ISP=INTERNET SERVICE PROVIDER

DEFINITION

An ISP (Internet service provider) is a company that provides individuals and other companies access to the Internet and other related services such as Web site building and virtual hosting. An ISP has the equipment and the telecommunication line access required to have a point-of-presence on the Internet for the geographic area served. Access ISP's connect customers to the Internet using copper, wireless or fiber connections. The larger ISP's have their own high-speed leased lines so that they are less dependent on the telecommunication providers and can provide better service to their customers. Among the largest national and regional ISPs are AT&T WorldNet, IBM Global Network, MCI, Netcom, UUNet, and PSINet.
ISPs also include regional providers such as New England's NEARNet and the San Francisco Bay area BARNet. They also include thousands of local providers. In addition, Internet users can also get access through online service providers (OSP) such as America Online and Compuserve.

The larger ISPs interconnect with each other through MAE (ISP switching centers run by MCI WorldCom) or similar centers. The arrangements they make to exchange traffic are known as peering agreements. There are several very comprehensive lists of ISPs world-wide available on the Web.

An ISP is also sometimes referred to as an IAP (Internet access provider). ISP is sometimes used as an abbreviation for *independent service provider* to distinguish a service provider that is an independent, separate company from a telephone company.

History of ISPs

The internet started off as a closed network between government research laboratories and relevant parts of universities. It became popular and then universities and colleges started giving more of their members access to it. As a result, commercial Internet Service Providers occurred to provide access for mainly those who missed their university accounts. In 1990, Brookline, Massachusetts-based The World became the 1st commercial ISP (see http://www.zakon.org/robert/internet/timeline/, also published as RFC 2235)

Considering the ubiquity of the internet it's kind of funny that so few people know much about its source. So long as people can access the internet they are unconcerned about from where it's coming. But recognizing the history of Internet Service Providers provides a meaningful link between the worlds most powerful tool and the person using it.

Originally, to access the internet you needed an account at a university or a government agency. The internet began accepting commercial traffic in the early 1990s, but it was limited and on nowhere near the scale of today. There were a small handful of companies, considered access points, that provided public access, but soon, as traffic increased, they became clogged. Major telecommunication companies began providing access privately. Smaller companies benefited from accessing the larger companies network, but soon they were charged for this access. This was around the mid 90s, right before the internet boom.
In 1995, MTI and AT & T began charging consumers a monthly rate of about $20. Businesses were charged considerably more as their connection was faster and more reliable. It's easy to imagine that everyday consumers had more patience for it than they do today considering how much less reliant they were on the internet during its infancy. This was before things like E-mail, Ebay, Itunes, and Youtube were household words, and internet tools people leaned on.
When the internet suddenly took off, ISPs were challenged to dramatically improve their infrastructure, router technology, and increase their access points. The bigger communication companies began developing subsidiaries that focused on making the internet more widely accessible. Even as technology improved, the web had to deal with more and more congestion. Access was greatly improved, but internet usage rose exponentially. The upshot is ISP's monthly charges typically diminished, but this also varied from country to country. Markets with fewer ISP's had a greater monopoly, and so were able to charge more than in regions where competition prevented companies from raising prices too high.
Lately there has been controversy between large ISP's and regulating agencies concerned about a lack of competition. In Canada, a new report released by Harvard indicates that the country is lacking in broadband speed, price, and market penetration. In response, big ISP's have suggested that this is a flawed statistic, and really what are needed are more citizens with computers, more Canadian content, and more Canadian research. In short, the two sides are trying to absolve themselves of blame by deflecting the responsibility to some other party. This is specifically a worthwhile case study because it's indicative of what's happening in most markets around the world. For ISP's to maintain price control they need to convince the general public and media sources that the problem isn't with broadband pricing. Likewise, regulators are generally going

after dominant players in order to check their control of the market and stop what they perceive as exploiting their position.
Today, it's difficult to imagine people living without some kind of internet access. We should be grateful for ISP's whose vision has paved the way for the internet explosion that has enriched our lives in so many ways. Hopefully new companies will continue springing up and internet access will stay in the financial reach of people everywhere.

Tier 1 network

Definition

Although there is no authority that defines tiers of networks participating in the Internet, the most common definition of a tier 1 network is one that can reach every other network on the Internet without purchasing IP transit or paying settlements.

By this definition, a tier 1 network is a transit-free network that peers with every other tier-1 network. But not all transit-free networks are tier 1 networks. It is possible to become transit-free by paying for peering or agreeing to settlements.

The most widely quoted source for identifying tier 1 networks is Renesys Corporation, but the base information to prove the claim is publicly accessible from many locations, such as the RIPE RIS database, the Oregon Route Views servers, the Packet Clearing House, and others.

It is difficult to determine whether a network is paying settlements if the business agreements are not public information, or covered under a non-disclosure agreement. The Internet "peering community" is roughly the set of peering coordinators present at Internet exchanges on more than one continent. The subset representing "tier 1" networks is collectively understood, but not published as such.

Strictly observing this definition of "tier 1" would exclude every network. For instance, many large telephone companies are tier 1 networks, but they buy, sell, or swap fiber amongst themselves. Payments between companies are not all known, nor whether they cover peering connections.

As a result, the term "tier 1 network" is used in the industry to mean a network with no overt settlements. An overt settlement would be a monetary charge for the amount, direction, or type of traffic sent between networks.

Common definitions of tier 2 and tier 3 networks:

- Tier 2: A network that peers with some networks, but still purchases IP transit or pays settlements to reach at least some portion of the Internet.
- Tier 3: A network that solely purchases transit from other networks to reach the Internet.

Routing

Internet traffic between any two tier 1 networks is critically dependent on the peering relationship of the partners, because a tier 1 network does not have any alternate transit paths. If two tier 1 networks arrive at an impasse and discontinue peering with each other , single-homed customers of each network will not be able to reach the customers of other networks. This effectively partitions the Internet and traffic between certain parts of the Internet is interrupted. This has happened several times during the history of the Internet . Those portions of the Internet typically remain partitioned until one side purchases transit, or until the collective pain of the outage or threat of litigation motivates the two networks to resume voluntary peering.

Lower tier ISPs and their customers may be unaffected by these partitions because they may have redundant interconnections with more than one tier-1 provider.

Internet exchange point

An Internet exchange point (IX or IXP) is a physical infrastructure through which Internet service providers

(ISPs) exchange Internet traffic between their networks (autonomous systems). IXPs reduce the portion of an ISP's traffic which must be delivered via their upstream transit providers, thereby reducing the average per-bit delivery cost of their service. Furthermore, the increased number of paths learned through the IXP improves routing efficiency and fault-tolerance.

The primary purpose of an IXP is to allow networks to interconnect directly, via the exchange, rather than through one or more 3rd party networks. The advantages of the direct interconnection are numerous, but the primary reasons are cost, latency, and bandwidth. Traffic passing through an exchange is typically not billed by any party, whereas traffic to an ISP's upstream provider is. The direct interconnection, often located in the same city as both networks, avoids the need for data to travel to other cities (potentially on other continents) to get from one network to another, thus reducing latency. The third advantage, speed, is most noticeable in areas that have poorly developed long-distance connections. ISPs in these regions might have to pay between 10 or 100 times more for data transport than ISPs in North America, Europe or Japan. Therefore, these ISPs typically have slower, more limited connections to the rest of the internet. However, a connection to a local IXP may allow them to transfer data without limit, and without cost, vastly improving the bandwidth between customers of the two adjacent ISPs.

A typical IXP consists of one or more network switches, to which each of the participating ISPs connect. Prior to the existence of switches, IXPs typically utilized FOIRL hubs or FDDI rings, migrating to Ethernetand FDDI switches as those became available in 1993 and 1994. ATM switches were briefly used at a few IXPs in the late 1990s, accounting for approximately 4% of the market at their peak, and there was an abortive attempt by the Stockholm IXP, NetNod, to use SRP/DPT (an ill-fated conjoinment of FDDI and SONET), but Ethernet has prevailed, accounting for more than 95% of all existing Internet exchange switch fabrics. All Ethernet port speeds are to be found at modern IXPs, ranging from 10 Mbit/s ports in use in small developing-country IXes, to ganged 10 Gbit/s ports in major centers like Seoul, New York, London, Frankfurt, Amsterdam, and Palo Alto.

The technical and business logistics of traffic exchange between ISPs is governed by mutual peering agreements. Under such agreements traffic is often exchanged without compensation. When an IXP incurs operating costs, they are typically shared among all of its participants. At the more expensive exchanges, participants pay a monthly or annual fee, usually determined by the speed of the port or ports which they're using, or much less commonly by the volume of traffic which they're passing across the exchange. Fees based on volume of traffic are unpopular because they provide a counterincentive to growth of the exchange. Some exchanges charge a setup fee to offset the costs of the switch port and any media adaptors (gigabit interface converters, small form-factor pluggable transceivers, XFP transceivers, XENPAKs, etc.) that the new participant requires.

Traffic exchange across an Internet exchange point

nternet traffic exchange between two participants on an IXP is facilitated by Border Gateway Protocol (BGP) routing configurations between them. They choose to announce routes via the peering relationship - either routes to their own addresses, or routes to addresses of other ISPs that they connect to, possibly via other mechanisms. The other party to the peering can then apply route filtering, where it chooses to accept those routes, and route traffic accordingly, or to ignore those routes, and use other routes to reach those addresses.

In many cases, an ISP will have both a direct link to another ISP and accept a route (normally ignored) to the other ISP through the IXP; if the direct link fails, traffic will then start flowing over the IXP. In this way, the IXP acts as a backup link.

When these conditions are met, and a contractual structure exists to create a market to purchase network services, the IXP is sometimes called a transit exchange. The Vancouver Transit Exchange, for example, is described as a "shopping mall" of service providers at one central location, making it easy to switch providers - "as simple as getting a VLAN to a new provider." The VTE is run by BCNET, a public entity.

Advocates of green broadband schemes and more competitive telecom services often advocate aggressive expansion of transit exchanges into every municipal area network so that competing service providers can place such equipment as video on demand hosts and PSTN switches to serve existing phone equipment, without being answerable to any monopoly incumbent.

