NAVIGATION ON THE INTERNET AND ITS HISTORY WITH GRAPH THEORY

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ABSTRACT

The Graph Theory examine vertices and sets of relevant vertices connected by edges, constitute an important branch of Math. Our study consists of two sections. In the first part where vertices represent the Internet and edges represent the connections, national and international network connections that use internet as a base and formation of these connections will be shaped by way of Graph Theory. In the second part historical development of the Internet will be shown chronologically. According to the Multiple Intelligence Theory, blending of oral and visual information appeal to more sense organ thereby the persistence of learning will be provided. When using graph theory with a timeline it is envisaged that chronological events will be transferred easily.

Key Words: Graph Theory, Internet, History of The Internet, Network Topologies

1.INTRODUCTION

Communication is one of the very basic need of human beings as a social entity. Technological developments in communication which has started with the invention of press has arrived to these days with telegram, newspaper, motion picture, telephone cables, radio, TV, communication satellites, computer networks and internet respectively(Güçdemir,2003:372). Computers which are originally envisaged to make severe calculations that is hard to accomplish by human brain, underwent a change between 1960-1980 and born as a means of communication. With the help of technological developments in that years, computers which operating locally connected each other, in turn constitute computer networks. With the connection of these local networks to each other the Internet risen up. Increasing number of communication channels which is caused by proliferation of computers and networks are the main reason behind the social and cultural alteration that is encountered today.

The excessive usage of Internet in daily life may cause many to consider it as just consist of social networks or searcing engines and developed solely for this purpose. But when we scrutinize its history, it is evident that it is designed for completely different reasons and evolved its current shape because of different factors.

1.1 Historical Developmet of the Internet

Todays internet, as it has always been, bushed out of seeds that US government had sowed. Soviets launching of sputnik in October 4, 1957 raised apprehension of Americans in terms of security(Ridgen,2007). President of that period, Eisenhower, found Advance Research Project Agency (ARPA)in February 7, 1958 to re-establish the dominance that USA lost in technological arena(Kleinrock,2010). The nuclear threat that was formed by Russia proved Americans of a command, control and communication system which was supposed to be solid and durable. The purpose of intended system was communication, software sharing and remote connection to terminals(Sebasta,2011:22). Single point of failure of the intended system was a matter which is not wanted by the experts. Because of this reason distrubuted architecture was adopted and there was more than one alternative to go from one point to another.

ARPA which is formed by Department of Defence get to work to create such a network. On May 1 1969, University of California (UCLA), Stanford Research Institute (SRI), University of Utah and UC Santa Barbara (UCSB) connected each other with a network named ARPAnet(Kurose, et al.,2010:88).

In 1970's many university and non-governmental establishment started to work for setting up their own network, free from ARPAnet. ALOHANet, Telenet, Cyclades and Tymnet was some of those. ALOHANet was developed to connect universities on Havaii island in 1971(Abrahamson, 2009). This network was differ from its contemporaries with the capability of linking wirelessly. Also the usage of @ sign with the same meaning of

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today coincided to 1971. In 1971 the very first e-mail was sent by Ray Tomlinson via network(Fleishmen,2012:52). Tomlinson, in his e-mail, used the @ sign with its meaning in English.

In 1972, the Telenet was found by Bolt Beranek and Newman in order to export packet switching method to commercial arena. The company started serving by set up its first network in 1975(Mathison, et al.,2012).

In 1973, the CYCLADES network was established with the efforts led by Louis Pouzin in France. The purpose of CYCLADES was enable French government to access different data bases which were located in remote areas(Pouzin,1973). Developed independently from ARPAnet, this network was the first architecture to put the responsibility on end systems instead of network itself, to transfer of data over network undividedly.

Tymeshare Coorp., which was found to serve as main frames in 1966, decided to install its own network due to problems that she had with ISP's. As a result of this decision Tymnet showed up (Mathison, et al.,2012).

