CHAPTER - I

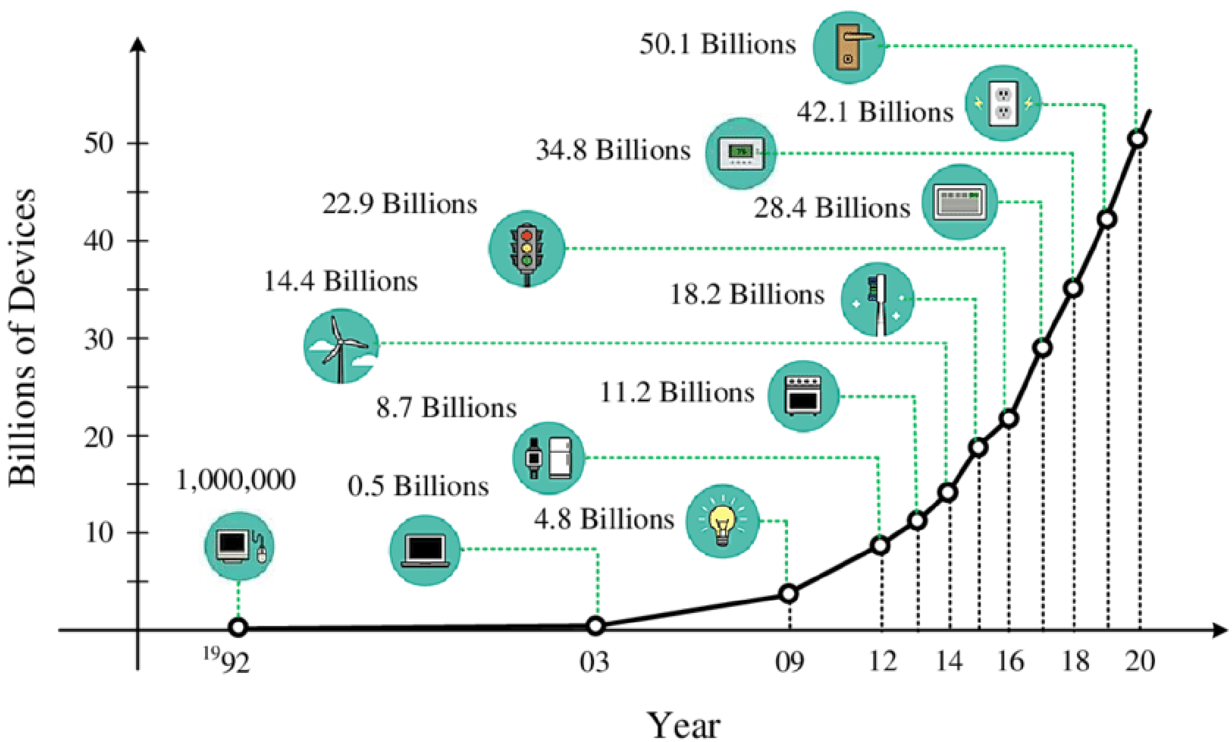
THE INTERNET IS NEVER AS IS

OverTheNet

Main Elements of the Internet - Overview

According to research, more than 5 billion devices gained access to the internet in 2015. By 2020, this number had increased to 25 billion. As of the beginning of 2022, the number of devices connected to the Internet has been determined as approximately 13.3 billion. It is estimated that this number will reach 76 billion in 2025.

The linear increase doubles itself every year. By 2025, the number of devices connected to the Internet will be approximately 10 times the world's population.



It's all about electromagnetic waves. These waves appear in various forms. Depending on the nature of electricity, various structures have been used to transmit electricity in the history of the internet. Depending on the efficiency of a structure, developments continue. Electromagnetic waves flowing from one end to the other carry what we now call information, knowledge, packet etc. For now, let’s call it “knowledge”. The knowledge encoded in electromagnetic waves is transferred from a transmitter/host (generating the information) to a receiver/client (learning the information).

These end-to-end systems need connections to enable this transmission. The electromagnetic wave has to flow through a system. We need "communication links" to ensure this electromagnetic wave communication. This transmission/reception process is provided by copper wire, fiber-optic cables, physical communication means, transmission lines such as radio spectra or free space optics. You can also do this knowledge transfer process by transmitting an "SOS" message with a standard flashlight, or by speaking. What matters is what your goal is.

In the light of technology, the capacity and efficiency of all these communication links have been tested. A series of system tests are performed, mainly based on Ohm Law and The Gauss's Law.

OHM LAW	V = IR V: voltage I: current R: resistance

The most basic circuit involves a single resistor and a source of electric potential or voltage. Electrons flow through the circuit producing a current of electricity. Resistance is a circuit property that offers opposition to the flow of electrons through a wire. The resistance is measured in ohms and depends on the geometry of the resistor and the material used in the resistor. At the atomic level, free electrons in a material are in constant random motion continually colliding with one another and the surrounding atoms of the material. When an electric field is applied, the electrons preferentially move in the direction opposite to the field. The planes in which the electrons are located can therefore determine the quality and speed of the transfer.Different materials have different values of electrical conductivity. Current is measured in amps. Current is charged particles which flow from the voltage source through conductive material to a ground. This information can be kept in mind for now.

The Gauss's Law relates the flux through any closed surface and the net charge enclosed within the surface. When this law is applied, we consider the existing transmission cable to be a Gaussian planar. The type of communication you use determines how robust the field or communication link information transmission can be. Overload or resistance are undesirable elements for communication.

The choice of communication links has been and continues to be determined over the years within the framework of such physical laws. To sum up, different links can transmit data at different rates, with the transmission rate of a link measured in bits/second. We call it simply bit-rate. Bit-rate/data-rate refers to the rate at which data is processed or transmitted. We can also define it as the number of bits per second passing through these communication links. It is usually measured in seconds, ranging from bps to kbps and mbps for smaller values.The knowledge generator sends the knowledge/bit it produces to the knowledge receiver in bits that can be transmitted in a given second. The bit-rate varies depending on the transmission characteristics of electromagnetic waves, communication links types or efficiency of the transferred area. Every device connected to the Internet communicates with each other at a certain bit-rate.

BIT-RATE	BR = D/T BR = Bit-Rate Volume D = Amount of Data (total bits) T = Time (seconds)

A certain number of bits can be called packets. It is similar to the process of generating a meaningful word from many letters, and the bit-rate rate determines how many letters are transmitted per second. These packets are transmitted from one end to the other at speeds close to the speed of light. End systems are also referred to as hosts because they host (that is, run) application programs such as a Web browser program, a Web server program, an email client program, or an e-mail server program. All of these issues will be discussed in detail in the following sections. These are not the details to be discussed here.

Various connection layers and forms have been developed for the healthy execution of communication. The existence of layers and forms is necessary in order for packets, which are collections of knowledge, to be transmitted in a meaningful way and to be produced and decoded again. Because humans cannot read machine language or electromagnetic waves directly. Basic concept of packet switch (router, link-layer switches) becomes meaningful at this stage. Knowledge must be produced, transmitted, stored, deflected, manipulated, reanalyzed, and understood. Packet switch is important for units responsible for processes of knowledge.

Packet switches can be found in many forms. But two subheadings draw attention the most: Router, Link-layer switches.

Both types of switches forward packets toward their destinations/receivers. Link-layer switches are typically used in access networks, while routers are typically used in the network core. One is more general, the other has more specific purposes within the kernel. As knowledge is transmitted, it passes through the paths created by these terms. These paths are called “routes”. Routes contain various sub-elements. Sometimes it can be a single plane, sometimes it requires complex maps. Each has its own logical process. There will always be a space for the "bits" to float, and these "bit" relays will always be needed for the correct propagation of knowledge.

Something's Owner is Always Found - Perspective

Every knowledge produced reaches the receiver by following routes such as from the source/generator to the packet switches, from the packet switches to other switches, and from there to other switches and so on, along the preferred communication links. The path can be long or short.

If we are talking about the internet world, we should call the concept of knowledge "bit". Every device produces bits, from the earliest technological means of communication (morse code systems, telegraphic transmissions etc.), to mid-range information generators (primarily traditional desktop PCs, Linux workstations, web pages and e-mail messages etc.) and advanced technological devices (laptops, smartphones, tablets, TVs, gaming consoles, thermostats, home security systems, home appliances, watches, eye glasses, cars, traffic control systems). There is a transmitter and receiver concept for all of them. Of course, they all have individual or global owners. The devices that you produce the knowledge, the devices that provide the distribution after the knowledge is produced, the systems that integrate these devices and the structures in which the knowledge is transmitted will always have an owner. Every produced thing has a producer band and the band has an owner, of course

Access to the Internet is impossible without an intermediary. Even if you create your own systems, you need other system manufacturers for global communication. When you do not prefer this, you need to establish a closed-circle system and the cycle continues within your own limited structure. Within the global open system, everyone without exception accesses the Internet through ISPs (Internet Service Providers).

ISPs are gateways to the global internet for you. ISPs are classified differently according to their capacity. There are ISPs owned by individuals, private companies, or governments. “Residential”, “Corporate”, “University-based”, and “Sub-provider” ISPs are the most well-known titles. Each ISP has its own knowledge transfer network, packet switches and communication links. The Internet is provided by these types of ISPs. These ISPs can be telephone companies, local cable companies, data generator and storage companies, private companies and universities.

Governments can also become ISPs within their own country. These ISPs offer wired and wireless access methods.

The Internet is all about connecting end systems to each other, so the ISPs that provide access to end systems must also be interconnected. Therefore, systems are interconnected with each other in the process.

As in every hierarchical table, there are units at the top and bottom in the ISP pyramid. They are called “lower-tier” and “upper-tier” generally. Both lower-tier and upper-tier ISPs can be national, international, or both. Lower-tiers are linked to upper-tier ISPs and access to the global is provided by upper-tiers. Names of some major ISPs: Level 3 Communications, AT&T, Sprint, NTT, Google, Akamai, Amazon etc.

An upper-tier ISP consists of high-speed routers interconnected with high-speed fiber-optic links. Although each ISP network is autonomous within itself, they interact with each other when it comes to global connections. It’s a “ Network of Networks”.

The internet didn't get to where it is today in a single day. Many levels have evolved over the years. It is a journey from simple systems to more complex systems. It evolved from a single branch to a tree with many branches, and from there to a forest. All these stages are called “Network Structures”. All these developments mostly developed depending on the parameters of the economic, political and cycle of needs.

Network Structure - Phase I

The concept of Access ISP (moderny IAP) emerged at this stage. Knowledge transfer methods and tools such as PCs, smartphones, Web servers, mail servers were connected to the Internet by Internet Access ISPs. The access ISP can provide either wired or wireless connectivity, using an array of access technologies including DSL (Digital Subscriber Line), cable, FiOS, FTTH, Wi-Fi, and cellular.

Access ISP does not have to be a telecommunication, a communication links or a cable company. A university (providing Internet access to students, staff, and faculty), or a company (providing access for its employees) can be an Access ISP. IAPs also include regional providers such as New England's NEARNet and the San Francisco Bay area BARNet.

Although each provides a circular service in itself, an additional understanding and intermediary was needed for a global knowledge transfer. The birth of Transfer ISPs arose. Transit ISP is a network of routers and communication links that not only spans the globe, but also has at least one router near each of the hundreds of thousands of access ISPs. As you can imagine, this is a very complex process. Additional designs require transmission means, cables and relay deployments, and data storage centers.

This entity table also established a seller/buyer relationship between ISPs. Access ISPs began paying fees to Global Transit ISPs. This fee is determined according to the bandwidth offered, data traffic and the number of users. Access ISPs became customers, Transit ISPs became vendors. In the free market, this competition has spawned many Access ISPs and their associated Transit ISPs. As this number increased, new models were needed.

Network Structure - Phase II

As the number of Transit ISPs and subunit Access ISPs connected to these ISPs increased, Phase-II emerged. Access ISPs used to have to submit to the prices offered by Transit ISPs, as there used to be a limited number of Transit ISPs. At this stage, the range of choices for Access ISPs has expanded. They can now choose among the competing global transit providers as a function of their pricing and services.

Transit ISPs also had to communicate with each other. As the numbers grew, the need for connectivity arose. Transit ISPs have to communicate with each other to set up the global internet network, or an undesirable vicious circle ensues. This time we can't talk about the global internet. At this stage, a global Transit ISP network and mechanism began to be established close to almost every Access ISP.

Thus, the first clusters were formed in Phase-II. Lower-tier was established by Access ISPs, Upper-tier by Transit ISPs.