List of Internet exchange points by size

Short name	Name	City	Country	Established	Members	Throughput (Gbit/s) maximum	Throughput (Gbit/s) average
DE-CIX	Deutscher Commercial Internet Exchange	Frankfurt am Main	Germany	1995	373	3206	945
AMS-IX	Amsterdam Internet Exchange	Amsterdam	Netherlands	1997	418	1180	811
LINX	London Internet Exchange	London	United Kingdom	1994	375	869	563
Equinix	Equinix Exchange	London,Paris, Amsterdam, Frankfurt am Main,Munich,Zürich, Geneva, New York, Washington D.C., Chicago,Dallas, Los Angeles, San Jose, Tokyo,Hong Kong, Singapore,Sydney	United States, Europe ,Asia-Pacific	1998	768	946	634
MSK-IX	Moscow Internet Exchange	Moscow	Russia	1995	340	570	336
UA-IX	Ukrainian Internet Exchange Network	Kiev	Ukraine	2000	110	319	197
JPNAP	Japan Network Access Point	Tokyo and Osaka	Japan	2001	75	273	234
Netnod	Netnod Internet Exchange in Sweden	Stockholm,Malmö, Sundsvall, Gothenburg,Luleå	Sweden	1997	64	204	118
ESPANIX	Spain Internet Exchange	Madrid	Spain	1997	53	168	88
NIX.CZ	Neutral Internet eXchange of the Czech Republic	Prague	Czech Republic	1996	105	171	97
NYIIX	New York International Internet eXchange	New York	USA	1996	135	145	93
JPIX	Japan Internet Exchange	Tokyo	Japan	1997	113	145	88
Any2	Any2 Exchange	Los Angeles,San	USA	2005	216	140	100

		Jose,Miami,Washington DC,Boston,Chicago, Reston,New York					
HKIX	Hong Kong Internet eXchange	Hong Kong	Hong Kong	1995	95+46	145	71
NL-ix	Netherlands Internet Exchange	Aalsmeer,Almere,Alphen a/d Rijn,Amsterdam, Arnhem,Capelle a/d Ijssel,Ede,Haarlem,Hilversum, Oude Meer,Rijen, Rotterdam, Schiphol-Rijk,Steenbergen	Netherlands	2002	259	113	78
PLIX	Polish Internet eXchange	Warsaw	Poland	2006	168	126	70
BIX	Budapest Internet Exchange	Budapest	Hungary	1996	51	98	70
SIX	Seattle Internet Exchange	Seattle	USA	1997	147	82	55
MIX	Milan Internet eXchange	Milan	Italy	2000	119	68	40
ECIX	European Commercial Internet Exchange	Düsseldorf,Berlin,Hamburg	Germany	2003	109	63	37
TorIX	The Toronto Internet Exchange	Toronto	Canada	1998	137	66	39
SVAO-IX	SVAO-IX	Moscow	Russia	2004	47	47	28
GR-IX	Greek Internet eXchange	Athens	Greece	1997	12	45	8
TOP-IX	Torino Piemonte Internet point eXchange	Turin	Italy	2002	65	33	10
NIX	Norwegian Internet eXchange	Oslo	Norway	1993	62	32	13
PTT Metro	PTT Metro	Americana,Belo Horizonte,Brasília, Campina Grande,Campinas, Curitiba, Florianópolis, Fortaleza,Goiânia	Brazil	2004	183	52	29

		,Londrina,Porto Alegre,Recife, Rio de Janeiro, Salvador,São José dos Campos,São Paulo					
BIX.BG	Bulgarian Internet eXchange	Sofia	Bulgaria	2009	38	31	17
SIX	Slovak Internet eXchange	Bratislava and Košice	Slovakia	1996	52	30	16
SPB-IX	Saint-Petersburg Internet Exchange	Saint-Petersburg	Russia	2005	98	30	12
VIX	Vienna Internet eXchange	Vienna	Austria	1996	104	29	20
Home-IX	Home-IX	Moscow	Russia	2006	52	28	13
BNIX	Belgium National Internet eXchange	Brussels	Belgium	1995	44	28	N/A
SIX	Slovenian Internet Exchange	Ljubljana	Slovenia	?	18	27	14
InterLAN	Romanian Internet Exchange	Bucharest	Romania	2005	62	25	11
FICIX	Finnish Communication and Internet Exchange	Espoo, Helsinki, Oulu	Finland	1993	27	24	14
SwissIX	Swiss Internet eXchange	Zürich	Switzerla nd	2001	132	21	9.4
LONAP	London Network Access Point	London	United Kingdom	1997	90	19	8
WORK-IX	WORK-IX	Hamburg	Germany	2002	33	19	4
SFINX	Service for French Internet eXchange	Paris	France	1995	85	17	N/A
INXS	Internet Exchange Point Munich	Munich	Germany	1994	41	17	7
BalkanIX	Balkan Internet eXchange	Sofia	Bulgaria	2009	17	16	7
BCIX	Berlin Commercial Internet	Berlin	Germany	2002	47	23	8

	Exchange						
PARIX	Paris Internet eXchange	Paris	France	2001	44	15	11
Pipe IX	Pipe IX	Sydney	Australia	2002	60+	13	13
NaMeX	Nautilus Mediterranean eXchange point	Rome	Italy	1995	40	13	7
ALP-IX	ALPs Internet Exchange	Munich	Germany	2008	18	13	5
INEX	Internet Neutral Exchange	Dublin	Ireland	1996	48	12	5
DIX	Danish Internet Exchange Point	Lyngby	Denmark	1994	45	11	N/A
RoNIX	Romanian Network for Internet eXchange	Bucharest	Romania	2001	37	11	7
AtlantaIX	Atlanta Internet Exchange	Atlanta	USA	2003	44	9	3
LAIIX	Los Angeles International Internet eXchange	Los Angeles	USA	1996	44	9	4
Pacific Wave	Seattle Network-to-Network Access Point	Seattle	USA	1998	28	8	1
GigaPix	Gigabit Portuguese Internet eXchange	Lisbon	Portugal	1995	20	8	5
NIXI	National Internet Exchange of India	Mumbai,Delhi,Chennai,Kolkata,Bangalore,Hyderabad,Ahmedabad	India	2003	86	14	8
GN-IX	Groningen Internet Exchange	Groningen	Netherlands	2001	65	7	2
PIRIX	PIRIX Internet Exchange	Saint-Petersburg	Russia	2009	40	6	4
Kh-IX	Kharkov Internet Exchange Point	Kharkov	Ukraine	?	50	5	3
TIX	Telehouse Internet Exchange	Zürich	Switzerland	1999	62	4	2
EKT-IX	Ekaterinburg Internet eXchange	Ekaterinburg	Russia	2008	29	4	2
TWIX	Taiwan Internet	Taipei		1996	26	3	2

	Exchange		Taiwan				
IIX	Israeli Internet Exchange	Petah Tikva	Israel	1996	18	3	2
FreeBIX	Free Belgian Internet Exchange	Brussels	Belgium	2003	30	2	1
Moebius	PTT Moebius	Rio de Janeiro	Brazil	2008	11	2	1
CIXP	CERN Internet Exchange Point	CERN,Geneva,Zürich	Switzerland	1989	40	2	1
VSIX	North East Neutral Access Point	Padova	Italy	2009	14	1	1

Ranking Internet Service Providers in USA by Size

The size is measured by some notion of the extent of their customer base. Very little information has been made publically available on this, and as far as I can tell, no attempt has ever been made to collate it.

About the only way to gain real information on the size of the customer base of any ISP is via their own announcements. Because of various ISP's philosophies regarding disclosure, some of this data comes from far more accurate and up-to-date sources than others. This is an unfortunate necessity. Of course, we have no real idea what the methodology is that they are using, nor can we tell whether these numbers are in any way accurate. Further, as is especially the case for the free service ISPs, it's hard to gain consensus on what these numbers mean, or how meaningful they are. Nonetheless, this information can show some relative sizes without needing to be horribly accurate.

ISP	Subscribership	Date	Source
America Online	22,200,000*	20050204	The Register
NetZero	8,600,000	20010503	Yahoo! (now United Online after merger with Juno)
Comcast	8,142,000	20050930	Leichtman Research Group
Microsoft Network	8,000,000	20040108	Yahoo!
Spinway	6,700,000	20004201	BlueLight press release on Spinway's demise
United Online	6,600,000***	20041025	United Online press release
SBC Communication	6,496,000****	20050930	Leichtman Research Group
EarthLink	5,400,000	20041021	CNet News
RoadRunner	4,557,000	20050930	Leichtman Research Group
Verizon	4,531,000****	20050930	Leichtman Research Group
Prodigy	3,500,000	20011019	Yahoo!, now part of SBC
1stUp.com	3,500,000	20000426	Internet News (before they folded)
Freei.Net	3,200,000	20000810	Freei web site(acquired by NetZero on November 1, 2000)
AltaVista (via 1stUp)	3,000,000	20001206	Yahoo! (at the time they discontinued free service)
Cox Communications	2,975,000	20050930	Leichtman Research Group

Bell South	2,678,000****	20050930	Leichtman Research Group	
Charter Communications	2,120,000	20050930	Leichtman Research Group	
Compuserve (AoL)	2,000,000*	20000630	2000 Annual Report to Shareholders	
Adelphia	1,656,700	20050930	Leichtman Research Group	
Cablevision	1,600,000	20050930	Leichtman Research Group	
AT&T Worldnet	1,500,000	20000502	Internet News	
Qwest	1,340,000****	20050930	Leichtman Research Group	
Mindspring	1,297,000	19991020	CNet News (merged with EarthLink on Feb. 7, 2000)	
MSN TV	1,000,000	20030503	Microsoft Press Release, renamed WebTV service	
Juno	910,000***	20010424	Yahoo! (Now merged with NetZero.)	
RCN	827,000	20020208	Yahoo!	
Bright House Networks	815,000	20050930	Leichtman Research Group	
OneMain	794,000	20000803	Yahoo!(Before acquisition by EarthLink)	
Gateway.net (AoL)	740,000	20000119	AoL web site	
Sprint DSL	638,000	20050930	Leichtman Research Group	
Covad	578,400	20050930	Leichtman Research Group	
GTE	491,000	19991129	San Francisco Chronicle, now part of Verizon	
CoreComm	462,000	20001013	Yahoo!	
Mediacom	453,000	20050930	Leichtman Research Group	
PeoplePC	450,000	2001	PeoplePC web site	
Insight	439,200	20050930	Leichtman Research Group	
IBM Global Internet	>400,000	19980421	Computer Retail Week (Acquired by AT&T Worldnet on December 8, 1998)	
Netcom	400,000	19990107	San Jose Mercury News (at the time of the Mindspring buyout)	
Voyager.net	368,000	20000927	Yahoo! (at the time of the CoreComm merger approval	
iFreedom	365,000	20000914	Yahoo! (referring its customers to NetZero)	
ALLTEL	359,975****	20050930	Leichtman Research Group	
Verio	300,000	20000324	Yahoo!	
SW Bell/Pacific Bell	300,000	19980515	Pacific Bell Internet press release, now part of SBC	
WorldSpy	260,000	20000710	Red Herring (at the time it folded)	
Millennium Digital Medium	250,000	20010323	Millennium Digital Medium web site	
Volaris Online	250,000	20011101	Volaris Online web site	
FlashNet	231,000	20000515	Yahoo! (at the time of the Prodigy acquisition)	
Cable One	219,900	20050930	Leichtman Research Group	
CenturyTel	219,879	20050930	Leichtman Research Group	
Bell Atlantic	200,000	19991129	San Francisco Chronicle, now part of Verizon	
Concentric	197,000	19991100	Second hand from a Concentric employee.	
Sprynet	180,000	19990107	San Jose Mercury News (at the time of the Mindspring buyout)	
High Speed Access	176,000	20010803	Yahoo! (now sold all its assets to Charter)	
BlueLight.com	174,000	20030206	United Online press release (at the time of the United Online acquisition)	
Everyones Internet	170,000	20020104	Houston Business Journal	
Eisa.com	165,000	19991201	eisa.com web page	
Cincinnati Bell	153,500****	20050930	Leichtman Research Group	
JPSnet	115,000	19990303	JPSnet press release (acquired by OneMain, now part of EarthLink)	
Internet Commerce &	112,000	20000613	Internet News	

Communication			
Cable & Wireless	>104,000	19990720	estimate from Prodigy press release at time of CW dial up acquisition
Slash net	100,000	19980518	Internet Week
GoAmerica	91,384	20030409	Yahoo!
IDT	80,000	19981020	IDT web site
Internet America	76,000	20031114	Yahoo!
Broadwing	76,000	20021231	April 2, 2003 issue of DSL Prime
VillageNet	70,000	19991123	VillageWorld press release
BiznessOnline.com	63,000	19991230	BusinessOnline.com Press Release
Aplus.Net	62,000	20010401	Aplus.Net web site
Primary Network	60,000	20000124	Primary Network press release (Now part of Mpower)
FirstWorld	58,700	20000216	CNet News (customers purchased by EarthLink)
InterLync	47,000	20000330	Email from an InterLync employee
Log on America	45,000	20000809	Log on America press release (Sold it's subscriber base to EarthLink)
PDQ.net	45,000	19990913	PDQ.net web site(at the time of the Internet America buyout)
Metricom	40,900	20010209	Yahoo! (before their demise)
Northpoint	40,000	20000330	CNet News (at the time of the AT&T acquisition)
Teleport	40,000	19991130	OneMain web site (at the time of the OneMain takeover)
WorldShare.net	38,000	20000406	WorldsShare.net employee email
21st Century	37,000	19991213	Internet News (at the time of the RCN takeover)
Big Net	35,000	20000202	Email from the Big Net CFO
TIAC	33,000	19990622	Internet News (at the time of the PSI buyout)
BestWeb	30,000	20010411	BusinessWeek online
Flashcom	24,500	20010222	TheStreet.com (as Covad acquires them)
HiWAAY Internet Services	23,500	20020311	Email from HiWAAY Internet employee
FIRST	20,000	20000123	Email from the 1st.net CEO
Fastnet	19,770	20001121	Yahoo!
CAIS Internet	16,000	20010529	Yahoo!
@Link	11,000	20010426	CNet News (as @Link closes its doors)
Brigadoon	7,000	19981102	CNet News
Primenet	?	?	No info on their web site.
Worldcom	?	?	No info on their web site.
Panix	?	?	No info on their web site.
InfiNet	?	?	No info on their web site.