ARPAnet was set up for the purpose of military studies. So it was used solely in campuses that serve the intention of DoD. Whats more, the costs of lines which were used to connect to the ARPAnet was so high that it was hard for companies to endure. Hence, the Usenet which connect Duke and North Carolina Universities was set up in 1979(Lambert,2005). Calling of it as ''poor man's network'' was an indication of its lower cost.

Pioneering work on interconnecting networks (under the sponsorship of the Defense Advanced Research Project Agengy (DARPA)), in essence creating network of networks, was done by Vinton Cerf and Robert Kahn(Kurose and Ross,2010:90). This structure constitute base to todays Internet.

Although computers which were connected to ARPAnet could communicate with each other, communication between independently developed networks might not possible. Because each of them was talking a different language. To be able to enable communication between separate networks Transmission Control Protocol(TCP) was developed. TCP accepted as a standart with Internet Protocol (IP) to connect networks in 1982 (Sebesta,2011:23).

With the worldwide acception of TCP/IP as a standart in 1982, there was a huge increase in the number of people who connected to the Internet. HOSTS.TXT files which used back then to match the ip addresses and host names of the computers (by this means isolate people from the complicacy of memorising ip addresses) become too big to handle this growth. It was obvious that more obsolete system was needed. Afterwards in January 1, 1985 Domain Name System (DNS) was developed(Pope, at al.,2012). First domain name symbolics.com was taken by Sybolics Computer firm in March 15,1985 (Boulton,2014:46).

Preparation for setting up the World Wide Web (w3) was started by Tim Barners-Lee in 1990. W3 is an information pool that helps people, who are in different locations, to share their ideas(Berners-Lee, et al.,1994).

Until the 1994 many command was given to the computers by command prompts. In 1994 Graphical User Interfaces (GUI) was developed by different companies and thus it became easier to surf on web. In 1995 it was allowed to use w3 by high and low(Jensen,2000).

When Internet born, data was sent over the phone lines. To accomplish this dial up modems were used. This modems was converting data to voice signal, sent it to the receiver and than converting it back to the data again with the help of modem at the other side. To be able to connect to the Internet, users must call their ISP and when the connection was established by the ISP one could reach the outer world. Although its invention reach back to 1940s, proliferation of the DSL technology was in 2000s.

Difference between DSL and dial-up is DSLs sending voice and data in different frequencies over the same cable. For example while frequencies under the 4KHz is used for voice communication, above is used for data (Brookshear,2009:182). One of the biggest disadvantage of using dial-up technology to access to the internet is while accessing to the internet the phone will be busy. Thanks to the DSLs ability of sending data and voice over the same cable simultaneously, it become possible to access to the internet without busying phone line.

With the increasing usage of DSL technology all over the world and thus, use of internet more conveniently at homes pave the way for the proliferation of popular web applications like e-mail, www, file sharing and instant messaging. These apps made the life easier and instead of being luxury, they become a basic needs which result increase in peoples dependence on Internet.

In the beginnings of 2000s Internet become an indispensible part of daily life and it was not sensible for people to spent their time sitting in front of a computer, because it would take much of their time. In this time very basic services from shopping and booking to health care and reading a magazine moved to the Internet. Proliferation of mobile devices thanks to the technological developments increased people needs to mobile Internet. The increasing ubiquity of high speed public WiFi networks and medium speed Internet access via cellular telephony networks made it possible to remain constantly connected(Kurose and Ross,2010:93).

Occurrence of WiFi technology goes back to decision that was taken by USA National Communication Committee in 1985 about openning of some part of wireless spectrum to public. But the standardization of invented technology was done by the Institute of Electrical and Electronic Engineers (IEEE) in June 1997(Erdem and Tuğral,2009:1-10). On the back of acception of WiFi as an industrial standart, number of devices which were use WiFi in homes increased and it become possible to control devices like TV, refrigerator and printer remotely. Almost every home and work place converted to a Local Area Network (LAN) which composed of WiFi enabled devices.