As this network expanded and the cost table increased, a new concept emerged: Regional ISP. Regional ISPs have become a transmission tool for Transit ISPs who cannot establish routers and communication links everywhere. Access ISP is connected to Regional ISP and Regional ISP is connected to Global Transit ISPs. And each of them began to charge each other.

After a certain stage, many local ISPs started to appear in the early stages of Phase-II and the network became more and more complex.

Network Structure - Phase III and Phase IV

This is the stage where the multi-tier hierarchy is clearly evident**.** Although the main connection pyramid was preserved, additional nodes and intermediaries emerged. Agents also started to set up their own roaming switches. The concepts of Points of presence (PoPs), peering, multi-homing, and Internet exchange points (IXPs) entered the internet era. It is a period dominated by PoPs at the very beginning. A PoP is simply a group of one or more routers (at the same location) in the provider's network where customer ISPs can connect into the provider ISP. For a customer network to connect to a provider's PoP, it can lease a high-speed link from a third-party telecommunications provider to directly connect one of its routers to a router at the PoP. Third-parties focused solely on PoPs and served as PoP connectivity providers. Thus, third-party companies, primarily non-ISPs, were also included in the internet structure.

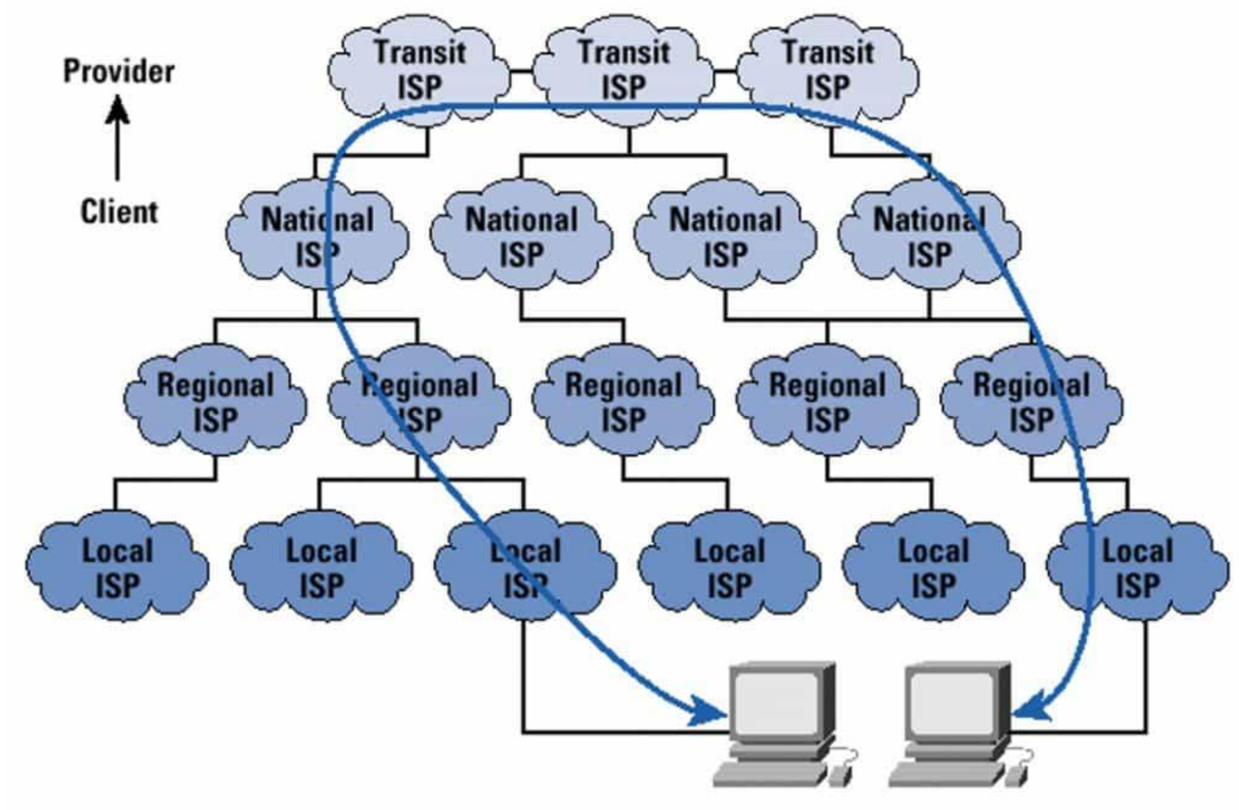
Multi-home solutions became popular later on. An access ISP may multi-home with two regional ISPs, or it may multi-home with two regional ISPs and also with a tier-1 (called Global Transit ISP for now) ISP. Similarly, a regional ISP may multi-home with multiple tier-1 ISPs. Even if there is a problem with a connection, the internet can still be provided with this method. Thus, we can call it the stage where internet access health and efficiency is provided for the first time. When an ISP multi-homes, it can continue to send and receive packets into the Internet even if one of its providers has a failure.

At this stage, the concept of peer was also born. In line with increasing costs and prices, some low-level tier ISPs have started to share their connection capacities with each other horizontally, not vertically. When two ISPs peer, it is typically settlement-free, that is, neither ISP pays the other. As noted earlier, tier-1 ISPs also peer with one another, settlement-free.

Along these same lines, a third-party company can create an Internet Exchange Point (IXP), which is a meeting point where multiple ISPs can peer together. An IXP is typically in a stand-alone building with its own switches. Due to each complexity of the network, the number of centers where the produced data passes and the points where the produced knowledge touches has increased. As the Internet structure becomes more complex, the probability of data manipulation has increased. Instead of moving from a single point to a single point, data has started to progress in a more complex structure.

In simple terms, an IXP is essentially a data center containing network switches that route traffic between the different network operators who share the costs of maintaining the physical infrastructure.

This ecosystem consists entirely of access ISPs, regional ISPs, tier-1 ISPs (global transit ISPs for now), PoPs, multi-homing, peering, and IXPs. This subtle transition between Phase III and IV has been made possible by the proliferation of these connection points.



Network Structure - Phase V

It is the stage in which today's internet structure begins to be defined. There is a complex network of intercontinental, transoceanic and a growing number of ISPs. The hierarchical order is even more pronounced. Many independent structures started to communicate with each other and created the global internet network. The importance of IXPs has increased even more and in some ways it has created hierarchical jumps.

Some of the Tier-I (formerly global Transit ISPs) ISPs have started to serve as Content Provider Networks (CPN). Tier 1 ISPs include AT&T, Verizon, Sprint, NTT, Singtel, PCCW, Telstra, Deutsche Telekom and British Telecom. A Tier 1 ISP only exchanges Internet traffic with other Tier 1 providers on a non-commercial basis via private settlement-free peering interconnections. The emergence of this new concept has changed the internet structure and continues to change. CPNs have started to take place at the top of this hierarchical structure. Worldwide data centers of CPNs, data network systems and hidden server systems to which they are connected have emerged. Some of these data centers house over one hundred thousand servers, while other data centers are smaller, housing only hundreds of servers. Some CPNs' data centers are spread across nearly all continents. CPNs have developed TCP/IP structures in which they connect to data centers, and connections to data centers are completely hidden. Private transport/connection networks and servers of CPNs bypass Tier-I ISPs or upper-tiers ISPs and either directly connect with low-tier ISPs or provide this communication via IXPs. To put it more succinctly, an Internet exchange point (IXP) is a physical location through which Internet infrastructure companies such as Internet Service Providers (ISPs) and CDNs connect with each other. For this reason, the importance and number of IXPs has increased and spread around the world. By creating its own network, a content provider not only reduces its payments to upper-tier ISPs, but also has greater control of how its services are ultimately delivered to end users. An additional detail, nowadays mostly networks talk between each other using the BGP (Border Gateway Protocol). This protocol allows networks to cleanly delineate between their internal requirements and their network-edge configurations. All peering at IXPs uses BGP. It should be studied under a separate heading. There are over 400 IXPs on the Internet today.

The list of companies includes major companies and organizations that use IXPs:

- CenturyLink
- Windstream
- Verizon Digital Media Services
- Bharti Airtel UK Limited
- Twitter
- Linkedin
- Salesforce.com
- Google
- Microsoft
- Amazon
- Digital Reality
- Williams College

IXP - Exchange Major Current List:

- 1IX (Amsterdam, Netherlands)
- 1IX (Kharkiv, Ukraine)
- 1IX (Kyiv, Ukraine)
- 1IX (Odessa, Ukraine)

- 1IX (Warsaw, Poland)
- 48 IX (Phoenix, AZ, United States)
- 4IXP (Rottweil, Germany)
- A.IX (Beirut, Lebanon)
- ABQIX (Albuquerque, NM, United States)
- ACT-IX (Canberra, ACT, Australia)
- AIXP (Arusha, Tanzania)
- AKL-IX (Auckland, New Zealand)
- AMPATH (Miami, FL, United States)
- AMR-IX (Amaravati, India)
- AMS-IX (Amsterdam, Netherlands)
- AMS-IX Bay Area (San Francisco, CA, United States)
- AMS-IX Caribbean (Willemstad, Curaçao)
- AMS-IX Chicago (Chicago, IL, United States)
- AMS-IX Hong Kong (Hong Kong, China)
- AMS-IX India (Mumbai, India)
- AMS-IX Kolkata (Kolkata, India)
- AMS-IX Singapore (Singapore, Singapore)
- ANI-IX Delhi (Delhi, India)
- ANIX (Tirana, Albania)
- AO-IXP (Luanda, Angola)
- APE (Auckland, New Zealand)
- ARMIX (Yerevan, Armenia)
- AZIX (Phoenix, AZ, United States)
- Aloha-IX (Honolulu, HI, United States)
- Angonix (Luanda, Angola)
- AqabaIX (Aqaba, Jordan)
- Asteroid Amsterdam IXP (Amsterdam, Netherlands)
- Asteroid Amsterdam IXP (Mombasa, Kenya)
- Asteroid Mombasa IXP (Mombasa, Kenya)
- Asteroid Nairobi IXP (Nairobi, Kenya)
- AuvernIX (Clermont Ferrand, France)
- B-IX (Belgrade, Serbia)
- B-IX (Bucharest, Romania)
- B-IX (Kapitan Andreevo, Bulgaria)
- B-IX (Skopje, North Macedonia)
- B-IX (Sofia, Bulgaria)
- BALT-IX (Frankfurt, Germany)
- BALT-IX (Kaunas, Lithuania)
- BALT-IX (Riga, Latvia)
- BALT-IX (Tallinn, Estonia)
- BALT-IX (Vilnius, Lithuania)

- BARIX (Bridgetown, Barbados)
- BBIX (Fukuoka, Japan)
- BBIX (Naha, Japan)
- BBIX (Osaka, Japan)
- BBIX (Sendai, Japan)
- BBIX (Tokyo, Japan)
- BBIX Amsterdam (Amsterdam, Netherlands)
- BBIX Chicago (Chicago, IL, United States)
- BBIX Dallas (Dallas, TX, United States)
- BBIX Hong Kong (Hong Kong, China)
- BBIX LA (Los Angeles, CA, United States)
- BBIX London (London, United Kingdom)
- BBIX Marseille (Marseille, France)
- BBIX Miami (Miami, FL, United States)
- BBIX Singapore (Singapore, Singapore)
- BBIX Thailand (Bangkok, Thailand)
- BCIX (Berlin, Germany)
- BDIXP (Bujumbura, Burundi)
- BFD-IX (Leeds, United Kingdom)
- BFIX (Ouagadougou, Burkina Faso)
- BHNIX (Sarajevo, Bosnia-Herzegovina)
- BINX (Gaborone, Botswana)
- BIX (Bergen, Norway)
- BIX (Budapest, Hungary)
- BIX (Jakarta, Indonesia)
- BIX (Jimbaran, Indonesia)
- BIX.BG (Sofia, Bulgaria)
- BIXP (Belize City, Belize)
- BKNIX (Bangkok, Thailand)
- BKNIX (Chiang Mai, Thailand)
- BKS-IX (Istanbul, Turkey)
- BNIX (Brussels, Belgium)
- BOSIX (Boston, MA, United States)
- BR-IX (Brno, Czech Republic)
- BREM-IX (Bremen, Germany)
- BW-IX (Karlsruhe, Germany)
- BY-IX (Minsk, Belarus)
- Bahamas-IX (Nassau, Bahamas)
- Balcan-IX (Amsterdam, Netherlands)
- Balcan-IX (Belgrade, Serbia)
- Balcan-IX (Bucharest, Romania)
- Balcan-IX (Budapest, Hungary)