- * This company typically reports their worldwide numbers. The number listed here represents US subscribers only.
- *** This number represents the total number of active subscribers including free subscribers.
- **** The numbers available represent only broadband subscribers. It is expected that this company has a not insignificant number of non-broadband subscribers, so the number given should be considered to be a lower bound.

Internet in Greece

Internet access in Greece relied on PSTN/ISDN modem dial-up until 2003, when ADSL was commercially launched in Greece by incumbent operator OTE. ADSL is currently the main broadband standard. Greece also has 3G mobile broadband (HSPA) and a more expensive Satellite Internet access.

Mobile broadband was heavily marketed during 2008 by Vodafone,Cosmote and Wind, leading to a surge in mobile Internet usage in Greece, primarily with mobile professionals and young users.

OTE ADSL

Typical download/upload speeds available over OTE's network are 2048/256, 4096/256, 8192/384 kbit/s and 24/1 Mbit/s. The latter three speeds were added in May 2007 and December 2007 (24/1 Mbit/s) and are available in selected areas (Greater Athens, Greater Thessaloníki and other major cities, mainly prefecture capitals), even though 4 Mbit/s do not require ADSL2+ infrastructure in order to work properly.

Customers can either subscribe only to OTE's ADSL access service and then buy an ADSL subscription from an ISP separately, or choose their preferred ISP and buy both services bundled (OTE bitstream wholesale, known as A.RY.S.). The latter is much less expensive, but the former offers the flexibility to change ISP more often (as frequently as every 2 months; a bundled package usually has a minimum contract length of 6 to 12 months).

OTE also offers its bundled service under the Conn-x brandname, but unlimited telephony service is only available within their network. In late May 2008, OTE announced an All-in-One package that combines ADSL access and local, national and mobile calls.

Local Loop Unbundling

A variety of new entrants have appeared since the liberalisation of the market and Local Loop Unbundling (LLU). These operators typically offer higher speed service and lower prices than OTE, but their customer support is in most cases inferior to that of the Greek incumbent.

New ADSL ISPs typically offer flat-rate nationwide voice services, ADSL access (up to 24 Mbit/s) and value-added services (including VoIP and IPTV), all of which are new to the Greek market. As such, the Greek press reports that OTE has lost nearly 500,000 households to new entrants and that customers continue to switch from OTE to LLU ISPs at increasing rates.

- Vivodi Telecom, a private company utilizing LLU since 2003, partly covers Athens and Thessaloníki with its network at the moment. In the past, it covered additional cities (such as Patras, Heraklion,Veria etc.). The customers in those cities were left without service. Vivodi offers triple play services based on ADSL2+, with speeds up to 20 Mbit/s, VoIP telephony and digital television.
- Tellas, a subsidiary of Wind Hellas, offers ADSL through its LLU network in districts of Athens, Thessaloniki, Larissa and Crete with speeds up to 12/1 Mbit/s. Tellas, which was the first to provide free national calls through their network, was severely criticized for taking advantage of the 12-month contracts in order to keep their prices high and uncompetitive. Under pressure, Tellas moved from 4/0,5 to 12/1 services in November 2007, but the service is apparently still unstable, as many of the clients complain about problems related to the faster connection and/or to the router. As of March 2008, Tellas offers unlimited phone calls to 38 countries and also 60 minutes of calls to Greek cellular networks. In May 2008, Tellas upgraded their downstream speed to 24 Mbit/s.
- Wind Hellas currently offers shared LLU and fixed telephony services with carrier preselect through its subsidiary Tellas and is expected to launch full LLU double and later triple play services under its brandname in the first quarter of 2008, eventually also renaming Tellas into Wind.
- Hellas On-Line (HOL), owned by Intracom Holdings (co-owner with Sitronics of Intracom Telecom, a leading Greek network equipment manufacturer and Integrator), offers up to 24/1 Mbit/s ADSL2+ & SDSL, connections in districts of Athens, Thessaloniki, Larissa, Katerini, Karditsa, Volos, Trikala, Thiva, Livadia, Chalkida, Patras, Nafplio, Mykonos. HOL merged with Attikes Tilepikinonies in 2007, acquiring an extensive optical SDH and Metro Ethernet network in the Attika region. In the past, HOL was accused of actively using traffic shaping in order to discourage the use of P2P applications. This was attributed to HOL's low overall bandwidth-to-user ratio at that time. This notion is no longer applicable due to major upgrades of its interconnection links. HOL has the largest (amongst alternative carriers) optical backhaul networks based on DWDM technology. HOL has signed an agreement with Vodafone, according to which it is Vodafone's partner for broadband services in Greece. The partnership has led to a formal relationship with Vodafone acquiring 18,5% of HOL on August 2009.
- Forthnet, launched its based on LLU offers in early 2007, and was supposed to have covered about 50% of the Greek population by the year's end; however, the coverage wizard on its website has been accused of being inaccurate in its predictions since Forthnet often postpones availability in a telephone exchange from deadline to deadline. It currently covers districts of large cities and offers speeds up to 24/1 Mbit/s.

- On Telecoms, a totally new entrant in the Greek telecoms market, was set up by Greek and Italian managers and entrepreneurs, amongst whom are some of the founders of FASTWEB in Italy. On Telecoms launched its services in January 2007, using LLU as its last-mile medium. On Telecoms offers speeds up to 16/0,5 Mbit/s (As of 9 January 2007). In April 2009, On Telecoms joined forces with NetOne and Algonet.
- Net One, a new company which started offering 10/1 Mbit/s double play services in April 2007, now offers service at up to 24/1 Mbit/s. NetOne had been very stable and functional; however, their VoIP services are generally less popular than the traditional PSTN services offered by most other providers, because the majority of users are not familiar with VoIP setup and/or they do not realize that even PSTN services are actually VoIP with a PSTN last mile conversion, and thus, they are as reliable and functional as native VoIP. In March 2008, Net One incorporated Algonet and these two joined with On Telecoms in April 2009.
- Vodafone started offering ADSL full LLU access (up to 24/1 Mbit/s) in October 2007 as a reseller of HOL's LLU infrastructure. In September 2009, Vodafone sent letters out to all their DSL customers informing them that they will be moving the accounts directly to HOL. As of October 28, no further information has been given to the Vodafone customers, and even some HOL sales representatives remain uninformed.
- Smaller companies also offer LLU services, but with limited coverage and uncompetitive prices.

Main Internet Providers (ISPs) through OTE's bitstream network

- Otenet, OTE's affiliate ISP.
- Forthnet
- Vivodi Telecom
- Hellas On Line
- Tellas

Mobile broadband access

Mobile broadband offers are available from all three national mobile phone operators Vodafone Greece,Wind Hellas and Cosmote. Speeds for both Wind Hellas and Cosmote providers are up to 28,8 Mbit/s download (HSDPA) and 5,72 Mbit/s upload, while Vodafon Greece offer broadband speed up to 42,2 Mbit/s download (HSDPA).

Satellite Broadband

Satellite service for remote areas is offered through the Hellas Sat satellite under the "Hellas Sat Net" brandname. OTE, as one of the owners of Hellas Sat, offers Hellas Sat Net service through its own distribution channels (website, shops etc.). The subscription packages either include a one-year commitment that is automatically renewed as unlimited time service after one year, or as a six-month limited subscription for "seasonal business" (as described on the oteshop website) that is renewable on demand.

The equipment is installed by Hellas Sat accredited engineers and it includes a Satnet S3020 DVB - RCS VSAT Terminal (Advantech) satellite modem and a 0,96 m Antenna (satellite dish with transmitter receiver).

Hellas Sat Net connections are also used to interconnect public administration offices and schools in remote areas (mostly remote islands of the Aegean Sea) to the national administration network Syzefxis and to the Internet).

Attempts at Internet censorship

On June 29, 2009, George Sanidas, the soon-to-be-retired Prosecutor of the Greek Supreme Court (Areios Pagos), declared that "Internet-based communications are not covered by current privacy laws" and are thus open to surveillance by the police. Such surveillance would be, according to Sanidas's mandate, completely legal. Following this proclamation, Greek bloggers, legal experts and notable personalities from the media have claimed that Sanidas's mandate contravenes both the Greek constitution and current EU laws regarding the privacy of Internet communications. Furthermore, this mandate has been greatly criticised as being a first step towards full censorship of all Internet content.

Furthermore, on August 6, 2009, the most-visited Greek blog (troktiko.blogspot.com) was shut down. Although Google cites potential violations of the terms of use, comments implying other reasons behind the closure of troktiko were published in several leading Greek blogs. The blog went back on-line a few months later.

Internet Penetration in Greece

Internet penetration in Greece was at 46% in 2009. There were a total of 2.154.282 broadband connections as of Q3 of 2010. This translates to 19,1% broadband penetration.

International Bandwidth Usage Statistics

International bandwidth usage has been growing at close to 60% year over year in the past 3 years. This explains the mammoth rise from consumption of close to 1.3 Terabyte per second to now over 30 Tbps.

A recent study by TeleGeography looked into the growth in usage pattern over the years worldwide. Here are the average bandwidth consumed in one second through these years

2002 : 1.3 Tbps
2003 : 2.5 Tbps
2004 : 3.6 Tbps
2005 : 5.1 Tbps
2006 : 7.05 Tbps
2007 : 11.5 Tbps
2008 : 19.1 Tbps
2009 : 31 Tbps

We are inching towards the 500 million broadband subscribers mark. The latest report from market research firm Point Topic shows that by the end of the first quarter of 2010, the world had 484.97 million broadband subscribers. That's an increase from the 469.92 million subscribers that we had recorded at the end of 2009. An interesting observation is that the number is way ahead of .numbers predicted by ABI research earlier this year

So where do all these subscribers come from? The report shows what we may have already guessed – North America and Europe alone contain more than 50% of the worldwide subscribers. Also, middle east and Africa bring in the least number of subscribers. Here is a percentage distribution of broadband subscribers from all the different regions of the world.
South & East Asia: 26.27%
Western Europe : 24.02%
North America : 20.05%
Asia Pacific : 13.72%
Latin America : 6.75%
Eastern Europe : 6.23%
Middle East & Africa : 2.95%

This may not be a very recent study. Published in October 2009, the ITIF Broadband rankings study looked into the average broadband speeds and cost in countries with the fastest internet connectivity. The results are interesting. One of the critical take-aways is that the price of broadband is, more often than not, proportional to the speed offered. That makes Japan the fastest and cheapest in terms of broadband connectivity.