Popularisation of WiFi at homes and offices suggested the question of setting up the same technology with enough acess point throughout all the city which named Municipal WiFi. It was tried a couple of different city like San Francisco, Chicago, Tempe, New York City, Boston and Mineapolis in USA but it failed because of different reasons(Jassem,2010).

One of the reasons behind the failure of Municipal WiFi project was 3G technology whose preliminary works were done at that time. First 3G network was set up in Japan in 1998. This rising technology spread like wild fire and reached more than 2 million users in 2006(Dahlman et al.,2007:3).

Developing communication technologies force people to demand more bandwith(Liu et al., 2014). To be able to satisfy this increasing demand 3'rd Generation Partnership Project (3GPP) started to work for transition to next generation (4G) on mobile broadband (3GPP,2006). 4G was superior to 3G in terms of bandwith, storage, compatibility and smooth connection between different systems(Shen and Xu,2014).

In April 2008, it was started to development of 5G with a protocol which was signed between NASA and m2mi corp(NASA,2008). It is foreseen that the global proliferation of 5G will be around 2020. Even if some nations working for upgrade to 5G, common mobile broadband technology which is used in this day and age to access the internet is 4G.

1.2 Development of Internet in Turkey

In 1986, Turkey Universities and Instituons Network (TUVAKA) was established in Turkey(Ulakbim,2015). This network was used only by national universities and research centers.Turkeys first international network connection established with European Academic and Research Network (CERN) in France, which was started by connection of Ege University in 1986 and continued with Anadolu, Yıldız Technical, İstanbul Technical, Boğaziçi, Fırat, Ortadoğu Technical, Bilkent and İstanbul universities in 1987 respectively(Cagıltay,2015).

According to a proposal from IT Department of Middle East Technical University (ODTÜ) to Scientific and Technological Research Council of Turkey (TUBİTAK), studies with respect to the Turkey's connection to the internet was started by Turkey's Internet Project Group (TR-NET) in 1991 (Cagıltay,2009:20). TR-NET is a project group formed by ODTÜ and TÜBİTAK to establish internet connection of Turkey. In 1992 Turkeys first experimental internet connection was establish between Netherlands and ODTÜ using X.25 protocol(Ulakbim,2015). Later on Turkeys first formal connection to the internet done to National Science Foundation Network (NSFNet) in USA with using routers in ODTÜ via TCP/IP(METU,2005).

Until 1996, universities (Ege, Bilkent, Boğaziçi and İstanbul Technical University etc.) and many other state instituons and organizations in Turkey could access to the internet using this 64Kpbs line which was countries' only gateway then. In 1995 speed of this line doubled (Ulakbim,2015). After, TURNET (which was found to serve business organizations and individual users in 1996) and Turkish National Academic Network (ULAKNET) (which is found to establish academic institutions network connection between Ankara, İzmir and İstanbul in 1997) started working respetively(Arısoy,2009).

In Agust 28, 1998 in order to generalize the Internet access on every corner of Turkey and provide fast and more quality service, Turk Telecom Network (TTnet), Turkish National Internet Infrastructure network contract signed (Telekom,2007).

In 1999 first wireless network of Turkey was established in ODTÜ. After completing planning efforts and purchasing of equipmets in 1999 pilot application of network finalized in April 2000. Within the concept of this project end users in Big Sport Hall, ODTÜ-MET and Psychological Counseling and Guidence center connected to the internet wirelessly(METU,2005). In 2005, TTnet WiFi hotspot was put into service in 160 point like hotels, airports, malls, cafes, restaurants, fair centers and universities(Telekom,2007).

In December 2003, project of connecting 42500 schools to the internet with ADSL technology is started by TT and Ministry of National Education partnership(Telekom,2007).

In September 7, 2007 Telecommunication instituon lodged a tender to transition to the 3G. But the tender was cancelled because there was only one bidder (which was Turkcell). Second tender was held in June 5, 2008.

According to this tender Turkcell get 3 channel, Avea and Vodafone get 2 channel each. Turkeys 3G transition date is July 30, 2009 (Wikipedia,2015).