- Balcan-IX (Frankfurt, Germany)
- Balcan-IX (Kapitan Andreevo, Bulgaria)
- Balcan-IX (Kyiv, Ukraine)
- Balcan-IX (London, United Kingdom)
- Balcan-IX (Sofia, Bulgaria)
- BaltIX (Baltimore, MD, United States)
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- Beirut-IX (Beirut, Lebanon)
- BelgiumIX (Antwerp, Belgium)
- BelgiumIX (Brussels, Belgium)
- BelgiumIX (Gent, Belgium)
- BelgiumIX (Leuven, Belgium)
- Benin-IX (Cotonou, Benin)
- Bharat IX Mumbai (Mumbai, India)
- Big APE (New York, NY, United States)
- Borneo-IX (Bandar Seri Begawan, Brunei)
- BreizhIX (Rennes, France)
- C2IX (Jakarta, Indonesia)
- CABASE Buenos Aires (Buenos Aires, Argentina)
- CABASE Concepcion del Uruguay (Concepción del Uruguay, Argentina)
- CABASE Jujuy (Buenos Aires, Argentina)
- CABASE Jujuy (Jujuy, Argentina)
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- CABASE-DLC (Buenos Aires, Argentina)
- CABASE-JUN (Buenos Aires, Argentina)
- CABASE-LPL (La Plata, Argentina)
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- CABASE-SZP (Buenos Aires, Argentina)
- CABASE-SZP (La Plata, Argentina)
- CABASE-TUC (Buenos Aires, Argentina)
- CABASE-TUC (San Miguel de Tucuman, Argentina)
- CAIX (Cairo, Egypt)
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- CAMIX (Yaounde, Cameroon)
- CAS-IX (Casablanca, Morocco)
- CATNIX (Barcelona, Spain)
- CFiX (Orlando, FL, United States)
- CGIX (Brazzaville, Congo, Rep.)
- CGIX (Oyo, Congo, Rep.)
- CGIX (Point Noire, Congo, Rep.)
- CHC-IX (Christchurch, New Zealand)
- CHIX (Christchurch, New Zealand)
- CHIX (Zug, Switzerland)
- CHIX (Zürich, Switzerland)
- CHN-IX Beijing (Beijing, China)
- CIIX (Los Angeles, CA, United States)
- CINX (Cape Town, South Africa)
- CIVIX (Abidjan, Côte d'Ivoire)
- CIX (Cork, Ireland)

- CIX (Katowice, Poland)
- CIX (Kraków, Poland)
- CIX (Warsaw, Poland)
- CIX (Zagreb, Croatia)
- CIX-ATL (Atlanta, GA, United States)
- CIXP (Geneva, Switzerland)
- CNI-IX (Bali, Indonesia)
- CNI-IX (Bandung, Indonesia)
- CNI-IX (Batam, Indonesia)
- CNX (Phnom Penh, Cambodia)
- CODIX (St. Petersburg, Russia)
- COIX (Bend, OR, United States)
- CON-IX Brisbane (Brisbane, QLD, Australia)
- CON-IX Melbourne (Melbourne, VIC, Australia)
- CON-IX Sydney (Sydney, NSW, Australia)
- CRIX (San José, Costa Rica)
- CSIX (Toronto, ON, Canada)
- CSIX (Vancouver, BC, Canada)
- Charlotte-IX (Charlotte, NC, United States)
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- DE-CIX Johor Bahru (Johor Bahru, Malaysia)

- DE-CIX Kolkata (Kolkata, India)
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- DE-CIX Palermo (Palermo, Italy)
- DE-CIX Phoenix (Phoenix, AZ, United States)
- DE-CIX Richmond (Richmond, VA, United States)
- DE-CIX Singapore (Singapore, Singapore)
- DET-IX (Detroit, MI, United States)
- DET-IX (Grand Rapids, MI, United States)
- DINX (Durban, South Africa)
- DIX (Aarhus, Denmark)
- DIX (Copenhagen, Denmark)
- DIXP (Dodoma, Tanzania)
- DN-IX (Donetsk, Ukraine)
- DO-IX (Essen, Germany)
- DRFortress (Honolulu, HI, United States)
- DRIX Ashburn (Washington, DC, United States)
- DRIX Atlanta (Atlanta, GA, United States)
- DRIX Chicago (Chicago, IL, United States)
- DRIX Dallas (Dallas, TX, United States)
- DRIX New York (New York, NY, United States)
- DRIX Phoenix (Phoenix, AZ, United States)
- DTEL-IX (Kyiv, Ukraine)
- Dallas-IX (Dallas, TX, United States)
- Dataline-IX (Moscow, Russia)
- DesMoinesIX (Des Moines, IA, United States)
- DjIX (Djibouti City, Djibouti)
- Douala-IX (Douala, Cameroon)
- ECIX-BER (Berlin, Germany)
- ECIX-DUS (Düsseldorf, Germany)
- ECIX-FRA (Frankfurt, Germany)
- ECIX-HAM (Hamburg, Germany)

- ECIX-MUN (Munich, Germany)
- EG-IX (Cairo, Egypt)
- EPIX (Katowice, Poland)
- EPIX (Poznan, Poland)
- EPIX (Warsaw, Poland)
- EQIX Bogota (Bogotá, Colombia)
- EQIX-AM (Amsterdam, Netherlands)
- EQIX-AT (Atlanta, GA, United States)
- EQIX-BA (Barcelona, Spain)
- EQIX-CA (Canberra, ACT, Australia)
- EQIX-CH (Chicago, IL, United States)
- EQIX-CU (Washington, DC, United States)
- EQIX-DA (Dallas, TX, United States)
- EQIX-DB (Dublin, Ireland)
- EQIX-DC (Washington, DC, United States)
- EQIX-DE (Denver, CO, United States)
- EQIX-FR (Frankfurt, Germany)
- EQIX-GV (Geneva, Switzerland)
- EQIX-HE (Helsinki, Finland)
- EQIX-HK (Hong Kong, China)
- EQIX-HOU (Houston, TX, United States)
- EQIX-LA (Los Angeles, CA, United States)
- EQIX-LD (London, United Kingdom)
- EQIX-LIS (Lisbon, Portugal)
- EQIX-MA (Manchester, United Kingdom)
- EQIX-MC (Muscat, Oman)
- EQIX-MD (Madrid, Spain)
- EQIX-MEL (Melbourne, VIC, Australia)
- EQIX-MI (Miami, FL, United States)
- EQIX-ML (Milan, Italy)
- EQIX-MT (Montreal, QC, Canada)
- EQIX-MX (Querétaro, Mexico)
- EQIX-NY (New York, NY, United States)
- EQIX-OS (Osaka, Japan)
- EQIX-PA (Paris, France)
- EQIX-PE (Perth, WA, Australia)
- EQIX-PO (San Francisco, CA, United States)
- EQIX-RJ (Rio de Janeiro, Brazil)
- EQIX-SE (Seattle, WA, United States)
- EQIX-SEO (Seoul, South Korea)
- EQIX-SG (Singapore, Singapore)
- EQIX-SK (Stockholm, Sweden)

- EQIX-SP (São Paulo, Brazil)
- EQIX-SV (San Francisco, CA, United States)
- EQIX-SY (Sydney, NSW, Australia)
- EQIX-TR (Toronto, ON, Canada)
- EQIX-TY (Tokyo, Japan)
- EQIX-WA (Warsaw, Poland)
- EQIX-ZH (Zürich, Switzerland)
- ERA-IX (Amsterdam, Netherlands)
- ESPANIX (Madrid, Spain)
- EdgeIX Adelaide (Adelaide, SA, Australia)
- EdgeIX Adelaide (Brisbane, QLD, Australia)
- EdgeIX Brisbane (Brisbane, QLD, Australia)
- EdgeIX Darwin (Darwin, NT, Australia)
- EdgeIX Hobart (Hobart, TAS, Australia)
- EdgeIX Melbourne (Melbourne, VIC, Australia)
- EdgeIX Perth (Perth, WA, Australia)
- EdgeIX Sydney (Sydney, NSW, Australia)
- Eurasia Peering (Moscow, Russia)
- Extreme IX Bangalore (Bangalore, India)
- Extreme IX Chennai (Chennai, India)
- Extreme IX Delhi (Delhi, India)
- Extreme IX Hyderabad (Hyderabad, India)
- Extreme IX Kolkata (Kolkata, India)
- Extreme IX Mumbai (Mumbai, India)
- FCIX (San Francisco, CA, United States)
- FD-IX (Chicago, IL, United States)
- FD-IX (Cleveland, OH, United States)
- FD-IX (Des Moines, IA, United States)
- FD-IX (Houston, TX, United States)
- FD-IX (Indianapolis, IN, United States)
- FD-IX (San Antonio, TX, United States)
- FD-IX (St. Louis, MO, United States)
- FICIX-1 (Helsinki, Finland)
- FICIX-2 (Helsinki, Finland)
- FICIX-3 (Oulu, Finland)
- FIXO (Kristiansand, Norway)
- FIXO (Oslo, Norway)
- FL-IX (Miami, FL, United States)
- FNIX (Vancouver, BC, Canada)
- FRYS-IX (Amsterdam, Netherlands)
- FSIX (Sandefjord, Norway)
- FURB IX (Blumenau, Brazil)

- FVG-IX (Udine, Italy)
- FVIXP (Osh, Kyrgyzstan)
- Filanko IX (Kyiv, Ukraine)
- France-IX Aix-en-Provence (Marseille, France)
- France-IX Annecy (Annecy, France)
- France-IX Grenoble (Grenoble, France)
- France-IX Lyon (Lyon, France)
- France-IX Marseille (Marseille, France)
- France-IX Paris (Lyon, France)
- France-IX Paris (Paris, France)
- Free IX (Geneva, Switzerland)
- Free IX (Lugano, Switzerland)
- Free IX (Zürich, Switzerland)
- GABIX (Libreville, Gabon)
- GCIIX (Chicago, IL, United States)
- GE-CIX (Altdorf, Switzerland)
- GE-CIX (Amsterdam, Netherlands)
- GE-CIX (Frankfurt, Germany)
- GE-CIX (Lelystad, Netherlands)
- GE-CIX (Moscow, Russia)
- GE-CIX (Zürich, Switzerland)
- GIBIRIX (Istanbul, Turkey)
- GIGAPIX (Lisbon, Portugal)
- GIGAPIX (Porto, Portugal)
- GIX (Accra, Ghana)
- GLV-IX (Riga, Latvia)
- GN-IX (Amsterdam, Netherlands)
- GN-IX (Groningen, Netherlands)
- GOMIX (Goma, Congo, Dem. Rep.)
- GPIEX (New York, NY, United States)
- GR-IX::Athens (Athens, Greece)
- GR-IX::Thessaloniki (Athens, Greece)
- GR-IX::Thessaloniki (Thessaloniki, Greece)
- GRAX (Graz, Austria)
- GREX (St. George’s, Grenada)
- GTIIX (Toronto, ON, Canada)
- GU-IX (Hagåtña, Guam)
- GULF-IX (Manama, Bahrain)
- GetaFIX (Cavite, Philippines)
- GetaFIX (Manila, Philippines)
- GigaNET (Kharkiv, Ukraine)
- GigaNET (Kyiv, Ukraine)

- GigaNET (Odessa, Ukraine)
- GigaNET (Warsaw, Poland)
- GigaNET (Zaporozhye, Ukraine)
- Global-IX (Amsterdam, Netherlands)
- Global-IX (Frankfurt, Germany)
- Global-IX (Helsinki, Finland)
- Global-IX (Moscow, Russia)
- Global-IX (St. Petersburg, Russia)
- Global-IX (Stockholm, Sweden)
- GrunIX (Groningen, Netherlands)
- H.I.X.P (Harare, Zimbabwe)
- HFXIX (Halifax, NS, Canada)
- HKIX (Hong Kong, China)
- HOUIX (Houston, TX, United States)
- HOUIX (Kansas City, MO, United States)
- HTN-CIX (Phnom Penh, Cambodia)
- HamroIX (Rome, Italy)
- Home-IX (Moscow, Russia)
- Houston-IX (Houston, TX, United States)
- ICX Bangalore (Bangalore, India)
- ICX Delhi (Delhi, India)
- ICX Dubai (Dubai, United Arab Emirates)
- ICX Marseille (Marseille, France)
- ICX Mumbai (Mumbai, India)
- ICX Muscat (Muscat, Oman)
- ICX Queretaro (Querétaro, Mexico)
- ICX Santiago (Santiago, Chile)
- ICX Seoul (Seoul, South Korea)
- ICX Taipei (Taipei, Taiwan)
- IF-IX (Ivano-Frankivsk, Ukraine)
- IIX (Tel Aviv, Israel)
- IIX-APJII (Jakarta, Indonesia)
- INEX (Cork, Ireland)
- INEX (Dublin, Ireland)
- IPNET-IX Delhi (Delhi, India)
- ITI-IX (Tashkent, Uzbekistan)
- IX Bradford (Leeds, United Kingdom)
- IX Cuiabá (Cuiaba, Brazil)
- IX Liverpool (Liverpool, United Kingdom)
- IX Palmas (Palmas, Brazil)
- IX-Denver (Council Bluffs, IA, United States)
- IX-Denver (Denver, CO, United States)