Here is the average cost of broadband (for 1 Mbps per month in USD) in the ten countries with the fastest internet connectivity
1. Japan : $0.27
2. Korea : $0.45
3. Finland: $2.77
4. Sweden : $0.63
5. France : $1.64
6. Netherlands : $4.31
7. Portugal : $10.99
8. Canada : $6.50
9. Poland : $13.00
10. Norway : $4.04
USA is the 15th country in the list and has an average broadband cost of $3.33 for 1 Mbps per month.

Server operating systems statistics usage

Server market share of software sold through commercial channels can be measured by two methods -

market share by units sold or market share by revenue. However, these methods may undercount the share of open source operating systems currently in use, since such operating systems may be obtained for free with or without a support plan and may be loaded onto machines that did not ship preloaded with them.

Another method is to survey publicly accessible servers, such as web servers on the Internet, and determine the operating system powering such servers by inspecting response messages. This method gives alternative insight into market share of operating systems actually installed on those servers, as opposed to the ones sold. This method, however, only includes servers publicly accessible on Internet.

Source	Date	Method	Linux	Microsoft Windows	Unix				Other
					All Unix	BSD	Solaris	Other Unix	
W3Techs	September 2010	Units (Web)	63.7%	33.7%	2.7%	2.4%	0.1%	0.2%	<0.1%
IDC	Q1 2010	Revenue	16.2%	48.9%	22.2%				
Security Space	July 2009	Units (Web)	74.29%	20.36%	5.35%	5.35%			
Netcraft	Jan 2009	Units (Web)	41.02%	41.59%	5.54%	3.30%	1.90%	0.34%	11.83%
Gartner	2007	Revenue	23.2%	66.8%	6.8%				

Notes:

- Netcraft survey in January 2009 checked 1,014,301 publicly accessible Web servers with valid SSL certificates.
- Security Space survey in August 2009 checked 38,549,333 publicly accessible Web servers.
- W3Techs survey in September 2010 checked the top 1 million Web servers (according to Alexa).

Operating systems

Windows Server 2008

Features

Windows Server 2008 is built from the same code base as Windows Vista; therefore, it shares much of the same architecture and functionality. Since the code base is common, it automatically comes with most of the technical, security, management and administrative features new to Windows Vista such as the rewritten networking stack (native IPv6, native wireless, speed and security improvements); improved image-based installation, deployment and recovery; improved diagnostics, monitoring, event logging and reporting tools; new security features such as BitLocker and ASLR; improved Windows Firewall with secure default configuration; .NET Framework 3.0 technologies, specifically Windows Communication Foundation, Microsoft Message Queuing and Windows Workflow Foundation; and the core kernel, memory and file system improvements. Processors and memory devices are modeled as Plug and Play devices, to allow hot-plugging of these devices. This allows the system resources to be partitioned dynamically usingDynamic Hardware Partitioning; each partition has its own memory, processor and I/O host bridge devices independent of other partitions.

Server Core

Windows Server 2008 includes a variation of installation called Server Core. Server Core is a significantly scaled-back installation where no Windows Explorer shell is installed. All configuration and maintenance is done entirely through command line interface windows, or by connecting to the machine remotely using Microsoft Management Console. However, Notepad and some control panel applets, such as Regional Settings, are available.

Server Core does not include the .NET Framework, Internet Explorer, Windows PowerShell or many other features not related to core server features. A Server Core machine can be configured for several basic roles:Domain controller/Active Directory Domain Services, ADLDS (ADAM), DNS Server, DHCP Server, file server, print server,Windows Media Server, IIS 7 web server and Hyper-V virtual server. Server Core can also be used to create a cluster with high availability using Failover Clustering or Network Load Balancing.

Andrew Mason, a program manager on the Windows Server team, noted that a primary motivation for producing a Server Core variant of Windows Server 2008 was to reduce the attack surface of the operating system, and that about 70% of the security vulnerabilities in Microsoft Windows from the prior five years would not have affected Server Core.

Active Directory roles

Active Directory roles are expanded with identity, certificate, and rights management services. Active Directory, until Windows Server 2003, allowed network administrators to centrally manage connected computers, to set policies for groups of users, and to centrally deploy new applications to multiple computers. This role of Active Directory is being renamed as Active Directory Domain Services (ADDS). A number of other additional services are being introduced, including Active Directory Federation Services (ADFS), Active Directory Lightweight Directory Services (AD LDS), (formerly Active Directory Application Mode, or ADAM), Active Directory Certificate Services (ADCS), and Active Directory Rights Management Services (ADRMS). Identity and certificate services allow administrators to manage user accounts and the digital certificates that allow them to access certain services and systems. Federation management services enable enterprises to share credentials with trusted partners and customers, allowing a consultant to use his company user name and password to log in on a client's network. Identity Integration Feature Pack is included as Active Directory Metadirectory Services. Each of these services represents a server role.

Failover Clustering

Windows Server 2008 offers high-availability to services and applications through Failover Clustering. Most server features and roles can be kept running with little to no downtime.

In Windows Server 2008 and Windows Server 2008 R2, the way clusters are qualified changed significantly with the introduction of the cluster validation wizard.The cluster validation wizard is a feature that is integrated into failover clustering in Windows Server 2008 and Windows Server 2008 R2. With the cluster validation wizard, you can run a set of focused tests on a collection of servers that you intend to use as nodes in a cluster. This cluster validation process tests the underlying hardware and software directly, and individually, to obtain an accurate assessment of how well failover clustering can be supported on a given configuration.

Note: This feature is only available in Enterprise and Datacenter editions of Windows Server.

Self-healing NTFS

In Windows versions prior to Windows Vista, if the operating system detected corruption in the file system of an NTFS volume, it marked the volume "dirty"; to correct errors on the volume, it had to be taken offline. With self-healing NTFS, an NTFS worker thread is spawned in the background which performs a localized fix-up of damaged data structures, with only the corrupted files/folders remaining unavailable without locking out the entire volume and needing the server to be taken down. The operating system now features S.M.A.R.T. detection techniques to help determine when a hard disk may fail.

Hyper-V

Hyper-V is hypervisor-based virtualization software, forming a core part of Microsoft's virtualization strategy. It virtualizes servers on an operating system's kernel layer. It can be thought of as partitioning a single physical server into multiple small computational partitions. Hyper-V includes the ability to act as a Xen virtualization hypervisor host allowing Xen-enabled guest operating systems to run virtualized. A beta version of Hyper-V shipped with certain x86-64 editions of Windows Server 2008, prior to Microsoft's release of the final version of Hyper-V on 26 June 2008 as a free download. Also, a standalone version of Hyper-V exists. This version also only supports the x86-64 architecture. While the x86 editions of Windows Server 2008 cannot run or install Hyper-V, they can run the MMC snap-in for managing Hyper-V.

Windows System Resource Manager

Windows System Resource Manager (WSRM) is being integrated into Windows Server 2008. It provides resource management and can be used to control the amount of resources a process or a user can use based on business priorities. Process Matching Criteria, which is defined by the name, type or owner of the process, enforces restrictions on the resource usage by a process that matches the criteria. CPU time, bandwidth that it can use, number of processors it can be run on, and allocated to a process can be restricted. Restrictions can be set to be imposed only on certain dates as well.

Server Manager

Server Manager is a new roles-based management tool for Windows Server 2008. It is a combination of Manage Your Server and Security Configuration Wizard from Windows Server 2003. Server Manager is an improvement of the Configure my serverdialog that launches by default on Windows Server 2003 machines. However, rather than serve only as a starting point to configuring new roles, Server Manager gathers together all of the operations users would want to conduct on the server, such as, getting a remote deployment method set up, adding more server roles etc., and provides a consolidated, portal-like view about the status of each role.

Other features

Other new or enhanced features include:

Core OS improvements

- Fully multi-componentized operating system.
- Improved hot patching, a feature that allows non-kernel patches to occur without the need for a reboot.
- Support for being booted from Extensible Firmware Interface (EFI)-compliant firmware on x86-64 systems.
- Dynamic Hardware Partitioning
    - Support for the hot-addition or replacement of processors and memory, on capable hardware.

Active Directory improvements

- Read-only domain controllers (RODCs) in Active Directory, intended for use in branch office or other scenarios where a domain controller may reside in a low physical security environment. The RODC holds a non-writeable copy of Active Directory, and redirects all write attempts to a Full Domain Controller. It replicates all accounts except sensitive ones. In RODC mode, credentials are not cached by default. Moreover, only the replication partner of the RODC needs to run Windows Server 2008.Also, local administrators can log on to the machine to perform maintenance tasks without requiring administrative rights on the domain.
- Restartable Active Directory allows ADDS to be stopped and restarted from the Management Console or the command-line without rebooting the domain controller. This reduces downtime for offline operations and reduces overall DC servicing requirements with Server Core. ADDS is implemented as a Domain Controller Service in Windows Server 2008.

Policy related improvements

- All of the Group Policy improvements from Windows Vista are included. Group Policy Management Console (GPMC) is built-in. The Group Policy objects are indexed for search and can be commented on.
- Policy-based networking with Network Access Protection, improved branch management and enhanced end user collaboration. Policies can be created to ensure greater Quality of Service for certain applications or services that require prioritization of network bandwidth between client and server.
- Granular password settings within a single domain - ability to implement different password policies for administrative accounts on a "group" and "user" basis, instead of a single set of password settings to the whole domain.

Disk management and file storage improvements

- The ability to resize hard disk partitions without stopping the server, even the system partition. This applies only to simple and spanned volumes, not to striped volumes.
- Shadow Copy based block-level backup which supports optical media, network shares and Windows Recovery Environment.
- DFS enhancements - SYSVOL on DFS-R, Read-only Folder Replication Member. There is also support for domain-based DFS namespaces that exceed the previous size recommendation of 5,000 folders with targets in a namespace.
- Several improvements to Failover Clustering (High-availability clusters).
- Internet Storage Naming Server (iSNS) enables central registration, deregistration and queries for iSCSI hard drives.

Protocol and cryptography improvements

- Support for 128- and 256-bit AES encryption for the Kerberos authentication protocol.
- New cryptography (CNG) API which supports elliptic curve cryptography and improved certificate management.
- Secure Socket Tunneling Protocol, a new Microsoft proprietary VPN protocol.
- AuthIP, a Microsoft proprietary extension of the IKE cryptographic protocol used in Ipsec VPN networks.
- Server Message Block 2.0 protocol in the new TCP/IP stack provides a number of communication enhancements, including greater performance when connecting to file shares over high-latency links and better security through the use of mutual authentication and message signing.

Improvements due to client-side (Windows Vista) enhancements

- Searching Windows Server 2008 servers from Windows Vista clients delegates the query to the server, which uses the Windows Search technology to search and transfer the results back to the client.
- In a networked environment with a print server running Windows Vista, clients can render print jobs locally before sending them to print servers to reduce the load on the server and increase its availability.
- Event forwarding aggregates and forwards logs of subscribed Windows Vista client computers back to a central console. Event forwarding can be enabled on the client subscribers from the central server directly from the event management console.