1.3 Graph Theory

Graph Theory was showed up by a Euler's lecture named "7 Bridge of Königsberg" published in 1736. City of Königsberg was located in the two shore of the Pregel River plus two island inside of the river. The island which is bigger than the other was connected to the two side of the river with two bridge for each shore. Smaller island connected to each shore with one bridge. There was also one bridge between the two island (Golumbic, 1980).
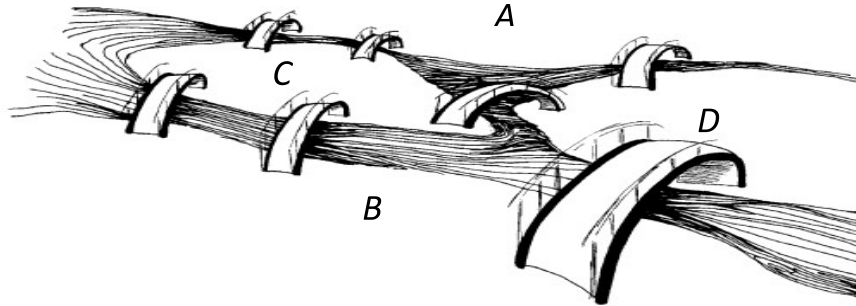
Figure 1: 7 Bridge of Königsberg

7 bridges problem: to devise a walk through the city that would cross each bridge once and only once, with the provisos that the islands could only be reached by the bridges and every bridge once accessed must be crossed to its other end. The starting and ending points of the walk must be the same (Bondy and Murty,2008).

Euler represented the four part of the city with dots and the bridges (which connect to these dots) with edges
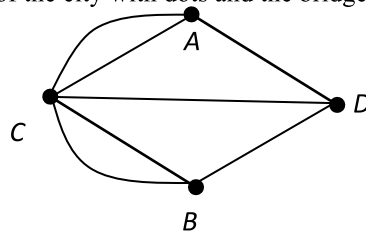

Figure 2: Display 7 bridges of Königsberg with the dots and edges

and symbolise the problem with this graph.Accordingly the problem of Königsberg Seven Bridge had this shape: Is ıt possible to turn back to the starting point crossing each edges once and only once? To be able to complete such a tour under the given circumstances number of dots with odd degree must be 0 or 2. By proving its imposibility, Euler revealed that there is no known solution for the problem(Trudeau, 1993).

With the studies done by Cayley in organic chemistry, Kirchhoff in electric grid and Hamilton in several areas showed that Graph Theory occupy an important position in different field of application.

By enabling lucid representation of problems in the area of computer science, engineering, financial systems, sociology, psychology, science etc. Graph Theory helps us to solve difficult problems both in daily life and in scientific matters.

1.4 Representation of Well-Known Network Topologies with Graph Theory

1.4.1 Full-Mesh Topology

In this topology every station is directly connected every other station in the network. By means of redundant lines communication continue in case of a failure in some connections. Fault tolerance of system is high.
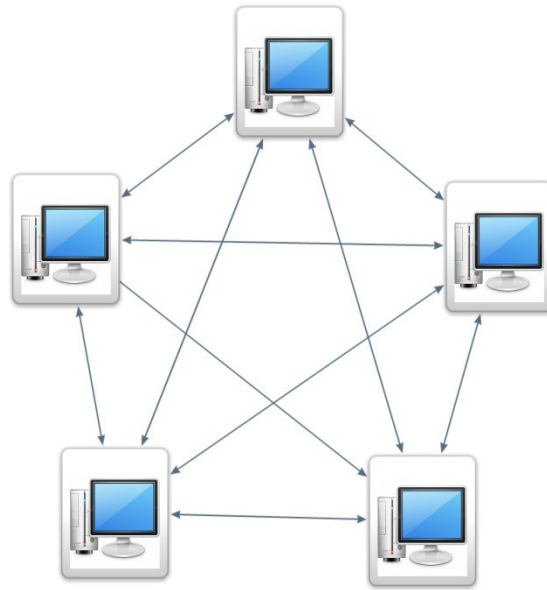
Figure 3: Graph Representation of Full Mesh Topology