- IX-Denver (Minneapolis-St.Paul, MN, United States)
- IX.KW (Kuwait City, Kuwait)
- IX.br Aracaju (Aracajú, Brazil)
- IX.br Belo Horizonte (Belo Horizonte, Brazil)
- IX.br Belém (Belém, Brazil)
- IX.br Boa Vista (Boa Vista, Brazil)
- IX.br Brasília (Brasilia, Brazil)
- IX.br Campina Grande (Campina Grande, Brazil)
- IX.br Campinas (Campinas, Brazil)
- IX.br Campo Grande (Campo Grande, Brazil)
- IX.br Cascavel (Cascavel, Brazil)
- IX.br Caxias do Sul (Caxias do Sul, Brazil)
- IX.br Cuiabá (Cuiaba, Brazil)
- IX.br Curitiba (Curitiba, Brazil)
- IX.br Florianópolis (Florianópolis, Brazil)
- IX.br Florianópolis (São José, Brazil)
- IX.br Fortaleza (Fortaleza, Brazil)
- IX.br Foz do Iguaçu (Foz do Iguaçú, Brazil)
- IX.br Goiânia (Goiânia, Brazil)
- IX.br João Pessoa (João Pessoa, Brazil)
- IX.br Lajeado (Lajeado, Brazil)
- IX.br Londrina (Londrina, Brazil)
- IX.br Maceió (Maceió, Brazil)
- IX.br Manaus (Manaus, Brazil)
- IX.br Maringá (Maringa, Brazil)
- IX.br Natal (Natal, Brazil)
- IX.br Palmas (Palmas, Brazil)
- IX.br Porto Alegre (Brasilia, Brazil)
- IX.br Porto Alegre (Nova Ponte, Brazil)
- IX.br Porto Alegre (Porto Alegre, Brazil)
- IX.br Porto Alegre (Santo Antônio de Jesus, Brazil)
- IX.br Recife (Recife, Brazil)
- IX.br Rio de Janeiro (Rio de Janeiro, Brazil)
- IX.br Salvador (Salvador, Brazil)
- IX.br Santa Maria (Santa Maria, Brazil)
- IX.br São José do Rio Preto (São José do Rio Preto, Brazil)
- IX.br São José dos Campos (São Paulo, Brazil)
- IX.br São Luís (São Luis, Brazil)
- IX.br São Paulo (Brasilia, Brazil)
- IX.br São Paulo (Campinas, Brazil)
- IX.br São Paulo (São Paulo, Brazil)
- IX.br Teresina (Teresina, Brazil)

- IX.br Vitória (Vitória, Brazil)
- IX.py (Asuncion, Paraguay)
- IX.py (Ciudad del Este, Paraguay)
- IXG (Tbilisi, Georgia)
- IXLeeds (Leeds, United Kingdom)
- IXOR (Malmö, Sweden)
- IXP Ecuador - STD (Santo Domingo, Dominican Republic)
- IXP Ecuador-MEC (Manta, Ecuador)
- IXP Mexicano (Mexico City, Mexico)
- IXP-HN (Tegucigalpa, Honduras)
- IXP.GT (Guatemala City, Guatemala)
- IXP.MX Querétaro (Querétaro, Mexico)
- IXP.mk (Skopje, North Macedonia)
- IXPN (Abuja, Nigeria)
- IXPN (Enugu, Nigeria)
- IXPN (Kano, Nigeria)
- IXPN (Lagos, Nigeria)
- IXPN (Port Harcourt, Nigeria)
- IXPlay Peers (Madrid, Spain)
- IXPlay Peers (Murcia, Spain)
- IXPlay Peers (Seville, Spain)
- InterLAN (Arad, Romania)
- InterLAN (Bucharest, Romania)
- InterLAN (Cluj Napoca, Romania)
- InterLAN (Constanta, Romania)
- InterLAN (Craiova, Romania)
- InterLAN (Frankfurt, Germany)
- InterLAN (Timisoara, Romania)
- Intered Panamá (Panama City, Panama)
- JAX NAP (Jacksonville, FL, United States)
- JEDIX (Jeddah, Saudi Arabia)
- JINX (Johannesburg, South Africa)
- JKT-IX (Jakarta, Indonesia)
- JPIX Fukuoka (Fukuoka, Japan)
- JPIX Metropolitan Tokyo (Tokyo, Japan)
- JPIX Osaka (Osaka, Japan)
- JPNAP Fukuoka (Fukuoka, Japan)
- JPNAP Osaka (Osaka, Japan)
- JPNAP Sendai (Sendai, Japan)
- JPNAP Tokyo (Tokyo, Japan)
- JSAX (Redding, CA, United States)
- JTIX (Bangkok, Thailand)

- JXIX (Jacksonville, FL, United States)
- JumboIX Cyprus (Limassol, Cyprus)
- JumboIX Lima (Lima, Peru)
- KA-NIX (Karlsruhe, Germany)
- KCIX (Kansas City, MO, United States)
- KCIX (Minneapolis-St.Paul, MN, United States)
- KG-IX (Bishkek, Kyrgyzstan)
- KH-IX (Kharkiv, Ukraine)
- KINIX (Kinshasa, Congo, Dem. Rep.)
- KINX (Seoul, South Korea)
- KIVIX (Bucharest, Romania)
- KIVIX (Chisinau, Moldova)
- KIXP (Nairobi, Kenya)
- KIXP MSA (Mombasa, Kenya)
- KLIX (Dhaka, Bangladesh)
- KOSIX (Pristina, Kosovo)
- KazNIX (Semey, Kazakhstan)
- KleyReX (Düsseldorf, Germany)
- KleyReX (Frankfurt, Germany)
- KleyReX (Hamburg, Germany)
- Kremen-IX (Kyiv, Ukraine)
- LBIX (Beirut, Lebanon)
- LILLIX (Lille, France)
- LILLIX (Valenciennes, France)
- LINX London (London, United Kingdom)
- LINX Manchester (Manchester, United Kingdom)
- LINX NoVA (Richmond, VA, United States)
- LINX NoVA (Washington, DC, United States)
- LINX Scotland (Edinburgh, United Kingdom)
- LINX Scotland (Glasgow, United Kingdom)
- LINX Wales (Cardiff, United Kingdom)
- LINX Wales (Llantarnam, United Kingdom)
- LITIX (Alytus, Lithuania)
- LITIX (Kaunas, Lithuania)
- LITIX (Klaipeda, Lithuania)
- LITIX (Panevezys, Lithuania)
- LITIX (Siauliai, Lithuania)
- LITIX (Vilnius, Lithuania)
- LIX (Riga, Latvia)
- LIXP (Kaunas, Lithuania)
- LIXP (Maseru, Lesotho)
- LIXP (Vilnius, Lithuania)

- LL-IX (Amsterdam, Netherlands)
- LL-IX (Katowice, Poland)
- LL-IX (San Francisco, CA, United States)
- LNK-IX (Bucharest, Romania)
- LONAP (London, United Kingdom)
- LSIX (Amsterdam, Netherlands)
- LSIX (Rotterdam, Netherlands)
- LSIX (The Hague, Netherlands)
- LU-CIX (Luxembourg, Luxembourg)
- LUBIX (Lubumbashi, Congo, Dem. Rep.)
- Linxdatacenter-IX (Moscow, Russia)
- LocIX (Amsterdam, Netherlands)
- LocIX (Apeldoorn, Netherlands)
- LocIX (Düsseldorf, Germany)
- LocIX (Frankfurt, Germany)
- LocIX (Groningen, Netherlands)
- LocIX (Lelystad, Netherlands)
- LocIX (Meppel, Netherlands)
- LocIX Dusseldorf (Düsseldorf, Germany)
- Lodz IX (Lodz, Poland)
- MAGPI (Philadelphia, PA, United States)
- MAN LAN (New York, NY, United States)
- MARIIX (Hagåtña, Guam)
- MARIX (Rabat, Morocco)
- MB-IX (Mbabane, Eswatini)
- MBIX (Winnipeg, MB, Canada)
- MD-IX (Chisinau, Moldova)
- MESH-IX (Mariupol, Ukraine)
- MEX-IX (McAllen, TX, United States)
- MGIX (Antananarivo, Madagascar)
- MICE (Albert Lea, MN, United States)
- MICE (Duluth, MN, United States)
- MICE (Minneapolis-St.Paul, MN, United States)
- MIE.MX (Tijuana, Mexico)
- MINAP (Milan, Italy)
- MIX (Blantyre, Malawi)
- MIX (Montgomery, AL, United States)
- MIX-IT (Bergamo, Italy)
- MIX-IT (Milan, Italy)
- MIX-IT (Palermo, Italy)
- MIX-IT Bologna (Bologna, Italy)
- MIX-IT Palermo (Palermo, Italy)

- MIXP (Port Louis, Mauritius)
- MIXP.me (Podgorica, Montenegro)
- MKEIX (Milwaukee, WI, United States)
- MMIX (Rangoon, Myanmar)
- MN-IX (Askar, Bahrain)
- MS-IX (Munster, Germany)
- MSK-IX Ekaterinburg (Ekaterinburg, Russia)
- MSK-IX Kazan (Kazan, Russia)
- MSK-IX Moscow (Moscow, Russia)
- MSK-IX Novosibirsk (Novosibirsk, Russia)
- MSK-IX Riga (Riga, Latvia)
- MSK-IX Rostov-on-Don (Rostov-on-Don, Russia)
- MSK-IX Samara (Samara, Russia)
- MSK-IX St. Petersburg (St. Petersburg, Russia)
- MSK-IX Stavropol (Stavropol, Russia)
- MSK-IX Vladivostok (Vladivostok, Russia)
- MT-IX (Budapest, Hungary)
- MUS-IX (Dallas, TX, United States)
- MYNAP (Kuala Lumpur, Malaysia)
- MadIX (Madison, WI, United States)
- Mashhad IX (Mashhad, Iran)
- Matrix IX (Jakarta, Indonesia)
- MegaIX Ashburn (Richmond, VA, United States)
- MegaIX Ashburn (Washington, DC, United States)
- MegaIX Auckland (Auckland, New Zealand)
- MegaIX Auckland (Hamilton, New Zealand)
- MegaIX Brisbane (Brisbane, QLD, Australia)
- MegaIX Dallas (Dallas, TX, United States)
- MegaIX Las Vegas (Las Vegas, NV, United States)
- MegaIX Los Angeles (Los Angeles, CA, United States)
- MegaIX Melbourne (Melbourne, VIC, Australia)
- MegaIX Perth (Perth, WA, Australia)
- MegaIX Seattle (Seattle, WA, United States)
- MegaIX Singapore (Singapore, Singapore)
- MegaIX Sofia (OM-NIX) (Sofia, Bulgaria)
- MegaIX Sydney (Sydney, NSW, Australia)
- MegaIX Toronto (Toronto, ON, Canada)
- Megalink-IXP (La Paz, Bolivia)
- MiamiIX (Miami, FL, United States)
- MonctonIX (Vancouver, BC, Canada)
- MyIX (Johor Bahru, Malaysia)
- MyIX (Kuala Lumpur, Malaysia)

