandwidth will be minimal. There is a

single, 64 Kbps international satellite link, to be augmented by the PTT's link which will only marginally ameliorate the current bottleneck at UTIC. There are no Internet Exchanges in Bosnia, nor are any contemplated. Access is currently via dial-up line only. Leased-line connections may be feasible in some areas but are not yet offered.

Dimension	Level	Explanation
Pervasiveness	(1) *Experimental*	Less than 0.1 percent of the population has Internet access. The network is used primarily by students, networking professionals, and foreigners.
Geographic Dispersion	(1) *Single Location*	The Internet network in Bosnia and its international connection are concentrated in one building. Some geographic dispersion will result from the commissioning of the PTT's network.
Sectoral Absorption	(1) *Rare*	The very small Bosnian user community comprises students and other computing professionals.
Connectivity Infrastructure	(1)	There is only a minimal infrastructure supporting the Internet in Bosnia. This situation will be only slightly improved when the PTT's network is commissioned.
Organizational Infrastructure	(2) *Controlled*	The PTT will be the only authorized purveyor of public Internet access, while the UTIC will offer connections to the academic community.
Sophistication of Use	(1) *Minimal*	There is only a small user community with inadequate assets at its disposal. Internet use is haphazard.

Table 25. Internet Dimensions for Bosnia

Organizational Infrastructure in Bosnia is best described as confused. There is currently only a single ISP in the country, the UTIC, but the PTT will come on-line in the near future, making two ISPs. The PTT has indicated that, once its service is operational, the UTIC will stop offering public Internet access and restrict itself to the academic community. The PTT intends to be the only ISP in the country for the foreseeable future, although some business groups are lobbying to be allowed to resell PTT access to the public. Since the PTT also controls the domestic infrastructure that UTIC would require to establish a nationwide academic network, the country is rated at Level 2 (Controlled) for this dimension.

Sophistication of Use of the Internet in Bosnia is Minimal (Level 1). There is only a very small user community and the assets at its disposal are inadequate for even routine reliance upon the Internet for daily functions. There are a few networking experts in the country, and a program to train more, but there are no highly skilled users beyond that professional core who could integrate the Internet into Bosnian daily life.

Determinants

The overriding factors that affected the development of the Internet through late 1997 were the war and its aftermath. It is surprising that the Internet is present in Bosnia at all. The primary impetus behind the university's plans for expansion is a desire to increase contact between academics in Bosnia as they reconstruct the country's educational system. However, it was the popularity of electronic mail that convinced the PTT that the establishment of a nationwide Internet network could be profitable. Table 26 lists some of the most important determinants of Bosnian Internet dimensions and describes their effects on those dimensions.

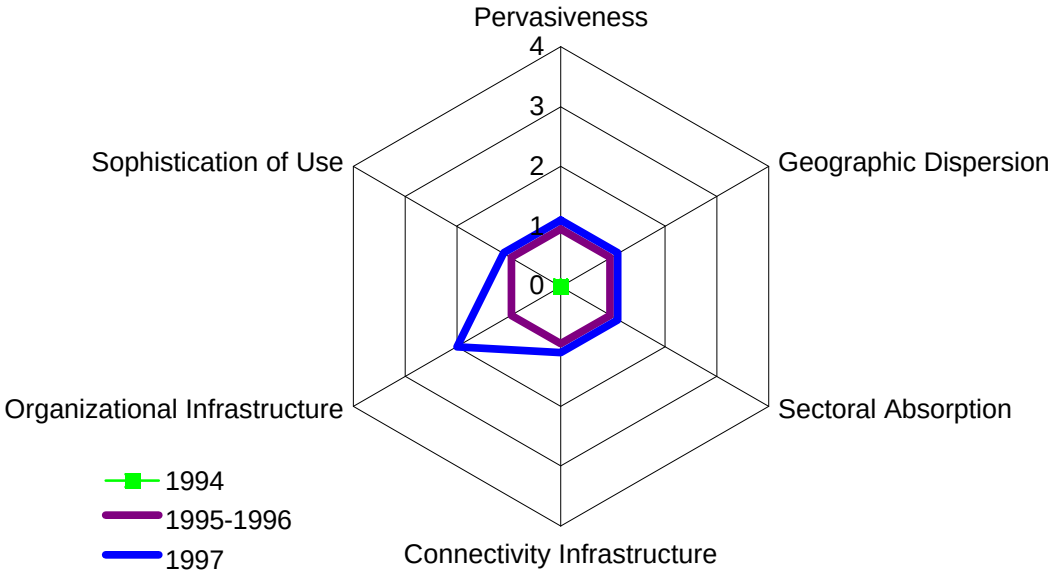

Figure 10. Internet Dimensions for Bosnia

Over the long term, the state of the telecommunications network will be a significant limiting factor in expanding the Internet in Bosnia. There are insufficient telephone lines to serve the existing population, and inter-city connections are in even shorter supply. Where service is available, it is relatively expensive, a situation that should change as the country recovers from the war and prices and services stabilize.

In the near term, however, equally limiting is the effective division of the telecommunications network into three separate entities, only one of which is responsive to Bosnian government authority. The operations of the other two networks are illegal, and the DPA specifies that they must be reconnected to the PTT, which the DPA also specifies must be privatized, but there are no signs of any changes in the near term.

Another brake on Internet development is the monopolistic policy of the Bosnian government. At a minimum, the PTT will continue to provide the infrastructure and international Internet links for all Internet activities in the country save the academic community. It is still questionable whether

private companies will be allowed to resell PTT Internet services, thereby essentially becoming ISPs. If and when the country's telecommunications networks are unified, the Croatian telephone company's Internet lines will certainly be disconnected, but there is no information regarding how the nominally-private ISPs in the RS might be treated. Most likely, their continued licenses to operate would be a Serbian precondition of system unification.