1.4.2 Partial Mesh Topology

This topology is the same with full-mesh except the amount of redundancy. Because of mainly cost and many other reason some of the connections that is seen on full-mesh is removed. Nevertheless it provide some redundancy.
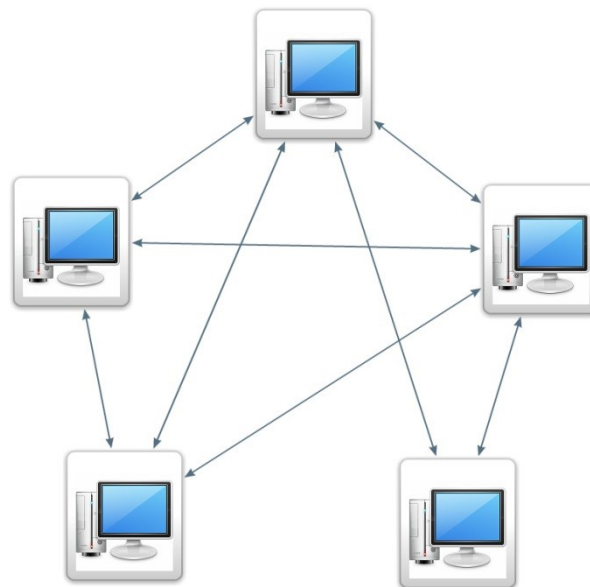

Figure 4: Graph Representation of Partial Mesh Topology

1.4.3 Ring Topology

In this topology communication will continue if only one line between the stations goes down. If two or more line go down at the same time there will be lameness in the communication.
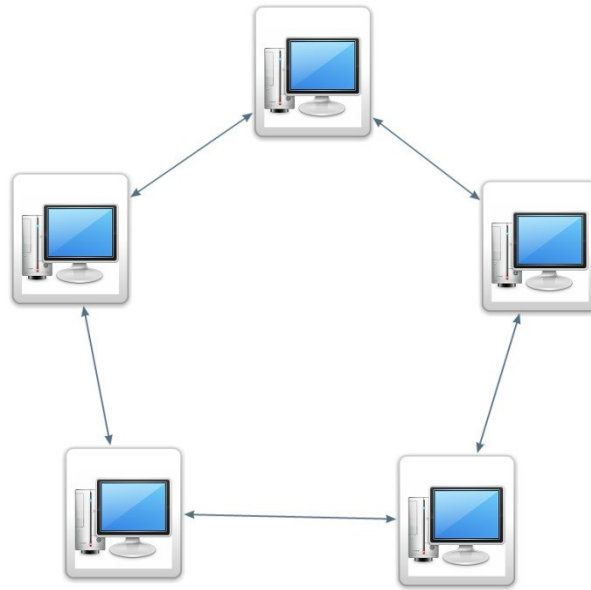
Figure 5: Graph Representation of Ring Topology

1.4.4 Star Topology

This is the most prevalent topology used present day. The problem encountered by a station effect no one except the station itself.

Figure 6: Graph Representation of Star Topology

2.PURPOSE OF THE STUDY

Increasing content sizes and online application variety skyrocketed the users need to the higher bandwidth. Nowadays, tolerance of people being offline fall mainly because many of routine operations go online. What we have in hand is Internet has arrived to a completely different point from it was supposed to be in its crawling days. So it is noted that understanding its development is also important. Seperately it is thought that Graph Theory will represent the historical development of the Internet from past to present richer in terms of visual presnement and show the cause and effect relation between the events more understandably.

3.METHOD

This study has a depictive nature and consist of two section. In the first part, where dots represent computer networks and connections represent edges, national and international network connection of all Internet enabled devices of present-day and creation of this networks is shaped by Graph Theory. In the second part historical development of the Internet is shown by Graph Theory.