- MyIX (Sarawak, Malaysia)
- N-IX (Nuremberg, Germany)
- NAP Colombia (Bogotá, Colombia)
- NAP del Caribe (Santo Domingo, Dominican Republic)
- NAP-Peru (Lima, Peru)
- NAP.EC (Guayaquil, Ecuador)
- NAP.EC (Quito, Ecuador)
- NAPAfrica CT (Cape Town, South Africa)
- NAPAfrica DB (Durban, South Africa)
- NAPAfrica JB (Johannesburg, South Africa)
- NASA-AIX (San Francisco, CA, United States)
- NCL-IX (Newcastle, United Kingdom)
- NDIX (Almelo, Netherlands)
- NDIX (Amersfoort, Netherlands)
- NDIX (Amsterdam, Netherlands)
- NDIX (Apeldoorn, Netherlands)
- NDIX (Arnhem, Netherlands)
- NDIX (Bocholt, Germany)
- NDIX (Brussels, Belgium)
- NDIX (Deventer, Netherlands)
- NDIX (Doetinchem, Netherlands)
- NDIX (Ede, Netherlands)
- NDIX (Eemshaven, Netherlands)
- NDIX (Eindhoven, Netherlands)
- NDIX (Enschede, Netherlands)
- NDIX (Frankfurt, Germany)
- NDIX (Groningen, Netherlands)
- NDIX (Hardenberg, Netherlands)
- NDIX (Hasselt, Belgium)
- NDIX (Heerlen, Netherlands)
- NDIX (Lelystad, Netherlands)
- NDIX (London, United Kingdom)
- NDIX (Munster, Germany)
- NDIX (Nijmegen, Netherlands)
- NDIX (Nordhorn, Germany)
- NDIX (Oss, Netherlands)
- NDIX (Rotterdam, Netherlands)
- NDIX (Stadtallendorf, Germany)
- NDIX (Tiel, Netherlands)
- NDIX (Tilburg, Netherlands)
- NDIX (Utrecht, Netherlands)
- NDIX (Venlo, Netherlands)

- NDIX (Winterswijk, Netherlands)
- NDIX (Zutphen, Netherlands)
- NDIX (Zwolle, Netherlands)
- NDIX (s-Hertogenbosch, Netherlands)
- NEO-IX (Akron, OH, United States)
- NEO-IX (Cleveland, OH, United States)
- NFX (Prague, Czech Republic)
- NIX-BD (Dhaka, Bangladesh)
- NIX.CZ (Bratislava, Slovakia)
- NIX.CZ (Prague, Czech Republic)
- NIX.CZ (Vienna, Austria)
- NIX.SK (Bratislava, Slovakia)
- NIX1 (Oslo, Norway)
- NIX2 (Oslo, Norway)
- NIXA (Kabul, Afghanistan)
- NIXI Ahmedabad (Ahmedabad, India)
- NIXI Bangalore (Bangalore, India)
- NIXI Chennai (Chennai, India)
- NIXI Delhi (Chennai, India)
- NIXI Delhi (Delhi, India)
- NIXI Guwahati (Guwahati, India)
- NIXI Hyderabad (Hyderabad, India)
- NIXI Kolkata (Kolkata, India)
- NIXI Mumbai (Mumbai, India)
- NIXVAL-ix (Valencia, Spain)
- NL-ix Amsterdam (Amsterdam, Netherlands)
- NL-ix Amsterdam (Breda, Netherlands)
- NL-ix Amsterdam (Enschede, Netherlands)
- NL-ix Amsterdam (Utrecht, Netherlands)
- NL-ix Berlin (Berlin, Germany)
- NL-ix Brussels (Brussels, Belgium)
- NL-ix Copenhagen (Copenhagen, Denmark)
- NL-ix Düsseldorf (Düsseldorf, Germany)
- NL-ix Frankfurt (Frankfurt, Germany)
- NL-ix London (London, United Kingdom)
- NL-ix Marseille (Marseille, France)
- NL-ix Paris (Paris, France)
- NL-ix Rotterdam (Rotterdam, Netherlands)
- NL-ix Rotterdam (The Hague, Netherlands)
- NLocIX (Lelystad, Netherlands)
- NLocIX (Meppel, Netherlands)
- NNENIX (Bangor, ME, United States)

- NNENIX (Portland, ME, United States)
- NPIX (Kathmandu, Nepal)
- NSW-IX (Sydney, NSW, Australia)
- NWAX (Portland, OR, United States)
- NYIIX LA (Los Angeles, CA, United States)
- NYIIX NY (New York, NY, United States)
- NYIIX Philadelphia (Philadelphia, PA, United States)
- NaMeX (Rome, Italy)
- NaMeX Bari (Bari, Italy)
- NaissIX (Niš, Serbia)
- NetIX (Amsterdam, Netherlands)
- NetIX (Athens, Greece)
- NetIX (Belgrade, Serbia)
- NetIX (Bratislava, Slovakia)
- NetIX (Bucharest, Romania)
- NetIX (Fortaleza, Brazil)
- NetIX (Frankfurt, Germany)
- NetIX (Hong Kong, China)
- NetIX (Istanbul, Turkey)
- NetIX (Kyiv, Ukraine)
- NetIX (London, United Kingdom)
- NetIX (Madrid, Spain)
- NetIX (Marseille, France)
- NetIX (Miami, FL, United States)
- NetIX (Milan, Italy)
- NetIX (Moscow, Russia)
- NetIX (New York, NY, United States)
- NetIX (Paris, France)
- NetIX (Prague, Czech Republic)
- NetIX (Ruse, Bulgaria)
- NetIX (Sofia, Bulgaria)
- NetIX (Stockholm, Sweden)
- NetIX (São Paulo, Brazil)
- NetIX (Thessaloniki, Greece)
- NetIX (Vienna, Austria)
- NetIX (Warsaw, Poland)
- NetIX (Washington, DC, United States)
- NetIX (Zagreb, Croatia)
- NetherLight (Amsterdam, Netherlands)
- Netnod Copenhagen (Copenhagen, Denmark)
- Netnod Copenhagen (Malmö, Sweden)
- Netnod Helsinki (Helsinki, Finland)

- Netnod-GBG (Gothenburg, Sweden)
- Netnod-LUL (Luleå, Sweden)
- Netnod-STH (Stockholm, Sweden)
- Netnod-SVL-GVL (Gävle, Sweden)
- Netnod-SVL-GVL (Sundsvall, Sweden)
- Norfolk-IX (Virginia Beach, VA, United States)
- NorrNod (Umeå, Sweden)
- OCIX (Saint Maarten, Sint Maarten)
- OGIX (Ottawa, ON, Canada)
- OIX (Eugene, OR, United States)
- OhioIX (Columbus, OH, United States)
- OmahaIX (Council Bluffs, IA, United States)
- OpenIXP (Jakarta, Indonesia)
- PCIX (Piacenza, Italy)
- PEIX (Charlottetown, PE, Canada)
- PHOpenIX (Cebu, Philippines)
- PHOpenIX (Manila, Philippines)
- PIRIX (St. Petersburg, Russia)
- PIT Chile (Arica, Chile)
- PIT Chile (Concepción, Chile)
- PIT Chile (Osorno, Chile)
- PIT Chile (Santiago, Chile)
- PIT Chile (Temuco, Chile)
- PIT Chile (Valparaíso, Chile)
- PITBOLIVIA (La Paz, Bolivia)
- PITBOLIVIA (Santa Cruz, Bolivia)
- PITER-IX (Frankfurt, Germany)
- PITER-IX (Helsinki, Finland)
- PITER-IX (Kyiv, Ukraine)
- PITER-IX (Moscow, Russia)
- PITER-IX (Riga, Latvia)
- PITER-IX (St. Petersburg, Russia)
- PITER-IX (Tallinn, Estonia)
- PIX (Poznan, Poland)
- PIX (Ramallah, Palestinian Territory)
- PIX (Warsaw, Poland)
- PKIX (Islamabad, Pakistan)
- PKIX (Karachi, Pakistan)
- PKIX (Lahore, Pakistan)
- PRBI IX (San Juan, PR, United States)
- Pacific Wave (Albuquerque, NM, United States)
- Pacific Wave (Denver, CO, United States)

- Pacific Wave (El Paso, TX, United States)
- Pacific Wave (Los Angeles, CA, United States)
- Pacific Wave (San Francisco, CA, United States)
- Pacific Wave (Seattle, WA, United States)
- Pacific Wave (Tokyo, Japan)
- PaducahIX (Paducah, KY, United States)
- Peering.cz (Bratislava, Slovakia)
- Peering.cz (Frankfurt, Germany)
- Peering.cz (Prague, Czech Republic)
- Peering.cz (Vienna, Austria)
- Phoenix-IX (Phoenix, AZ, United States)
- PipeIX Adelaide (Adelaide, SA, Australia)
- PipeIX Brisbane (Brisbane, QLD, Australia)
- PipeIX Canberra (Canberra, ACT, Australia)
- PipeIX Hobart (Hobart, TAS, Australia)
- PipeIX Melbourne (Melbourne, VIC, Australia)
- PipeIX Sydney (Sydney, NSW, Australia)
- Pit Perú (Arequipa, Peru)
- Pit Perú (Lima, Peru)
- Pit Perú (Trujillo, Peru)
- QCIX (Davenport, IA, United States)
- QCIX (Waterloo, IA, United States)
- QIX (Drummondville, QC, Canada)
- QIX (Montreal, QC, Canada)
- QIX (Umm Qarn, Qatar)
- QLD-IX (Brisbane, QLD, Australia)
- RB-IX (Ufa, Russia)
- RED-IX (Abakan, Russia)
- RED-IX (Achinsk, Russia)
- RED-IX (Irkutsk, Russia)
- RED-IX (Krasnoyarsk, Russia)
- RED-IX (Novosibirsk, Russia)
- REDIX (Chennai, India)
- REUNIX (St. Denis, Réunion)
- RINEX (Kigali, Rwanda)
- RIX (Nago, Japan)
- RIX (Naha, Japan)
- RIX (Reykjavik, Iceland)
- ROPN-IX (Bucharest, Romania)
- R_iX (Bergen op Zoom, Netherlands)
- R_iX (Breda, Netherlands)
- R_iX (Rotterdam, Netherlands)

- R_iX (The Hague, Netherlands)
- Raleigh-IX (Raleigh, NC, United States)
- Remki Internet Exchange (RIX) (Guntur, India)
- Rheintal IX (Eschen, Liechtenstein)
- Rheintal IX (Feldkirch, Austria)
- Rheintal IX (Konstanz, Germany)
- Rheintal IX (St. Gallen, Switzerland)
- Rheintal IX (Zürich, Switzerland)
- Richmond-IX (Richmond, VA, United States)
- RoNIX (Bacau, Romania)
- RoNIX (Brasov, Romania)
- RoNIX (Bucharest, Romania)
- RoNIX (Cluj Napoca, Romania)
- RoNIX (Constanta, Romania)
- RoNIX (Craiova, Romania)
- RoNIX (Frankfurt, Germany)
- RoNIX (Iasi, Romania)
- RoNIX (Pitesti, Romania)
- RoNIX (Suceava, Romania)
- RoNIX (Tarnu-Severin, Romania)
- RoNIX (Timisoara, Romania)
- Ruhr-CIX (Essen, Germany)
- S-IX (Stuttgart, Germany)
- SA-IX (Adelaide, SA, Australia)
- SA-IX (Brisbane, QLD, Australia)
- SAIX (Johannesburg, South Africa)
- SAIX (Riyadh, Saudi Arabia)
- SAIX (Salzburg, Austria)
- SAT-IX (San Antonio, TX, United States)
- SBIX (Baden, Switzerland)
- SBIX (Zug, Switzerland)
- SEECIX (Athens, Greece)
- SFINX (Paris, France)
- SFMIX (San Francisco, CA, United States)
- SGIX (Singapore, Singapore)
- SIX (Bratislava, Slovakia)
- SIX (Ceské Budejovice, Czech Republic)
- SIX (Kosice, Slovakia)
- SIX (Salt Lake City, UT, United States)
- SIX (Seattle, WA, United States)
- SIX (Stavanger, Norway)
- SIX-Ljubjana (Ljubljana, Slovenia)