Miscellaneous improvements

- Windows Deployment Services replacing Automated Deployment Services and Remote Installation Services. Windows Deployment Services (WDS) support an enhanced multicast feature when deploying operating system images.
- Internet Information Services 7 - Increased security, Robocopy deployment, improved diagnostic tools, delegated administration.
- Windows Internal Database, a variant of SQL Server Express 2005, which serves as a common storage back-end for several other components such as Windows System Resource Manager, Windows SharePoint Services and Windows Server Update Services. It is not intended to be used by third-party applications.
- An optional "Desktop Experience" component provides the same Windows Aero user interface as Windows Vista, both for local users, as well as remote users connecting through Remote Desktop.

Removed features

- The Open Shortest Path First (OSPF) routing protocol component in Routing and Remote Access service was removed.
- Services for Macintosh, which provided file and print sharing via the now deprecated AppleTalk protocol, has been removed. Services for Macintosh were removed in Windows XP from client operating systems but were available in Windows Server 2003.
- NTBackup is replaced by Windows Server Backup, and no longer supports backing up to tape drives.As a result of NTBackup removal, Exchange Server 2007 does not have volume snapshot backup functionality; however Exchange Server 2007 SP2 adds back an Exchange backup plug-in for Windows Server Backup which restores partial functionality.Windows Small Business Server and Windows Essential Business Server both include this Exchange backup component.
- The POP3 service has been removed from Internet Information Services 7.0.The SMTP (Simple Mail Transfer Protocol) service is not available as a server role in IIS 7.0, it is a server feature managed through IIS 6.0.
- NNTP (Network News Transfer Protocol) is no longer part of Internet Information Services 7.0.
- Post Office Protocol component has been deprecated and will no longer be supplied as part of Windows OS.

Editions

Most editions of Windows Server 2008 are available in x86-64 (64-bit) and x86 (32-bit) versions. Windows Server 2008 for Itanium-based Systems supports IA-64 processors. Microsoft has optimized the IA-64 version for high-workload scenarios like database servers and Line of Business (LOB) applications. As such it is not optimized for use as a file server or media server. Microsoft has announced that Windows Server 2008 is the last 32-bit Windows server operating system. Windows Server 2008 is available in the editions listed below, similar to Windows Server 2003.

- Windows Server 2008 Standard (x86 and x86-64)
- Windows Server 2008 Enterprise (x86 and x86-64)
- Windows Server 2008 Datacenter (x86 and x86-64)
- Windows HPC Server 2008 (Codenamed "Socrates") (replacing Windows Compute Cluster Server 2003)
- Windows Web Server 2008 (x86 and x86-64)
- Windows Storage Server 2008 (Codenamed "Magni") (x86 and x86-64)
- Windows Small Business Server 2008 (Codenamed "Cougar") (x86-64) for small businesses
- Windows Essential Business Server 2008 (Codenamed "Centro") (x86-64) for medium-sized businesses
- Windows Server 2008 for Itanium-based Systems
- Windows Server 2008 Foundation (Codenamed "Lima")

Server Core is available in the Web, Standard, Enterprise and Datacenter editions. It is not available in the Itanium edition. Server Core is simply an alternate installation option supported by some of the editions, and not a separate edition by itself. Each architecture has a separate installation DVD. The 32-bit version of Windows Server 2008 Standard Edition is available to verified students for free through Microsoft's DreamSpark program.

Service Packs

Microsoft occasionally releases service packs for its Windows operating systems to fix bugs and also add new features.

Service Pack 2

Because Windows Server 2008 is based on the Windows NT 6.0 Service Pack 1 kernel, the RTM release is considered to be Service Pack 1; accordingly, the first service pack is called Service Pack 2. Announced on

October 24, 2008, this service pack contains the same changes and improvements as the Windows Vista Service Pack 2, as well as the final release of Hyper-V 1.0, and an approximate 10% reduction in power usage.

The first SP2 beta build was sent out in in October 2008, a public beta arrived in December 2008, and an RC-escrow build was given to testers in January 2009. Windows Vista and Windows Server 2008 share a single service pack binary, reflecting the fact that their code bases were joined with the release of Server 2008. On May 26, 2009, Service Pack 2 was ready for release. It is now available in Windows Update.

Windows Server 2008 R2

A second release, Windows Server 2008 R2, was released on October 22, 2009.Retail availability began September 14, 2009.Windows Server 2008 R2 reached the RTM milestone on July 22, 2009.Like Windows 7, it is built on Windows NT 6.1. New features include new virtualization features, new Active Directory features, IIS 7.5, and support for 256 logical processors. Support for 32-bit-only processors (x86) has been removed. On July 22, 2009, Microsoft officially announced that they had released both Windows Server 2008 R2 and Windows 7 to manufacturing. Windows Server 2008 R2 Server was generally available for download from MSDN and Technet on August 19 and for retail purchase from October 22, 2009.

System requirements

System requirements for Windows Server 2008 are as follows:

	Minimum for Windows Server 2008	Recommended for Windows Server 2008	Minimum for Windows Server 2008 R2	Recommended for Windows Server 2008 R2
Processor	1 Ghz (x86) or 1.4 GHz (x64) or Intel Itanium2	2 GHz or faster	1.4 GHz (x64 processor) or Intel Itanium 2	
Memory	512 MB RAM (may limit performance and some features)	2 GB RAM or higher • Maximum (32-bit systems): 4 GB RAM (Standard) or 64 GB RAM (Enterprise, Datacenter) • Maximum (64-bit systems): 8 GB (Foundation) or 32 GB RAM (Standard) or 2 TB RAM (Enterprise, Datacenter and Itanium-Based Systems)	512 MB RAM	Maximum: 8 GB (Foundation) or 32 GB (Standard) or 2 TB (Enterprise, Datacenter, and Itanium-Based Systems)
Video adapter and monitor	Super VGA (800 x 600)	Super VGA (800 x 600) or higher resolution	Super VGA (800 x 600)	Super VGA (800 x 600) or higher resolution
Hard drive disk free space	• Minimum (Non-Foundation 32-bit systems): 20 GB or greater • Minimum (Non-Foundation 64-bit systems): 32 GB or greater • Foundation: 10 GB or greater. • Computers with more than 16 GB of RAM require more disk space for paging , hibernation, and dump files	40 GB or higher	• 32 GB or greater for editions other than Foundation • Foundation: 10 GB or greater • Computers with more than 16 GB of RAM require more disk space for paging, hibernation, and dump files	
Optical drive	DVD-ROM			
Devices	Super VGA (800 x 600) or higher-resolution monitor, keyboard and mouse			

Windows Server 2008 R2

A reviewer guide published by the company describes several areas of improvement in version R2. These include new virtualization capabilities (Live Migration, Cluster Shared Volumes usingFailover Clustering and Hyper-V), reduced power consumption, a new set of management tools and new Active Directory capabilities such as a "recycle bin" for deleted AD objects. IIS 7.5 has been added to this release which also includes updated FTP server services. Security enhancements include the addition of DNSSEC support for DNS Server Service (note: even though DNSSEC as such is supported, only one signature algorithm is available (#5 / RSA/SHA-1). Since many zones use a different algorithm - not least the root zone - this means that in reality Windows still can't serve as a recursive resolver) and encrypted clientless authenticated VPN services through DirectAccess for clients using Windows 7. The DHCP server supports a large number of enhancements such as MAC address-based control filtering, converting active leases into reservations or Link Layer based filters, IPv4 address exhaustion at scope level , DHCP Name protection for non-Windows machines to prevent name squatting, better performance through aggressive lease database caching, DHCP activity logging, auto-population of certain network interface fields, a wizard for split-scope configuration, DHCP Server role migration using WSMT, support for DHCPv6 Option 15 (User Class) and Option 32 (Information Refresh Time). The DHCP server runs in the context of the Network Service account which has less privileges to reduce potential damage if compromised.

Windows Server 2008 R2 supports up to 64 physical processors or up to 256 logical processors per system. (Note:Only the Datacenter and Itanium editions can take advantage of the capability of 64 physical processors. Enterprise, the next-highest edition after those two, can only use 8.) When deployed in a file server role, new File Classification Infrastructure services allow files to be stored on designated servers in the enterprise based on business naming conventions, relevance to business processes and overall corporate policies.

Server Core includes a subset of the .NET Framework, so that some applications (including ASP.NET web sites and Windows PowerShell 2.0) can be used.

Performance improvement was a major area of focus for this release; Microsoft has stated that work was done to decrease boot time, improve the efficiency of I/O operations while using less processing power, and generally improve the speed of storage devices, especially iSCSI.

Active Directory has several new features when raising the forest and domain functional levels to Windows Server 2008 R2. When raising the domain function level, two added features are Authentication Mechanism Assurance and Automatic SPN Management. When raising the forest functional level, the Active Directory recycle bin feature is available and can be enabled using the Active Directory Module for Powershell.

Small Server Hardware Requirements Guide

Server administrators can use this guide in combination with the free Confluence trial period to evaluate their server hardware requirements. Because server load is difficult to predict, live testing is the best way to determine what hardware a Confluence instance will require in production.

Peak visitors are the maximum number of browsers simultaneously making requests to access or update the Confluence server. Visitors are counted from their first page request until the connection is closed and if public access is enabled, this includes internet visitors as well as logged in users. Storage requirements will vary depending on how many pages and attachments you wish to store inside Confluence.

Minimum Hardware Requirements

On small instances, server load is primarily driven by peak visitors.

5 Concurrent Users

- 2GHz+ CPU
- 512MB RAM
- 5GB database space

25 Concurrent Users

- Quad 2GHz+ CPU
- 2GB+ RAM
- 10GB database space

Example Hardware Specifications

These are example hardware specifications for non-clustered Confluence instances. It not recorded whether the RAM refers to either total server memory or memory allocated to the JVM, while blank settings indicate that the information was not provided.

Accounts	Spaces	Pages	CPUs	CPU (GHz)	RAM (Meg)	Notes
150	30	1,000	1	2.6	1,024	
350	100	15,000	2	2.8	700	
5,000	500		4	3	2,024	
10,000	350	16,000	2	3.8	2,024	
10,000	60	3,500	2	3.6	4,048	
21,000	950		2	3.6	4,048	
85	100	12,5	4	2,6	4,048	3 machines total: application server, database server, Apache HTTPD + LDAP tunnel server.

Server Load & Scalability

When planning server hardware requirements for your Confluence deployment, you will need to estimate the server scalability based on peak visitors, the editor to viewer ratio and total content.

- The editor to viewer ratio is how many visitors are performing updates versus those only viewing content
- Total content is best estimated by a count of total spaces

Confluence scales best with a steady flow of visitors rather than defined peak visitor times, few editors and few spaces. Users should also take into account:

- Total pages is not a major consideration for performance. For example, instances hosting 80K of pages can consume under 512 meg of memory
- Always use an external database, and check out the performance tuning guides.

As mentioned on the documentation for Operating Large or Mission-Critical Confluence Installations, some important steps are loadtesting your usecase and monitoring the system continuously to find out where your system could do better and what might need to improve in order to scale further.

Maximum Reported Usages

These values are largest customer instances reported to Atlassian or used for performance testing. Clustering for load balancing, database tuning and other performance tuning is recommended for instances exceeding these values.

Most Spaces	1700
Most Internal Users	15K
Most LDAP Users	100K
Most Pages	80K

Hard Disk Requirements

All wiki content is stored in the database, while attachments use either the database or filesystem. For example, the wiki instance you are reading now uses approximately 1 GB of database space and 9.4 GB of disk space.