4. FINDINGS

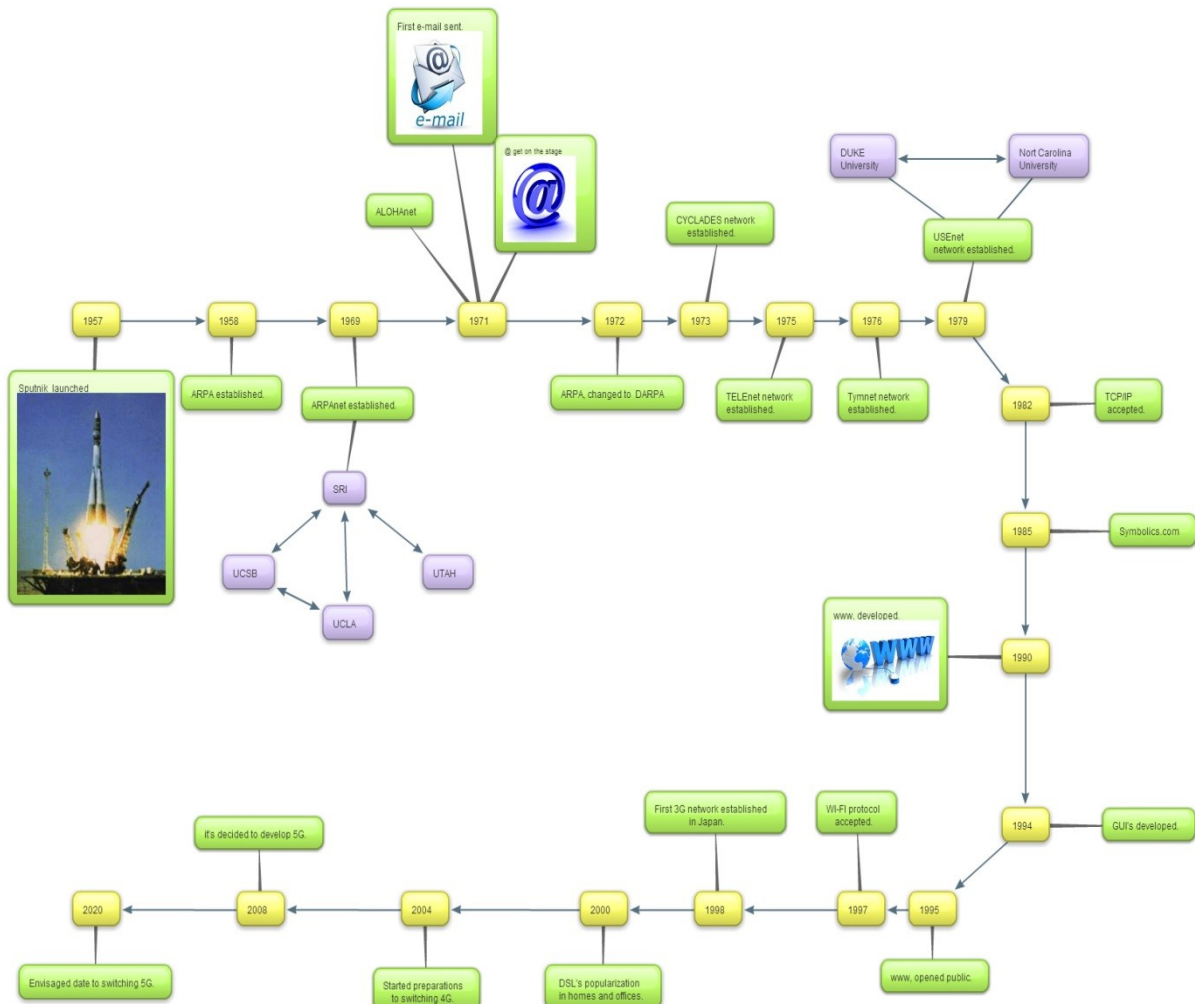### 4.1 Representation of World Internet History with Graph Theory