- SIXP (Serekunda, Gambia)
- SJIX (Saint John, NB, Canada)
- SKNIX (Basseterre, Saint Kitts and Nevis)
- SLIX (Salt Lake City, UT, United States)
- SMILE (Riga, Latvia)
- SNAP (Atlanta, GA, United States)
- SNS-IX (Tashkent, Uzbekistan)
- SOAX (Medford, OR, United States)
- SOAX (Redding, CA, United States)
- SOE (Singapore, Singapore)
- SOIXP (Mogadishu, Somalia)
- SOLIX (Stockholm, Sweden)
- SONIX Gothenburg (Gothenburg, Sweden)
- SONIX Stockholm (Stockholm, Sweden)
- SOX (Belgrade, Serbia)
- SOX (Bijeljina, Serbia)
- SOX (Niš, Serbia)
- SOX (Singapore, Singapore)
- SOX (Sofia, Bulgaria)
- SOX (Vienna, Austria)
- SP-iXP Mumbai (Mumbai, India)
- SPRINGIX (Springfield, MO, United States)
- SR-IX (Bishkek, Kyrgyzstan)
- STACIX (Frankfurt, Germany)
- STACIX (Nuremberg, Germany)
- STHIX (Copenhagen, Denmark)
- STHIX (Gothenburg, Sweden)
- STHIX (Malmö, Sweden)
- STHIX (Stockholm, Sweden)
- STHIX (Sundsvall, Sweden)
- STHIX (Umeå, Sweden)
- STIX (Bolzano, Italy)
- STLIX (Houston, TX, United States)
- STLIX (Kansas City, MO, United States)
- STLIX (St. Louis, MO, United States)
- STUIX (Taipei, Taiwan)
- SUPRnet (Kanab, UT, United States)
- SUPRnet (Salt Lake City, UT, United States)
- SUPRnet (St. George, UT, United States)
- SUPRnet (Washington, DC, United States)
- SUR-IX (Paramaribo, Suriname)
- SXMIX (Gustavia, Saint Barthélemy)

- SXMIX (Saint Martin, Saint Martin)
- Sacramento-IX (Sacramento, CA, United States)
- SanDiego-IX (San Diego, CA, United States)
- Sea-IX (Krasnodar, Russia)
- Sea-IX (Rostov-on-Don, Russia)
- Securebit IX (Zug, Switzerland)
- Sejong Neutral-IX (Busan, South Korea)
- Sejong Neutral-IX (Daegu, South Korea)
- Sejong Neutral-IX (Daejeon, South Korea)
- Sejong Neutral-IX (Gwangju, South Korea)
- Sejong Neutral-IX (Seoul, South Korea)
- Shiraz-IX (Shiraz, Iran)
- SmartHub IPX (Fujairah, United Arab Emirates)
- SpaceIX (Moscow, Russia)
- Speed-IX (Amsterdam, Netherlands)
- Speed-IX (Apeldoorn, Netherlands)
- Speed-IX (Groningen, Netherlands)
- Speed-IX (Lelystad, Netherlands)
- Speed-IX (Meppel, Netherlands)
- Speed-IX (The Hague, Netherlands)
- SpokaneIX (Coeur d'Alene, ID, United States)
- SpokaneIX (Spokane, WA, United States)
- StarLight (Chicago, IL, United States)
- SwissIX (Baden, Switzerland)
- SwissIX (Basel, Switzerland)
- SwissIX (Bern, Switzerland)
- SwissIX (Lugano, Switzerland)
- SwissIX (Zürich, Switzerland)
- T-CIX (Sofia, Bulgaria)
- TAS-IX (Tashkent, Uzbekistan)
- TGIX (Lome, Togo)
- TIROL-IX (Innsbruck, Austria)
- TIX (Dar Es Salaam, Tanzania)
- TIX (Dodoma, Tanzania)
- TIX (Florence, Italy)
- TIX (Tromsø, Norway)
- TIX (Zanzibar, Tanzania)
- TN-IX (Novokuznetsk, Russia)
- TN-IX (Novosibirsk, Russia)
- TOP-IX (Alessandria, Italy)
- TOP-IX (Aosta, Italy)
- TOP-IX (Asti, Italy)

- TOP-IX (Biella, Italy)
- TOP-IX (Cuneo, Italy)
- TOP-IX (Ivrea, Italy)
- TOP-IX (Milan, Italy)
- TOP-IX (Novara, Italy)
- TOP-IX (Turin, Italy)
- TOP-IX (Verbania, Italy)
- TOP-IX (Vercelli, Italy)
- TORIX (Toronto, ON, Canada)
- TOUIX (Toulouse, France)
- TPIX (Taipei, Taiwan)
- TPIX (Warsaw, Poland)
- TRDIX (Trondheim, Norway)
- TREX (Tampere, Finland)
- TRUE-IX (Bangkok, Thailand)
- TTIX (Port of Spain, Trinidad and Tobago)
- TWIX (Kaoshiung, Taiwan)
- TWIX (Taichung, Taiwan)
- TWIX (Taipei, Taiwan)
- Tabriz IX (Tabriz, Iran)
- TahoeIX (Reno, NV, United States)
- Tehran IX (Tehran, Iran)
- Texas-IX (Austin, TX, United States)
- Texas-IX (Houston, TX, United States)
- Texas-IX (San Antonio, TX, United States)
- Thinx Poland (Bialystok, Poland)
- Thinx Poland (Gdansk, Poland)
- Thinx Poland (Katowice, Poland)
- Thinx Poland (Koszalin, Poland)
- Thinx Poland (Kraków, Poland)
- Thinx Poland (Lodz, Poland)
- Thinx Poland (Lublin, Poland)
- Thinx Poland (Plock, Poland)
- Thinx Poland (Poznan, Poland)
- Thinx Poland (Radom, Poland)
- Thinx Poland (Szczecin, Poland)
- Thinx Poland (Warsaw, Poland)
- Thinx Poland (Wroclaw, Poland)
- Turk-IX (Istanbul, Turkey)
- UA-IX (Kyiv, Ukraine)
- UAE-IX (Dubai, United Arab Emirates)
- UIXP (Kampala, Uganda)

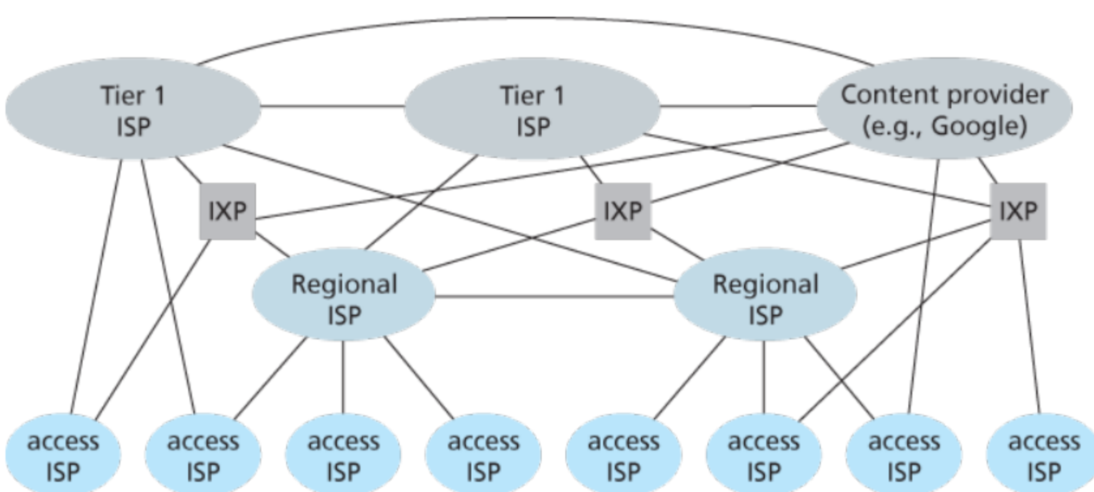
- ULN-IX (Ulyanovsk, Russia)
- Unmetered.Exchange (Toronto, ON, Canada)
- Unmetered.Exchange (Vancouver, BC, Canada)
- VANIX (Vancouver, BC, Canada)
- VIC-IX (Melbourne, VIC, Australia)
- VIX (Vienna, Austria)
- VIX.VU (Port Vila, Vanuatu)
- VNIX (Danang, Vietnam)
- VNIX (Hanoi, Vietnam)
- VNIX (Ho Chi Minh City, Vietnam)
- VSIX (Milan, Italy)
- VSIX (Padua, Italy)
- Vegas-IX (Las Vegas, NV, United States)
- W-IX (Amsterdam, Netherlands)
- W-IX (Cheboksary, Russia)
- W-IX (Chelyabinsk, Russia)
- W-IX (Ekaterinburg, Russia)
- W-IX (Frankfurt, Germany)
- W-IX (Kazan, Russia)
- W-IX (Kyiv, Ukraine)
- W-IX (Moscow, Russia)
- W-IX (Novosibirsk, Russia)
- W-IX (Omsk, Russia)
- W-IX (Perm, Russia)
- W-IX (Samara, Russia)
- W-IX (St. Petersburg, Russia)
- W-IX (Tyumen, Russia)
- W-IX (Voronezh, Russia)
- WA-IX (Perth, WA, Australia)
- WAF-IX (Lagos, Nigeria)
- WIX (Washington, DC, United States)
- WIX (Wellington, New Zealand)
- WLG-IX (Wellington, New Zealand)
- WRIX (Katowice, Poland)
- WRIX (Poznan, Poland)
- WRIX (Radom, Poland)
- WRIX (Warsaw, Poland)
- WRIX (Wroclaw, Poland)
- Waterloo IX (Kitchener, ON, Canada)
- YAR-IX (Yaroslavl, Russia)
- YEGIX (Calgary, AB, Canada)
- YEGIX (Edmonton, AB, Canada)

- YRIX (Billings, MT, United States)
- YXEIX (Saskatoon, SK, Canada)
- YYCIX (Calgary, AB, Canada)
- btix (Thimphu, Bhutan)
- iAIX (Hong Kong, China)
- iX-OKC (Oklahoma City, OK, United States)
- irix (Sarawak, Malaysia)

CPN Impact on the Internet

This “bypass” approach of CPNs determines how data is transferred between users and end systems. This private connection approach of CPNs has led to the movement of user data in a single center direction.

The lower-tier ISPs connect to the higher-tier ISPs, and the higher-tier ISPs interconnect with one another. Users and content providers are customers of lower-tier ISPs, and lower-tier ISPs are customers of higher-tier ISPs. In recent years, major CPNs have also created their own networks and connect directly into lower-tier ISPs where possible.



In addition, Web caches are increasingly playing an important role in the Internet. A CDN (Content Distribution Networks) company installs many geographically distributed caches throughout the Internet, thereby localizing much of the traffic. There are shared CDNs (such as Akamai and Limelight) and dedicated CDNs (such as Google and Netflix). CDN and CPN are close concepts, and most CPNs serve as a CDN.

A CDN manages servers in multiple geographically distributed locations, stores copies of the contents (types of Web pages , documents, images, and audio videos) in its servers. The CDN may be a private CDN, that is, owned by the content provider itself; for example, Google's CDN distributes YouTube videos and other types of content. The CDN may alternatively be a third-party CDN that distributes content on behalf of multiple content providers; Akamai, Limelight and Level-3 all operate third-party CDNs.

CDNs use a variety of methods to influence the world and shorten data transmission times.

According to the agreement, they can embed the private or open server clusters in the server centers of the direct access ISPs and provide access from there to the users served by the Access ISPs. This means that a CDN can distribute its own server to many points. This process is two-sided. Data can flow both from CDN to user and from user to CDN. Akamai takes this approach with clusters in approximately 1,700 locations.

Another method is to embed these server clusters in IXPs and connect Regional or Access ISPs there. Limelight and many other CDN companies prefer it.