Here is a breakdown of the disk usage requirements for this wiki, as at December 2008:

Database size	1003 MB
Home directory size	9.4 GB

Size of selected database tables

Data	Rows	Size
Content bodies (incl. all versions of blogs, pages and comments)	170462	145 MB
Content metadata (incl. title, author)	188697	48 MB
Content and user properties	193652	42 MB
Users	20679	5.8 MB
Attachment metadata	25718	5.0 MB
Labels	43235	4.5 MB

Size of selected home directory components

Data	Files	Size
Attachments (incl. all versions)	27484	5.9 GB
Usage index (now disabled)	240	2.6 GB
Search index	10	236 MB
Office Connector cache	44	222 MB
Temporary files	7269	201 MB
Plugin files	1508	139 MB
Thumbnails	10154	84 M
Did-you-mean search index	3	9.9 MB

some examples of big server hardware with prices:

• 1U Form Factor • Single Intel Xeon or Core 2 Duo • Intel 3210 Chipset • 4 SAS/SATA Hard Drives • Up to 8GB of DDR2 ECC Memory • 300W Power Supply	Single processor with 4 hard drives	Starting at: **$1,099**
• 1U Form Factor • Single Core i7 • Intel X58 Chipset • 4 SAS/SATA Hard Drives • 6 DDR3 ECC DIMM Slots • Up to 12GB Memory Maximum • Integrated IPMI • 280W Power Supply	Single Core i7 with four hard drives	Starting at: **$1,380**
• 1U Form Factor • 2 Intel Xeon 5500/5600 • Intel 5520 Chipset • 4 SAS/SATA Drive Bays • 18 DDR3 Slots • 144GB Memory Maximum • 700W Redundant Power Supply	High memory capability and optional 10 gigabit ethernet	Starting at: **$2,244**
• 1U Form Factor • Dual Xeon 5500 • Intel 5520 Chipset • 2 SATA Hard Drives • 12 DDR3 ECC Reg Slots • Up to 48GB Memory Maximum • 1200W Power Supply	Twin server with optional DDR or QDR Infiniband	Starting at: **$2,836**
• 1U Form Factor • Quad Xeon 7000 Series • Intel 7300 Chipset • 3 SAS/SATA Hard Drives • 24 DDR2 ECC FBDIMM Slots • Up to 192GB Memory Maximum • 1000W Power Supply	Quad Intel Xeon server Supports six core processors	Starting at: **$3,950**
• 2U Form Factor • Dual Xeon 7000 • Intel 7300 Chipset • 6 SAS/SATA Hard Drives • 24 DDR2 ECC FBDIMM Slots • Up to 192GB Memory Maximum • 1200W Redundant Power Supply	Quad Intel Xeon server Supports six core processors	Starting at: **$4,502**

• 4U Form Factor • Dual Intel Xeon 5500 • Intel 5520 Chipset • 36 SATA Drive Bays • 12 DDR3 Slots • 48GB Memory Maximum • 1400W Redundant Power	4U 36 bay storage server	Starting at: **$6,277**
• 4U Form Factor • 4 Xeon 7000 series processor • Intel 7300 chipset • 8 x 2.5" SAS • 32x DDR2 FBDIMM • 256GB Memory Maximum • 1570W Redundant Power Supply		Starting at: **$8,929**

Storage units prices:

• 2U 8 Bay DAS • Single RAID Controller with 256MB Cache • Two 4G Fiber Channel Host Ports • Up to 8 SATA Drive Bays • 350W Redundant Power Supply	Fiber Channel Direct Attached Storage	Starting at: **$4,534**
• 3U 16 Bay iSCSI Target • Single RAID Controller with 256MB Cache • Four Gigabit Ethernet Host Ports • Up to 16 SATA Drive Bays • 530W Redundant Power Supply	16TB iSCSI Target Module	Starting at: **$4,988**

Hardware technology

Server processors

The processors that are most commonly used in servers belong most of the times in three big cpu's families

1)Intel Xeon family, 2)Intel Itanium family, 3)the newest member of Intel's family i7 multycore cpu's,

4)AMD's Opteron

Itanium

Itanium is a family of 64-bit Intel microprocessors that implement the Intel Itanium architecture (formerly called IA-64). Intel markets the processors for enterprise servers and high-performance computing systems. The architecture originated at Hewlett-Packard (HP), and was later jointly developed by HP and Intel.

The Itanium architecture is based on explicit instruction-level parallelism, in which the compiler decides which instructions to execute in parallel. This contrasts with other superscalar architectures, which depend on the processor to manage instruction dependencies at runtime. Itanium cores up to and including Tukwila execute up to six instructions per clock cycle.

The first Itanium processor, codenamed Merced, was released in 2001. Though its speed would have been impressive had it been introduced on time in 1999, it ran only half as fast as the contemporary x86-based Pentium 4.

Itanium-based systems have been produced by HP (the HP Integrity Servers line) and several other manufacturers. As of 2008, Itanium was the fourth-most deployed microprocessor architecture for enterprise-class systems, behind x86-64, IBM POWER, and SPARC. The most recent processor, Tukwila, originally planned for release in 2007, was released on February 8, 2010.

High-end server market

When first released in 2001, Itanium's performance, compared to better-established RISC and CISC processors, was disappointing.Emulation to run existing x86 applications and operating systems was particularly poor, with one benchmark in 2001 reporting that it was equivalent at best to a 100 MHz Pentium in this mode (1.1 GHz Pentiums were on the market at that time). Itanium failed to make significant inroads, and also suffered from the successful introduction of x86-based systems into this market. Journalist John C. Dvorak, commenting in 2009 on the history of the Itanium processor, said "This continues to be one of the great fiascos of the last 50 years" in an article titled "How the Itanium Killed the Computer Industry". Tech columnist Ashlee Vance commented that the delays and underperformance "turned the product into a joke in the chip industry." In an interview, Donald Knuth said "The Itanium approach...was supposed to be so terrific —until it turned out that the wished-for compilers were basically impossible to write." A former Intel official reported that the Itanium business had become profitable for Intel in late 2009.

By 2009, the chip was almost entirely deployed on servers made by HP, which had over 95% of the Itanium server market share, making the main operating system for Itanium HP-UX. Both Red Hat and Microsoft have announced plans to drop Itanium support in future versions of their operating systems due to lack of market interest; however, other Linux distros including Debian are available for Itanium. On March 22nd, 2011, Oracle announced discontinuation of development on Itanium. Support for existing products will continue. On March 22nd, 2011 Intel reaffirmed its commitment to Itanium with multiple generations of chips in development and on schedule.

History

Development: 1989–2000

In 1989, HP determined that reduced instruction set computer (RISC) architectures were approaching a processing limit at one instruction per cycle. HP researchers investigated a new architecture, later named explicitly parallel instruction computing (EPIC), that allows the processor to execute multiple instructions in each clock cycle. EPIC implements a form of very long instruction word (VLIW) architecture, in which a single instruction word contains multiple instructions. With EPIC, the compiler determines in advance which instructions can be executed at the same time, so the microprocessor simply executes the instructions and does not need elaborate mechanisms to determine which instructions to execute in parallel. The goal of this approach is twofold: to enable deeper inspection of the code at compile time to identify additional opportunities for parallel execution, and to simplify processor design and reduce energy consumption by eliminating the need for runtime scheduling circuitry.

HP believed that it was no longer cost-effective for individual enterprise systems companies such as itself to develop proprietary microprocessors, so it partnered with Intel in 1994 to develop the IA-64 architecture, derived from EPIC. Intel was willing to undertake a very large development effort on IA-64 in the expectation that the resulting microprocessor would be used by the majority of enterprise systems manufacturers. HP and Intel initiated a large joint development effort with a goal of delivering the first product, Merced, in 1998.

During development, Intel, HP, and industry analysts predicted that IA-64 would dominate in servers, workstations, and high-end desktops, and eventually supplant RISC andcomplex instruction set computer (CISC) architectures for all general-purpose applications. Compaq and Silicon Graphics decided to abandon further development of the Alphaand MIPS architectures respectively in favor of migrating to IA-64.

Several groups developed operating systems for the architecture, including Microsoft Windows, Linux, and UNIX variants such as HP-UX, Solaris, Tru64 UNIX, andMonterey/64 (the last three were canceled before reaching the market). By 1997, it was apparent that the IA-64 architecture and the compiler were much more difficult to implement than originally thought, and the delivery of Merced began slipping. Technical difficulties included the very high transistor counts needed to support the wide instruction words and the large caches. There were also structural problems within the project, as the two parts of the joint team used different methodologies and had slightly different priorities. Since Merced was the first EPIC processor, the development effort encountered more unanticipated problems than the team was accustomed to. In addition, the EPIC concept depends on compiler capabilities that had never been implemented before, so more research was needed.

Intel announced the official name of the processor, Itanium, on October 4, 1999. Within hours, the name Itanic had been coined on a Usenet newsgroup, a reference to Titanic, the "unsinkable" ocean liner that sank in 1912. "Itanic" has since often been used by The Register, and others, to imply that the multibillion dollar investment in Itanium—and the early hype associated with it—would be followed by its relatively quick demise.

Itanium (Merced): 2001

By the time Itanium was released in June 2001, its performance was not superior to competing RISC and CISC processors. Itanium competed at the low-end (primarily 4-CPU and smaller systems) with servers based on x86 processors, and at the high end with IBM's POWER architecture and Sun Microsystems' SPARC architecture. Intel repositioned Itanium to focus on high-end business and HPCcomputing, attempting to duplicate x86's successful "horizontal" market (i.e., single architecture, multiple systems vendors). The success of this initial processor version was limited to replacing PA-RISC in HP systems, Alpha in Compaq systems and MIPS in SGI systems, though IBM also delivered a supercomputer based on this processor. POWER and SPARC remained strong, while the 32-bit x86 architecture continued to grow into the enterprise space. With economies of scale fueled by its enormous installed base, x86 has remained the preeminent "horizontal" architecture in enterprise computing.

Only a few thousand systems using the original Merced Itanium processor were sold, due to relatively poor performance, high cost and limited software availability. Recognizing that the lack of software could be a serious problem for the future, Intel made thousands of these early systems available to independent software vendors (ISVs) to stimulate development. HP and Intel brought the next-generation Itanium 2 processor to market a year later.

The Itanium 2 processor was released in 2002, and was marketed for enterprise servers rather than for the whole gamut of high-end computing. The first Itanium 2, code-named McKinley, was jointly developed by HP and Intel. It relieved many of the performance problems of the original Itanium processor, which were mostly caused by an inefficient memory subsystem. McKinley contained 221 million transistors (of which 25 million were for logic), measured 19.5 mm by 21.6 mm (421 mm2) and was fabricated in a 180 nm, bulk CMOS process with six layers of aluminium metallization.

In 2003, AMD released the Opteron, which implemented its 64-bit architecture (x86-64). Opteron gained rapid acceptance in the enterprise server space because it provided an easy upgrade from x86. Intel responded by implementing x86-64 in its Xeon microprocessors in 2004.

Intel released a new Itanium 2 family member, codenamed Madison, in 2003. Madison used a 130 nm process and was the basis of all new Itanium processors until Montecito was released in June 2006.

In March 2005, Intel announced that it was working on a new Itanium processor, codenamed Tukwila, to be released in 2007. Tukwila would have four processor cores and would replace the Itanium bus with a new Common System Interface, which would also be used by a new Xeon processor. Later that year, Intel revised Tukwila's delivery date to late 2008.