Figure 7: Representation of World Internet History with Graph Theory

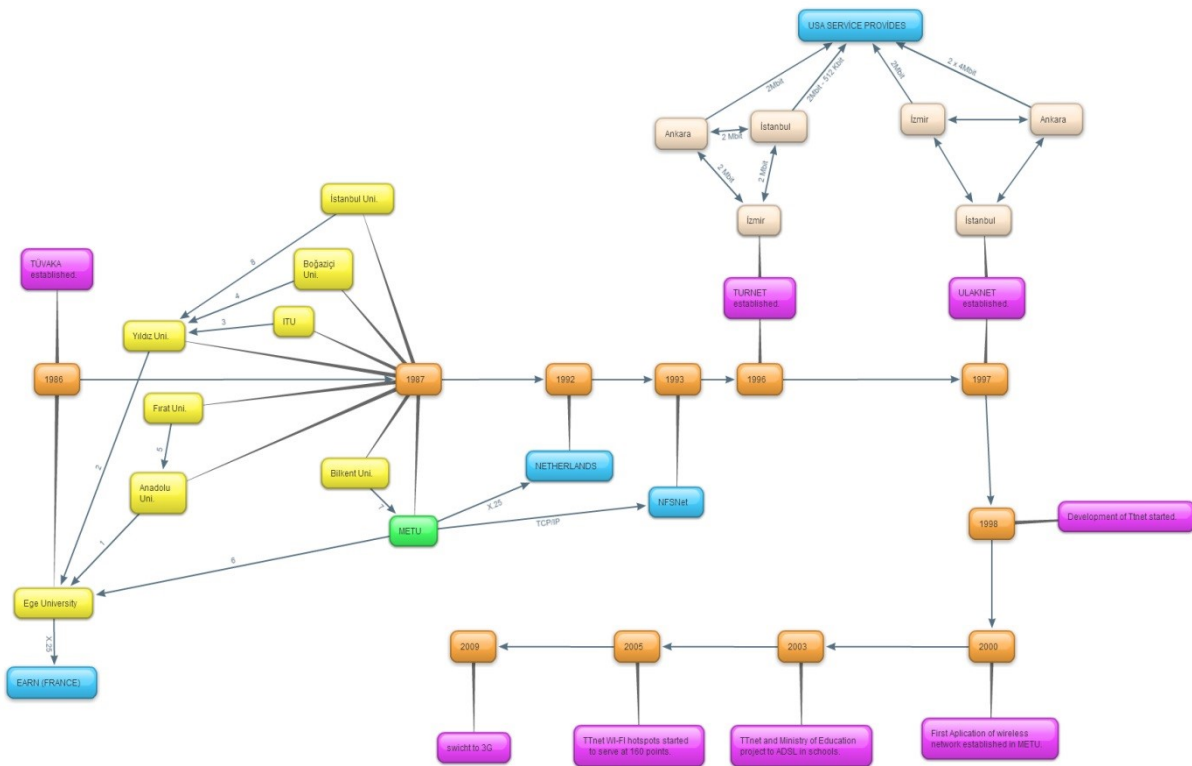**4.2 Representation of Turkey's Internet History With Graph Theory**

Figure 8: Representation of Turkey's Internet History With Graph Theory

5.CONCLUSION

Teaching material is one of the key element of teaching-learning process. Especially after the adoption of student centered education concept, usage of teaching materials by educators has gained huge importance. Teacher who was supposed to be a counseller, is not responsible for giving the lecture ideally but obligated to teach the lesson fertilely and asure the permanence of the knowledge, instead(Ulusoy and Gülüm,2009).

While teaching topics like history which is contain quite a few abstract notion, using visual materials is more effective than just using written material. It is evident that students learn easly with visual description. Whats more, students which learn better in oral way may need visual support to learn some concepts(Ulusoy and Gülüm,2009).

In this study, it is concluded that Graph Theory present the historical development of the Internet from past to present richer in terms of visual presenment and show the cause and effect relation between the events more understandably. In this way it equip the educators with a new material which help them to learn chronologic informations via visual description more easily. Besides it is thought that students talents of organize abstract informations and combine concept through synthesis will be developed with the help of this material.

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