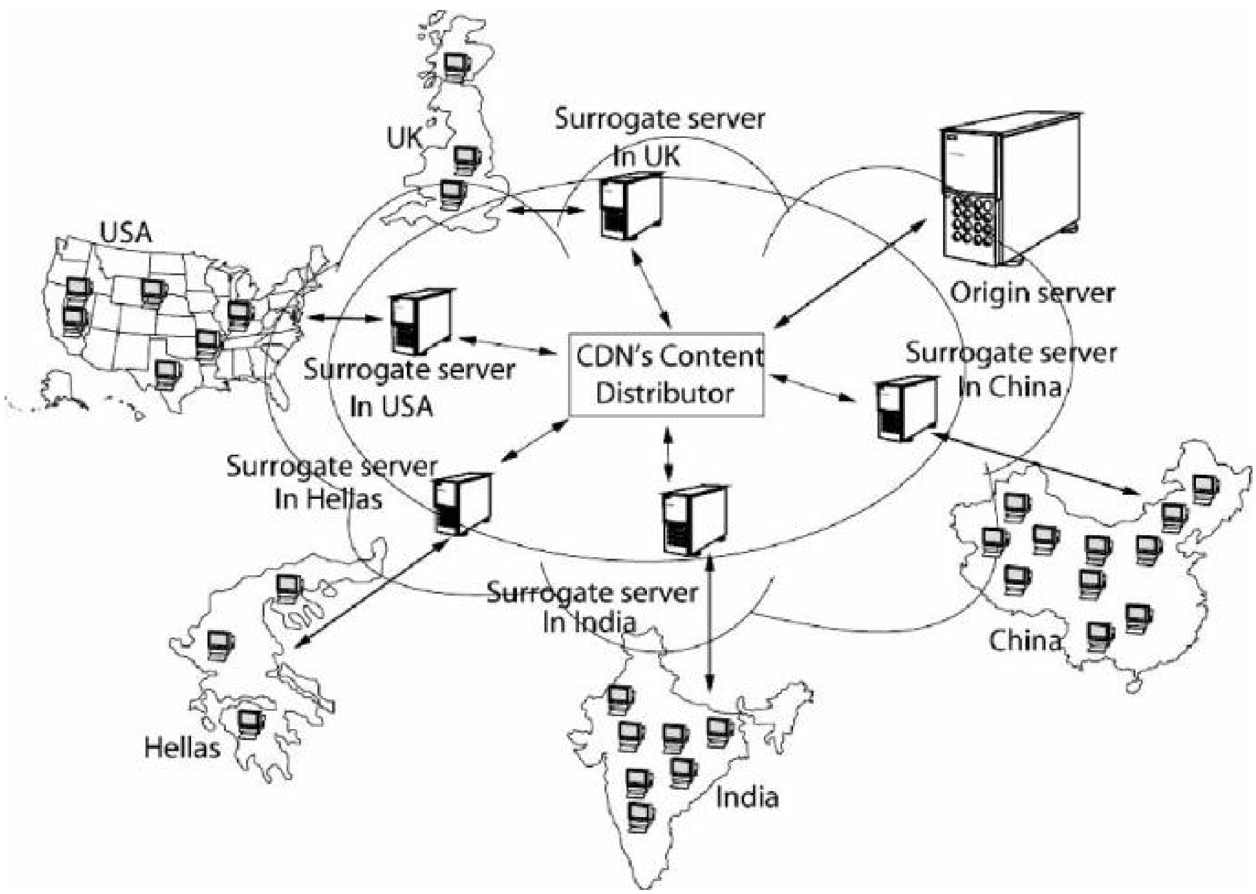
Once the clusters are placed, they are ready for user queries and the contents are started to be copied to these centers. In both methods, there is a continuous flow and transfer of data between the low-tier and upper-tier. That is why the concept of web caching is important for CDNs.

Major CDN Providers List:

- Akamai
- Amazon CloudFront
- Amazon Web Services (AWS)
- Azure CDN
- CacheFly
- Cloudflare
- CDN77
- Fastly
- Google Cloud CDN
- StackPath
- Verizon Media Platform

- Limelight Networks
- Windows Azure
- CDNlion
- SoftLayer
- ITWorksCDN
- CloudOYE.com
- Octoshape
- HiberniaCDN
- WebMobi Networks
- CDNvideo

At the core of any CDN deployment is a cluster selection strategy, that is, a mechanism for dynamically directing clients to a server cluster or a data center within the CDN. One simple strategy is to assign the client to the cluster that is geographically closest. Geolocation is important for CDNs. For this reason, they prefer servers close to Access ISPs or IXPs.



CloudFlare's server locations in 3 different continents:

EUROPE	N.AMERICA	ASIA

Amsterdam, NL	Ashburn, US	Ahmedabad, IN
Athens, GR	Atlanta, US	Almaty, KZ
Barcelona, ES	Boston, US	Astara, AZ
Belgrade, RS	Buffalo, US	Baku, AZ
Berlin, DE	Calgary, CA	Bandar Seri Begawan, BN
Brussels, BE	Charlotte, US	Bangkok, TH
Bucharest, RO	Chicago, US	Bengaluru, IN
Budapest, HU	Columbus, US	Bhubaneshwar, IN
Chișinău, MD	Dallas, US	Cagayan, PH
Copenhagen, DK	Denver, US	Cebu, PH
Cork, IE	Detroit, US	Chandigarh, IN
Dublin, IE	Honolulu, US	Chennai, IN
Düsseldorf, DE	Houston, US	Chiang Mai, TH
Edinburgh, GB	Indianapolis, US	Chittagong, BD
Ekaterinburg, RU	Jacksonville, US	Colombo, LK
Frankfurt, DE	Kansas City, US	Dhaka, BD
Geneva, CH	Las Vegas, US	Fukuoka, JP
Gothenburg, SE	Los Angeles, US	Hanoi, VN
Hamburg, DE	Mcallen, US	Ho Chi Minh City, VN
Helsinki, FI	Memphis, US	Hong Kong
Istanbul, TR	Miami, US	Hyderabad, IN
Khabarovsk, RU	Minneapolis, US	Islamabad, PK
Krasnoyarsk, RU	Montgomery, US	Jakarta, ID
Kyiv, UA	Montréal, CA	Jashore, BD
Lisbon, PT	Nashville, US	Johor Bahru, MY
London, GB	Newark, US	Kanpur, IN
Luxembourg City, LU	Norfolk, US	Karachi, PK
Madrid, ES	Omaha, US	Kathmandu, NP
Manchester, GB	Ottawa, CA	Kolkata, IN
Marseille, FR	Philadelphia, US	Kuala Lumpur, MY
Milan, IT	Phoenix, US	Lahore, PK
Minsk, BY	Pittsburgh, US	Macau
Moscow, RU	Portland, US	Male, MV
Munich, DE	Richmond, US	Mandalay, MM
Nicosia, CY	Sacramento, US	Manila, PH
Oslo, NO	Salt Lake City, US	Mumbai, IN
Palermo, IT	San Diego, US	Nagpur, IN
Paris, FR	San Jose, US	Naha, JP
Prague, CZ	Saskatoon, CA	Nasiriyah, IQ
Reykjavík, IS	Seattle, US	New Delhi, IN
Riga, LV	St. Louis, US	Osaka, JP
Rome, IT	Tallahassee, US	Patna, IN
Sofia, BG	Tampa, US	Phnom Penh, KH
St. Petersburg, RU	Toronto, CA	Seoul, KR
Stockholm, SE	Vancouver, CA	Singapore, SG
Tallinn, EE	Winnipeg, CA	Surat Thani, TH
Thessaloniki, GR		Taipei

Vienna, AT Vilnius, LT Warsaw, PL Zagreb, HR Zürich, CH		Tashkent, UZ Tbilisi, GE Thimphu, BT Tokyo, JP Ulaanbaatar, MN Vientiane, LA Yangon, MM Yerevan, AM Yogyakarta, ID

Microsoft Azure CDN server locations in 3 different continents:

EUROPE	**N.AMERICA**	**ASIA**
Vienna, Austria Brussels, Belgium Sofia, Bulgaria Zagreb, Croatia Prague, Czech Republic Copenhagen, Denmark Helsinki, Finland Marseille, France Paris, France Saint Denis, France Berlin, Germany Duesseldorf, Germany Frankfurt, Germany Munich, Germany Athens, Greece Budapest, Hungary Dublin, Ireland Milan, Italy Rome, Italy Oslo, Norway Warsaw, Poland Lisbon, Portugal Bucharest, Romania Barcelona, Spain Madrid, Spain	Montreal, Canada Toronto, Canada Vancouver, Canada Querétaro, Mexico San Juan, Puerto Rico Ashburn, VA, USA Atlanta, GA, USA Boston, MA, USA Boydton, VA, USA Cheyenne, WY, USA Chicago, IL, USA Dallas, TX, USA Denver, CO, USA Honolulu, HI, USA Houston, TX, USA Jacksonville, FL, USA Las Vegas, NV, USA Los Angeles, CA, USA Miami, FL, USA Minneapolis, MN, USA Nashville, TN, USA New York, NY, USA Newark, NJ, USA Philadelphia, PA, USA Phoenix, AZ, USA	Chai Wan, Hong Kong SAR Hong Kong Jakarta, Indonesia Osaka, Japan Tokyo, Japan Kuala Lumpur, Malaysia Manila, Philippines Singapore Busan, South Korea Seoul, South Korea Taipei, Taiwan Taipei City, Taiwan Bangkok, Thailand Ho Chi Minh City, Vietnam

Stockholm, Sweden Geneva, Switzerland Zurich, Switzerland London, United Kingdom Manchester, United Kingdom Kyiv, Ukraine	Portland, OR, USA San Antonio, TX, USA San Diego, CA, USA San Jose, CA, USA Seattle, WA, USA	

CDNs make connections with other servers when necessary or pull the content there to the server close to the user when necessary.

If we talk about Google, there are a total of 14 mega-data and control centers, 8 in North America, 4 in Europe and 2 in Asia. All these data centers and data-control locations are interconnected by Google's own private network. When a user makes a request, usually the query is first sent through the local ISP to a nearby login cache where the content is retrieved; While providing the static content to the client, the nearby cache also forwards the query over Google's private network to one of the mega data centers where personalized search results are received. The request information is sent to both the local ISP, the local server and Google's mega data center. These huge datacenters house over 100,000 servers and keep in touch with requests around the world. These servers are responsible for almost all Google services. An estimated 50 clusters in IXPs scattered throughout the world, with each cluster consisting on the order of 110–550 servers. Except for the local ISPs, the Google cloud services are largely provided by a network infrastructure that is independent of the public Internet. Local ISPs are just query tools. Google has its own loop network.

Google Cloud CDN server locations in 3 different continents:

EUROPE	**N.AMERICA**	**ASIA**
Amsterdam, Netherlands Budapest, Hungary Dublin, Ireland Frankfurt, Germany Groningen, Netherlands Hamburg, Germany Hamina, Finland Helsinki, Finland London, England Madrid, Spain	Ashburn, Virginia, US Atlanta, Georgia, US Charleston, South Carolina, US Chicago, Illinois, US Council Bluffs, Iowa, US Dallas/Fort Worth, Texas, US Denver, Colorado, US Las Vegas, Nevada, US Lenoir, North Carolina, US Los Angeles, California, US Miami, Florida, US Montréal, Québec, Canada	Changhua County, Taiwan Chennai, India Hong Kong SAR, China Jakarta, Indonesia Kuala Lumpur, Malaysia Mumbai, India Delhi, India Osaka, Japan Seoul, South Korea Singapore Taipei, Taiwan Tokyo, Japan

Marseille, France Milan, Italy Munich, Germany Paris, France Prague, Czech Republic Sofia, Bulgaria St. Ghislain, Belgium Stockholm, Sweden Warsaw, Poland Zurich, Switzerland	New York, New York, US Querétaro, Mexico Salt Lake City, Utah, US San Francisco, California, US Seattle, Washington, US The Dalles, Oregon, US Toronto, Ontario, Canada Tulsa, Oklahoma, US	

CDNs also have their own DNS structures and most of the redirects are provided through these DNS structures. CDN learns the IP address of the client's LDNS (Local DNS) server via the client's DNS lookup. This determination is made either according to the traffic density or according to the proximity of the location. If it's based on geolocation, the location is determined through this IP and the CDN chooses the most efficient server cluster. For a client based on the current traffic conditions, CDNs can instead perform periodic real-time measurements of delay and loss performance between their clusters and clients. A CDN can have each of its clusters periodically send probes (for example, ping messages or DNS queries) to all of the LDNSs around the world. The point to be noted is that each query is captured and recorded by the cache.

Nearly all CDNs use partner networks around the world or can interact with other CDNs through their own queries.

Some important IP ranges and their owners:

For Google Cloud IP-ranges: https://www.gstatic.com/ipranges/cloud.json
For Amazon AWS IP-ranges: https://ip-ranges.amazonaws.com/ip-ranges.json
For Microsoft Office Endpoints:
https://endpoints.office.com/endpoints/worldwide?clientrequestid=b10c5ed1-bad1-445f-b386-b919946339a7
For Azure IP-ranges: https://www.azurespeed.com/Information/AzureIpRanges
For Cloudflare IPV4 ranges: https://www.cloudflare.com/ips-v4
For Cloudflare IPV6 ranges: https://www.cloudflare.com/ips-v6

These IP points can change or their ranges can be transferred.

Today's internet is knitted with such intertwined structures. From the low level to the high level, every point interacts with each other. Each ISP, local or not, can depend on or interact with the CPN at the top of the pyramid on a global scale. As you read above, each CPN/CDN has its own private network and communication and is closed to the open-world. Cloud services such as AWS, Salesforce, IBM also provide services to governments and most governments around the world choose these services for financial gain. In addition, it should be noted that these services also have agreements with third-party companies as ancillary services.