In November 2005, the major Itanium server manufacturers joined with Intel and a number of software vendors to form the Itanium Solutions Alliance to promote the architecture and accelerate software porting. The Alliance announced that its members would invest $10 billion in Itanium solutions by the end of the decade.

In 2006, Intel delivered Montecito (marketed as the Itanium 2 9000 series), a dual-core processor that roughly doubled performance and decreased energy consumption by about 20 percent.

Intel released the Itanium 2 9100 series, codenamed Montvale, in November 2007. In May 2009 the schedule for Tukwila, its follow-on, was revised again, with release to OEMs planned for the first quarter of 2010.

Itanium 9300 (Tukwila): 2010

The Itanium 9300 series processor, codenamed Tukwila, was released on 8 February 2010 with greater performance and memory capacity.

The device uses a 65 nm process, includes two to four cores, up to 24 MB on-die caches, Hyper-Threading technology and integrated memory controllers. It implements double-device data correction, which helps to fix memory errors. Tukwila also implements Intel QuickPath Interconnect (QPI) to replace the Itanium bus-based architecture. It has a peak interprocessor bandwidth of 96 GB/s and a peak memory bandwidth of 34 GB/s. With QuickPath, the processor has integrated memory controllers and interfaces the memory directly, using QPI interfaces to directly connect to other processors and I/O hubs. QuickPath is also used on Intel processors using the Nehalem microarchitecture, making it probable that Tukwila and Nehalem will be able to use the same chipsets. Tukwila incorporates four memory controllers, each of which supports multiple DDR3 DIMMs via a separate memory controller, much like the Nehalem-based Xeon processor code-named Beckton.

Market share

In comparison with its Xeon family of server processors, Itanium has never been a high-volume product for Intel. Intel does not release production numbers. One industry analyst estimated that the production rate was 200,000 processors per year in 2007.

According to Gartner Inc., the total number of Itanium servers sold by all vendors in 2007 was about 55,000. This compares with 417,000 RISC servers (spread across all RISC vendors) and 8.4 million x86 servers. From 2001 through 2007, IDC reports that a total of 184,000 Itanium-based systems have been sold. For the combined POWER/SPARC/Itanium systems market, IDC reports that POWER captured 42% of revenue and SPARC captured 32%, while Itanium-based system revenue reached 26% in the second quarter of 2008. According to an IDC analyst, in 2007 HP accounted for perhaps 80% of Itanium systems revenue. According to Gartner, in 2008 HP accounted for 95% of Itanium sales. HP's Itanium system sales were at an annual rate of $4.4Bn at the end of 2008, and declined to $3.5Bn by the end of 2009, compared to a 35% decline in UNIX system revenue for Sun and an 11% drop for IBM, with an x86-64 server revenue increase of 14% during this period. Itanium customers may have deferred purchases to wait for the release of Tukwila-based systems.

Xeon

The Xeon is a brand of multiprocessing- or multi-socket-capable x86 microprocessors from Intel Corporation targeted at the non-consumer server, workstation and embedded system markets

The Xeon brand has been maintained over several generations of x86 and x86-64 processors. Older models added the Xeon moniker to the end of the name of their corresponding desktop processor, but more recent models used the name Xeon on its own. The Xeon CPUs generally have more cache than their desktop counterparts in addition to multiprocessing capabilities.

P6-based Xeon(Historical review)

Pentium II Xeon

The first Xeon-branded processor was the Pentium II Xeon (code-named "Drake"). It was released in 1998, replacing the Pentium Pro in Intel's server lineup. The Pentium II Xeon was a "Deschutes" Pentium II (and shared the same product code: 80523) with a full-speed 512 KB, 1 MB, or 2 MB L2 cache. The L2 cache was implemented with custom 512 KB SRAMs developed by Intel. The number of SRAMs depended on the amount of cache. A 512 KB configuration required one SRAM, a 1 MB configuration: two SRAMs, and a 2 MB configuration: four SRAMs on both sides of the PCB. Each SRAM was a 12.90 mm by 17.23 mm (222.21 mm²) die fabricated in a 0.35 µm four-layer metal CMOS process and packaged in a cavity-down wire-bonded land grid array (LGA). The additional cache required a larger module and thus the Pentium II Xeon used a larger slot, Slot 2. It was supported by the 440GX dual-processor workstation chipset and the 450NX quad- or octo-processor chipset.

Pentium III Xeon

In 1999, the Pentium II Xeon was replaced by the Pentium III Xeon. Reflecting the incremental changes from the Pentium II "Deschutes" core to the Pentium III "Katmai" core, the first Pentium III Xeon, named "Tanner", was just like its predecessor except for the addition of Streaming SIMD Extensions (SSE) and a few cache controller improvements. The product codes for Tanner mirrored that of Katmai; 80525.

The second version, named "Cascades", was based on the Pentium III "Coppermine" core. The "Cascades" Xeon used a 133 MT/s bus and relatively small 256 KB on-die L2 cache resulting in almost the same capabilities as the Slot 1 Coppermine processors, which were capable of dual-processor operation but not quad-processor operation.

To improve this situation, Intel released another version, officially also named "Cascades", but often referred to as "Cascades 2 MB". That came in two variants: with 1 MB or 2 MB of L2 cache. Its bus speed was fixed at 100 MT/s, though in practice the cache was able to offset this. The product code for Cascades mirrored that of Coppermine; 80526.

Current versions of Xeon processors

5500-series "Gainestown"

Gainestown or Nehalem-EP, the successor to the Xeon Core microarchitecture, is based on the Nehalem microarchitecture and uses the same 45 nm manufacturing methods as Intel's Penryn. The first processor released with the Nehalem microarchitecture is the desktop Intel Core i7, which was released in November 2008. Server processors of the Xeon 55xx range were first supplied to testers in December 2008.

The performance improvements over previous Xeon processors are based mainly on:

- Integrated memory controller supporting three memory channels of DDR3 SDRAM.
- A new point-to-point processor interconnect QuickPath, replacing the legacy front side bus. Gainestown has two QuickPath interfaces.
- Hyper-threading (2x per core, starting from 5518), that was already present in pre-Core Duo processors.

C3500/C5500-series "Jasper Forest"

Jasper Forest is a Nehalem-based embedded processor with PCI Express connections on-die, core counts from 1 to 4 cores and power envelopes from 23 to 85 watts.

The uni-processor version without QPI comes as LC35xx and EC35xx, while the dual-processor version is sold as LC55xx and EC55xx and uses QPI for communication between the processors. Both versions use a DMI link to communicate with the 3420 that is also used in the 3400-series Lynfield Xeon processors, but use an LGA 1366 package that is otherwise used for processors with QPI but no DMI or PCI Express links. The CPUID code of both Lynnfield and Jasper forest is 106Ex, i.e. family 6, model 30.

The Celeron P1053 belongs into the same family as the LC35xx series, but lacks some RAS features that are present in the Xeon version.

3600/5600-series "Gulftown"

Gulftown or Westmere-EP, a six-core 32 nm Westmere-based processor, is the basis for the Xeon 36xx and 56xx series and the Core i7-980X. It launched in the first quarter of 2010. The 36xx-series follows the 35xx-series Bloomfield uni-processor model while the 56xx-series follows the 55xx-series Gainstown dual-processor model and both are socket compatible to their predecessors.

6500/7500-series "Beckton"

Beckton or Nehalem-EX (EXpandable server market) is a Nehalem-based processor with up to eight cores and uses buffering inside the chipset to support up to 16 standard DDR3 DIMMS per CPU socket without requiring the use of FB-DIMMS. Unlike all previous Xeon MP processors, Nehalem-EX uses the new LGA 1567 package, replacing the Socket 604 used in the previous models, up to Xeon 7400 "Dunnington". The 75xx models have four QuickPath interfaces, so it can be used in up-to eight-socket configurations, while the 65xx models are only for up to two sockets. Designed by the Digital Enterprise Group (DEG) Santa Clara and Hudson Design Teams, Beckton is manufactured on the P1266 (45 nm) technology. Its launch in March 2010 coincided with that of its direct competitor, AMD's Opteron 6xxx "Magny-Cours".

Most models limit the number of cores and QPI links as well as the L3 Cache size in order to get a broader range of products out of the single chip design.

Intel Core i7

Intel Core i7 is an Intel brand name for several families of desktop and laptop 64-bit x86-64 processors using the Nehalem, Westmere, and Sandy Bridge microarchitectures. The Core i7 brand is targeted at the business and high-end consumer markets for both desktop and laptop computers, and is distinguished from the Core i3 (entry-level consumer), Core i5 (mainstream consumer) brands.

In each of the first three microarchitecture generations of the brand, Core i7 has family members using two distinct system-level architectures, and therefore two distinct sockets. In each generation, the highest-performing Core i7 processors use the same socket and QPI-based architecture as the low-end Xeon processors of that generation, while lower-performing Core i7 processors use the same socket and PCIe/DMI/FDI architecture as the Core i5.

"Core i7" is a successor to the Intel Core 2 brand. The Core i7 identifier was first applied to the initial family of processors codenamed Bloomfield introduced in 2008. In 2009 the name was applied to Lynnfield and Clarksfield models. Prior to 2010, all models were quad-core processors. In 2010, the name was applied to dual-core Arrandale models, and the Gulftown Core i7-980X Extreme processor which has six hyperthreaded cores. In January 2011, Intel released a line of Sandy Bridge based chips under the Core i7 brand.

Intel representatives stated that the moniker Core i7 is meant to help consumers decide which processor to purchase as the newer Nehalem-based products are released in the future.[8] The name continues the use of the Intel Core brand. The first Core i7 was officially launched on November 17, 2008.

Processor cores

The initial Core i7 processors released were codenamed Bloomfield, branded as Core i7-9xx along with their Xeon 3500-series counterparts. As of 2009, they are Intel's high-end Desktop processors, sharing the Socket 1366 platform with the single and dual-processor server processors.

Lynnfield is the second processor sold under the Core i7 brand, while at the same time being sold as Core i5. Unlike Bloomfield, it does not have a QPI interface but directly connects to a southbridge using a 2.5 GT/s Direct Media Interface and to other devices using PCI Express links in its Socket 1156. Core i7 processors based on Lynnfield have Hyper-Threading, which is disabled in Lynnfield-based Core i5 processors.

Clarksfield is the mobile version of Lynnfield and available under the Core i7 Mobile brand, as part of the Calpella platform. It was released at the Intel Developer Forum on September 23, 2009.

The second mobile Core i7 processor family is Arrandale, sold as the Core i7-6xx processors and featuring an integrated graphics processing unit but only two processor cores, half of Clarksfield. Clarkdale, the desktop version of Arrandale, will not be sold as Core i7, but only as Core i3 and Core i5. All support Intel's Hyper Threading (HT).

Gulftown is the die shrink of the original Core i7, featuring 6 cores, 32 nm process, Hyper-Threading (for a total of 12 logical threads), 12 MB of cache, Turbo Boost and Intel QuickPath connection bus.

Sandy Bridge is the second generation Intel Core i7 series processor, and is based on microarchitecture also named "Sandy Bridge". It was released on January 9, 2011 at the end of CES 2011.

AMD's OPTERON CPU

Opteron is AMD's x86 server and workstation processor line, and was the first processor which supported the AMD64 instruction set architecture (known generically as x86-64). It was released on April 22, 2003 with the SledgeHammer core (K8) and was intended to compete in the server and workstation markets, particularly in the same segment as the Intel Xeon processor. Processors based on the AMD K10 microarchitecture (codenamed Barcelona) were announced on September 10, 2007 featuring a new quad-core configuration. The most-recently released Opteron CPUs are the 8- and 12-core Socket G34 Opterons, code-named "Magny-Cours.".