Table 26. Effect of Determinants on Dimensions in Bosnia

Determinant Quality	Affected Dimension
Monopolistic economic policies	Pervasiveness—inhibited by lack of competition Organizational Infrastructure—constrained by monopolist policies
Unsettled foreign relations	Pervasiveness—limited by inability to offer services to two-thirds of the country's population due to partitioning and Croatian interference Geographic Dispersion—limited by direct Croatian operation of a portion of the PSTN and other telecommunications services Connectivity Infrastructure—limited by lack of PTT access to the RS
Insecure domestic situation	Sectoral Absorption—inhibited by preoccupation with other problems Connectivity Infrastructure—limited by a lack of funds due to unwillingness of potential investors to commit money because of the potential for renewed conflict
Severely damaged infrastructure	Pervasiveness—limited by lack of local and inter-city telephone lines Geographic Dispersion—limited by lack of trunk lines Sectoral Absorption—precluded by significant damage to potential client sectors (e.g., health care, government, businesses) Connectivity Infrastructure—limited by destruction of a significant portion of the telecommunications network and emphasis on restoration of basic services
Stifling bureaucracy	Organizational Infrastructure—competition limited or precluded by presence of multiple corrupt constituencies in the overlapping, inefficient bureaucracies
Lack of stakeholders	Limits the potential development of all dimensions due to the lack of strong advocates
Destruction of supporting industry	Connectivity Infrastructure—limited due to the requirement to import all equipment and software at great expense; ameliorated to some extent by foreign donations Sophistication of Use—While a small core of hardware and software professionals remain, the war caused a massive "brain drain" as many of the best and brightest departed for safety
Dysfunctional competitive environment	Organizational Infrastructure—development of commercial competition is hampered by the insider trading and secret deal-making that characterize the Bosnian business landscape; competition is for pay-offs and high profits rather than in the marketplace

The current and projected poor states of the economy are also seriously limiting factors, in that investment funds are scarce on the one hand and consumer (i.e., potential subscriber) funds are even more constrained for most of the population. Additionally, even for those who can afford computers, there is no steady supply of equipment, peripherals, consumable supplies, or electricity.

Problems and Prospects

The outlook for the further development of the Internet in Bosnia in the near term is poor, even as projects currently underway reach fruition. Further development is largely dependent upon the political situation.

As long as the country is divided, the telephone network will likely remain similarly divided, reducing the potential for the establishment of a single Internet infrastructure within the country. Policy-makers in Zagreb and Belgrade will determine whether there is any network growth in the Croatian- and Serb-majority areas, respectively. The PTT network could eventually provide adequate services within the Bosnian-majority areas of the Federation, but further Internet development must compete with other, generally higher-priority, telecommunications projects for scarce budget resources. Furthermore, the potential customer base beyond the major urban areas is questionable. The most likely Internet users in the smaller cities and towns are members of the local governments, who could use Internet communications to improve coordination efforts. (Coordination works both ways, however. Those working against the peace process could also benefit from the availability of electronic mail and common data access.)

Both the Soros Foundation and University of Sarajevo have established good foundations for further proliferation of their networks, including training programs and the presence of a cadre of networking professionals (notably lacking at the PTT). However, they are hampered in their efforts to establish nationwide networks to serve, respectively, the NGO and academic communities both by PTT policy in the Bosnian-majority areas and by the continued partition of the country and telecommunications network.

Tab A **Bosnia Glossary**

APC	Association for Progressive Communications—APC was founded in 1989 to coordinate the operation and development of networks devoted to peace, ecology, human rights, and other "progressive" causes.
Bosnia	The Republic of Bosnia and Hercegovina
DM	Deutsche Mark
DPA	Dayton Peace Agreement—The "General Framework Agreement for Peace in Bosnia and Herzegovina," initialed by the parties in Dayton, Ohio, on 21 November 1995 and signed in Paris on 14 December 1995.
Federation	The Muslim-Croat Federation of Bosnia-Hercegovina—The portion of the Republic of Bosnia and Hercegovina to be governed by a Muslim-Croat coalition under the provisions of the Dayton Accords.
HPT	Croatian Post and Telecommunications—The state monopoly telecommunications company of Croatia, which also controls part of the Bosnian PSTN and offers Internet access in one Federation city.
HVO	Croatian Defense Council—An ethnic-Croat militia in Bosnia with responsibility for administering areas under Croat control prior to the establishment of the Federation.
IDP	Internally Displaced Person
IFOR	(DPA) Implementation Force
Muslim	For the purposes of this chapter, a Bosnian adhering to the Islamic faith.
OHR	Office of the High Representative (for implementation of the DPA)
OSCE	Organization for Security and Cooperation in Europe
OSI	Open Society Institute (Soros Foundation)
PTT	Post, Telegraph, and Telephone—The republican PTT is the *JP PTT Saobraca*, the Joint Stock Company for PTT Operations. It is 100 percent state-owned.
RS	Republika Srpska
SFOR	Stabilization Force—NATO-led military coalition to stop the war in Bosnia.
SGI	Silicon Graphics Inc.
Srpska	The Republika Srpska—The portion of the Republic of Bosnia and Hercegovina governed by ethnic Serbs under the provisions of the DPA.
UTIC	University TeleInformatic Center—University of Sarajevo's Internet center
ZTN	ZaMir Transnational Network

EKIS

Haris Had`iali}, Director
Delegated authority by the Director of Telecommunications to manage the *.ba* national TLD through UTIC. Has authority to directly manage the *.edu.ba* domain, and registers domain names, assigns IP numbers, and maintains the domain name server for the other domains (e.g., *.com, .net, .org, .gov*).
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