For example, most official sites belonging to the EU commission use AWS service. The European Commission has long been interested in the cloud computing industry, conducting public consultations as early as 2011 and as participants in earlier debates regarding the costs and benefits of cloud technologies. Below are the names of some government based services:

- AWS GovCloud
- Microsoft Office 365 Government and Azure Government
- IBM SmartCloud for Government
- Salesforce Government Cloud
- Huddle
- Oracle Government Cloud

Tier-I ISPs (formerly Transit ISP, some now called CPN) own their network infrastructure and have direct control over how traffic flows through these connections. CDN security and privacy are still unclear today and are quite fragile. Today, governments have unfortunately become customers of private companies. In addition, the USA and the UK have started to work on making their cloud operations available to the public. This may pose a risk to the public's data privacy.

Another issue that needs to be discussed urgently is internet cable and connection owners. Most major CDNs have their own internet cables and hubs. They own or lease transoceanic fiber optic transport. Google owns major shares of 63,605 miles of submarine cables and holds partial ownership of 8.5% of submarine cables worldwide. Content providers like Facebook and Amazon are increasingly building private cables to support their cloud services.

Content Providers	**Cable Miles**	**Cable Kilometers**
Google	63605	102362
Facebook	57079	91859
Amazon	18987	30557
Microsoft	4104	6605

In addition, giant companies acting as CPN/CDN can also serve as ISPs in locales. Alphabet company Google Fiber has built residential fiber service covering dozens of US markets. Top areas served by Google Fiber are in competitive markets with other internet providers like Salt Lake City, Austin and Kansas City. Among all internet providers in Atlanta, Google Fiber has the 2nd most fiber coverage. Among fiber providers in Irvine, CA, Google Fiber has the 2nd most coverage.

Below you will see the structure of major companies.

Cable Ownership Information - Google:

Provider	**Cable name**	**Ownership**	**Length in km**
Google	Junior	Sole owner	390
Google	Tannat	Part owner	2000
Google	Hong Kong-Guam (HK-G)	Part owner	3900
Google	INDIGO-West	Part owner	4600
Google	INDIGO-Central	Part owner	4850
Google	Dunant	Sole owner	6400
Google	Havfrue	Part owner	7200
Google	Southeast Asia Japan Cable (SJC)	Part owner	8900
Google	Japan-Guam-Australia South (JGA-S)	Part owner	9500
Google	Unity	Part owner	9620
Google	Curie	Sole owner	10000
Google	Monet	Part owner	10556
Google	FASTER	Part owner	11629
Google	Pacific Light Cable Network (PLCN)	Part owner	12817

Cable Ownership Information - Facebook:

Provider	**Ownership**	**Length in km**
MAREA	Part owner	6605
Havfrue	Part owner	7200
Asia Pacific Gateway (APG)	Part owner	10400
Southeast Asia-Japan Cable 2 (SJC2)	Part owner	10500
Pacific Light Cable Network (PLCN)	Part owner	12817
Hong Kong-Americas (HKA)	Part owner	13780
JUPITER	Part owner	14557
Bay to Bay Express (BtoBE) Cable System	Part owner	16000

Cable Ownership Information - Amazon:

Provider	**Ownership**	**Length in km**
Bay to Bay Express (BtoBE) Cable System	Part owner	16000
JUPITER	Part owner	14557

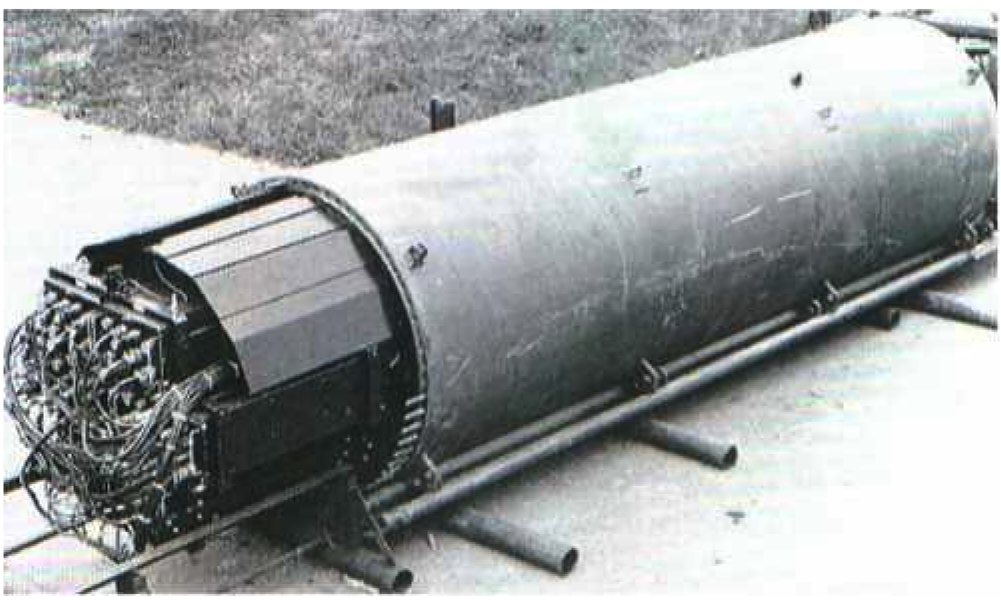
Cable Ownership Information - Microsoft:

Provider	**Ownership**	**Length in km**
MAREA	Part owner	6605

Cable Espionage - Ivy Bells & PRISM

Cable espionage is one of the cyber security espionage methods that dates back to 1978. Operation Ivy Bells is the best example of this.

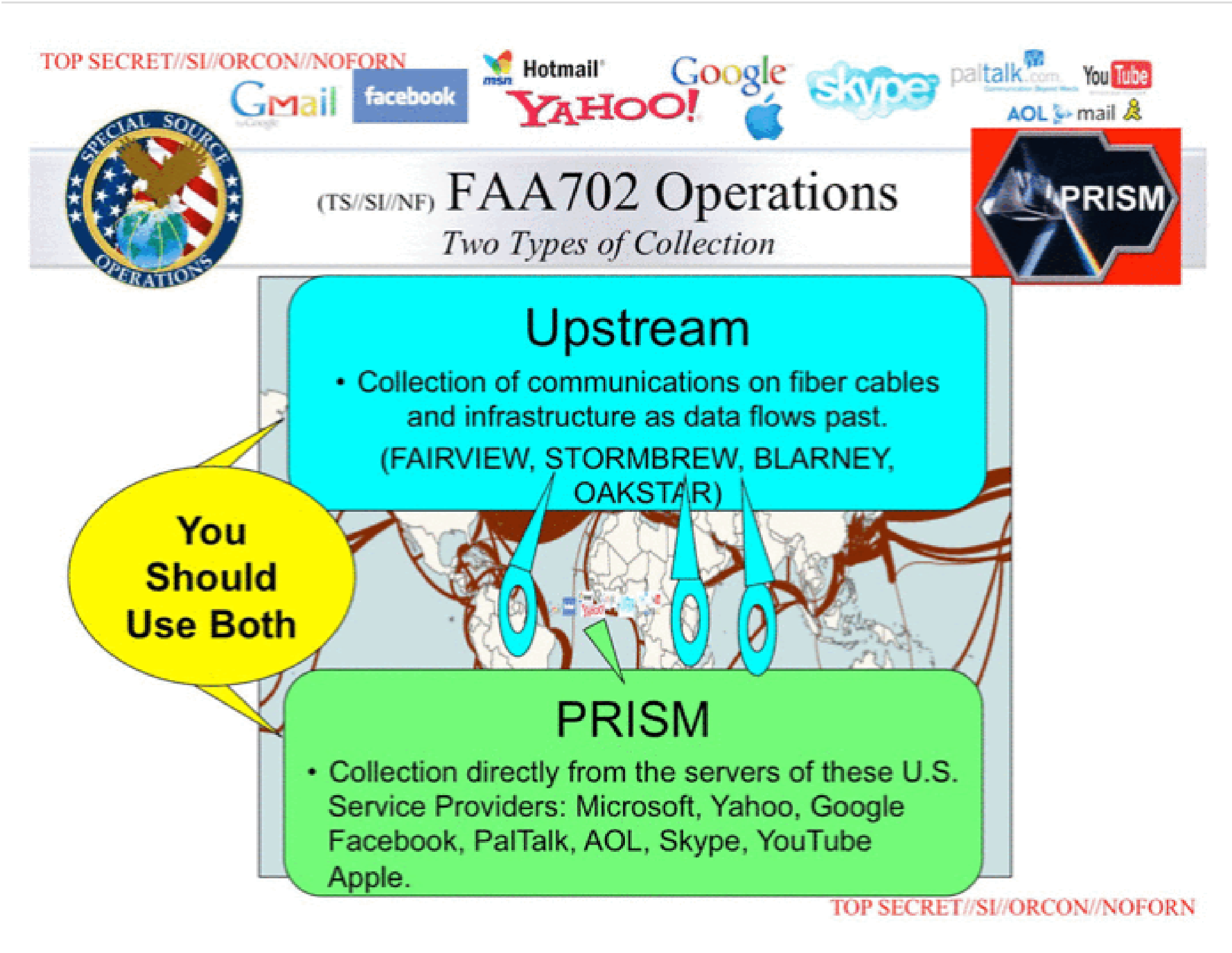
The combined efforts of the Central Intelligence Agency (CIA), United States Navy, and the National Security Agency (NSA) produced one of the most dangerous and ambitious covert submarine operations in history in an effort to gain the upper hand in the rapidly evolving information war.



Military unit divers from the specially equipped submarine USS Halibut (SSN 587) were sent to Soviet territorial waters to place a "listening cock" on the 5-inch diameter cable that provided military communications. In an effort to alter the balance of the Cold War, these men scoured the ocean floor for a five-inch diameter cable carrying secret Soviet communications between military bases. This "listening cock" consisted of an additional 20 feet of cable, its main purpose being to share the flow direction of the bits that provided the actual communication. The "bits" flowing along a cable to enable communication would also pass through the cable the USS soldiers attached. For a while this approach worked and the "bits" could be caught. The plan was so solid that every step of it was thought through. If the Soviet soldiers noticed this espionage and intervened, this "cock" would go to the bottom of the water. If the cable malfunctioned and the Soviets raised it for repair, the bug, by design, would fall to the bottom of the ocean. Each month, Navy divers retrieved the recordings and installed a new set of tapes. The Soviets were so confident in security that they didn't even use any additional encryption method. NSA spies easily obtained critical communications logs. This mission was successfully carried out until 1981, but the Soviet soldiers eventually detected the espionage. It was one of the NSA agents that made them notice. After a long probe, U.S. counterintelligence agents determined an NSA employee, Ronald Pelton, betrayed Operation Ivy Bells to the Soviets. He sold the secret of Operation Ivy Bells for $35,000, which ended nearly a decade of espionage.

“Ivy Bells” is an operation that needs to be learned about espionage, which is experienced and will be experienced in the internet age.

The NSA PRISM secret program is also an example of this cable espionage and is contemporary. The top-secret PRISM program allows the U.S. intelligence community to gain access from nine Internet companies to a wide range of digital information, including e-mails and stored data, on foreign targets operating outside the United States. At the same time, the American public was spied on under this program. PRISM is a tool used by the US National Security Agency (NSA) to collect private electronic data belonging to users of major internet services like Gmail, Facebook, Outlook, and others. It’s the latest evolution of the US government’s post-9/11 electronic surveillance efforts, which began under President Bush with the Patriot Act, and expanded to include the Foreign Intelligence Surveillance Act (FISA) enacted in 2006 and 2007.



PRISM Providers are:

- Microsoft
- Yahoo
- Google
- Facebook
- PalTalk
- YouTube
- Skype
- AOL
- Apple

Under the PRISM program, the NSA and CIA have reached agreements with these companies. They collect data from Google, Facebook, Apple and others. The NSA can require companies like Google and Facebook to send data to the government, as long as the requests meet the classified plan's criteria. Data was obtained from "upstream" wiretaps and US service providers that pull data directly from undersea telecommunications cables under the PRISM Program. One of the slides in the leaked PRISM presentation instructs analysts to "use both" of these resources.

They are also the clearest proof that cable spying is possible. Today, the cables are owned by private companies and the control is completely in their hands. Because of their hidden transmission networks, the open-world is unaware of the control that is at the heart of companies.

The next topic will be about these types of espionage.