Technical features

Two key capabilities

Opteron combines two important capabilities in a single processor:

1. native execution of legacy x86 32-bit applications without speed penalties
2. native execution of x86-64 64-bit applications

The first capability is notable because at the time of Opteron's introduction, the only other 64-bit architecture marketed with 32-bit x86 compatibility (Intel's Itanium) ran x86 legacy-applications only with significant speed degradation. The second capability, by itself, is less noteworthy, as major RISC architectures such as (SPARC, Alpha, PA-RISC, PowerPC, MIPS) have been 64-bit for many years. In combining these two capabilities, however, the Opteron earned recognition for its ability to run the vast installed base of x86 applications economically, while simultaneously offering an upgrade-path to 64-bit computing.

The Opteron processor possesses an integrated memory controller supporting DDR SDRAM, DDR2 SDRAM or DDR3 SDRAM (depending on processor generation). This both reduces the latency penalty for accessing the main RAM and eliminates the need for a separate northbridge chip.

Multi-processor features

In multi-processor systems (more than one Opteron on a single motherboard), the CPUs communicate using the Direct Connect Architecture over high-speed HyperTransport links. Each CPU can access the main memory of another processor, transparent to the programmer. The Opteron approach to multi-processing is not the same as standard symmetric multiprocessing; instead of having one bank of memory for all CPUs, each CPU has its own memory. Thus the Opteron is a Non-Uniform Memory Access (NUMA) architecture. The Opteron CPU directly supports up to an 8-way configuration, which can be found in mid-level servers. Enterprise-level servers use additional (and expensive) routing chips to support more than 8 CPUs per box.

In a variety of computing benchmarks, the Opteron architecture has demonstrated better multi-processor scaling than the Intel Xeon. This is primarily because adding an additional Opteron processor increases memory bandwidth, while that is not always the case for Xeon systems, and the fact that the Opterons use a switched fabric, rather than a shared bus. In particular, the Opteron's integrated memory controller allows the CPU to access local RAM very quickly. In contrast, multiprocessor Xeon system CPUs share only two common buses for both processor-processor and processor-memory communication. As the number of CPUs increases in a typical Xeon system, contention for the shared bus causes computing efficiency to drop. Intel is migrating to a memory architecture similar to the Opteron's for the Intel Core i7 family of processors and their Xeon derivatives.

AMD Opteron with six cores

In April 2005, AMD introduced its first multi-core Opterons. At the time, AMD's use of the term multi-core in practice meant dual-core; each physical Opteron chip contained two processor cores. This effectively doubled the computing performance available to each motherboard processor socket. One socket can now deliver the performance of two processors, two sockets can deliver the performance of four processors, and so on. Because motherboard costs increase dramatically as the number of CPU sockets increase, multicore CPUs enable a multiprocessing system to be built at lower cost.

AMD's model number scheme has changed somewhat in light of its new multicore lineup. At the time of its introduction, AMD's fastest multicore Opteron was the model 875, with two cores running at 2.2 GHz each. AMD's fastest single-core Opteron at this time was the model 252, with one core running at 2.6 GHz. For multithreaded applications, or many single threaded applications, the model 875 would be much faster than the model 252.

Second-generation Opterons are offered in three series: the 1000 Series (single socket only), the 2000 Series (dual socket-capable), and the 8000 Series (quad or octo socket-capable). The 1000 Series uses the AM2 socket. The 2000 Series and 8000 Series use Socket F.

AMD launched its Third-Generation Quad-core Opteron chips on September 10, 2007 with hardware vendors to follow suit with servers in the following month. Based on a core design codenamed Barcelona, new power and thermal management techniques are planned for the chips. Existing dual core DDR2 based platforms will be upgradeable to quad core chips. The fourth generation was launched in June 2009 with the Istanbul hexa-cores.

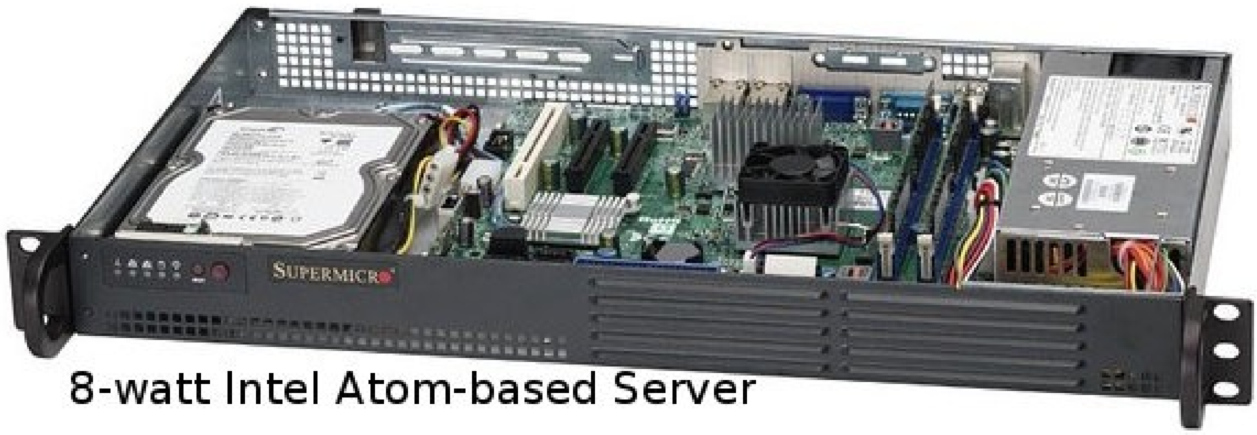
AMD released its latest generation of Opteron CPUs in March 2010 with the Magny-Cours Opteron 6100 series CPUs for Socket G34. These are 8- and 12-core multi-chip module CPUs consisting of two four or six-core dies with a high-speed, on-package HyperTransport 3.1 link connecting the two dies. These CPUs update the multi-socket Opteron platform to use DDR3 memory and increased the maximum HyperTransport link speed from 2.40 GHz (4.80 GT/sec) for the Istanbul CPUs to 3.20 GHz (6.40 GT/sec.)

AMD has also changed the naming scheme for its current and upcoming Opteron models. Opteron 4000 series CPUs on Socket C32 (released July 2010) are dual-socket capable and are targeted at uniprocessor and dual-processor uses. The Opteron 6000 series CPUs on Socket G34 are quad-socket capable and are targeted at high-end dual-processor and quad-processor applications.

Recognition

In the February 2010 issue of Custom PC (a UK based computing magazine focused on PC hardware), the AMD Opteron 144 (released in Summer 2005) appeared in the "Hardware Hall of Fame". It was described as "The best overclocker's CPU ever made" due to its low cost and ability to run at speeds way beyond its stock speed (according to Custom PC, it could run at "close to 3 GHz on air").

New servers trend: Power savings over performance



Today's CPUs offer compute abilities that so greatly exceed servers of even five years ago that the trend today is no longer for more and more compute power, but rather a balance between power and energy efficiency, with perhaps even a slant more toward energy efficiency than any other single factor.

On May 4, SuperMicro Computers announced an Intel Atom-based rack server. This CPU is not the traditional super-tested Xeon-based server CPU that Intel typically sells, but is rather the low-power netbook/low-end notebook CPU that is sold to consumers. SuperMicro's interest in the new Atom-powered server came from its low power consumption. In addition, there is Atom's lower pricetag, which compared to the highest-end Xeons costing over $1600, the $45 and $29 Atom pricetags are very appealing for "slower" server applications.[Note: Atom offers more performance per clock than its Netburst/Pentium 4 architecture did.]

In addition, on May 20 Dell began selling a VIA Nano-powered server, the XS11-VX8, which offers the densest 2U rack x86 system available on the market today: 12 servers per 2U rack, with each server consuming a maximum of 30 watts (not just CPU, but the entire server), for a 2U power consumption of 360 watts for 12 separate CPUs and a massive throughput/compute ability. Dell claims the system provides a 34% lower total cost of ownership, not just in hardware purchase price, but also long-term expenses including power and cooling, over faster, more expensive CPUs. In fact, it was an extremely large server farm customer that came to Dell and said “We want you to build this low-power, massive throughput server” that caused it to be created in the first place.

In addition, AMD has told Geek.com recently on several occasions that their server customers are interested more in performance-per-watt than maximum performance. And it’s in that area where AMD has had the lead for quite some time — especially with their low-wattage EE (energy/extremely efficient) server CPUs. Intel has played catch-up in recent iterations, though the cost savings for AMD’s chips are still there.

According to The Wall Street Journal, an Intel spokesman, Bill Calder, said most customers need servers with a lot more performance than Atom can offer. Calder does concede that there may be some server applications where Atom’s technology can play a role. And this is something Intel didn’t expect, but is “not discouraging”. Calder said, “There’s a lot of interesting innovation around Atom”.

Our Opinion

This trend toward lower power makes a lot of sense. Consider that even a quad-core CPU today operating at 3.2GHz does approximately 12.8 billion things per second (3.2GHz x 4 cores x an average of one instruction per clock per core). While this theoretical maximum may be exceeded in some instances thanks to the super-scalar super-pipelined designs of modern 64-bit x86 CPUs, overall it will actually be something less, like around 6.4 billion or fewer things it can do per second — due primarily to memory system limitations, as well as some computations which take multiple clock cycles to complete.

Still, 6.4 billion things is a large number. Now, consider the idea of Dell’s Nano-based server, for example, the XS11-VX8, codenamed “Fortuna”. This device packs 12 64-bit Nano CPUs into a 2U case, with each CPU operating between 1.0GHz and 1.8GHz, resulting in a theoretical maximum workload of 12.0 billion to 21.6 billion things it can do per second. If we divide the average in half ((12.0 + 21.6)/2) we get 16.8 billion things per second, which is 2.63x more than the high-end quad server, and on commensurate power.

In addition to that phenomenal potential for throughput, the reality is that in such a system many more physical cores can be brought down to full idle speed when not in use, allowing for even greater power savings than is possible in the quad-core configurations (even those with isolated power planes), because physical servers could be completely turned off during periods of low use.

So here we have a VIA Nano-based XS11-VX8 type server, one which provides 2.63x more throughput than your average quad-core server, with a commensurate level of power consumption, that can be scaled up/down as needed (by turning more servers physically on/off, or putting them into Nano’s C6 deep power state, which draws well under one watt, and closer to 0.2 watts on the CPU itself), operating in a server farm. While no single machine is a performance monster, the reality is the aggregate throughput by many more slower cores, compared to four faster cores, is evident.

Server farms are learning the lesson that for certain workloads, the more slower, lower power consuming cores you can through at a massively parallel workload, the more throughput, performance, and cost savings will be had.

ARM is the future

It is for this reason that I believe the industry will ultimately settle on ARM as an ISA. It is the most prolific CPU in the world, and its power saving abilities greatly exceed those of anything x86 has to offer (from VIA, Intel, AMD or any other minor player). ARM CPUs provide more performance-per-watt than anything x86 can offer, though this has traditionally been because x86 was going for performance, while ARM was going for usability.

In the future, server farms operating entirely on thousands of tiny ARM cores will be what we see. Each of them consuming milliwatts per CPU (at 22nm and beyond), with massive compute abilities, bandwidth, etc., and all in a 32-bit and 64-bit environment, providing the power necessary to be green (scaling up/down quickly as performance needs arise, saving power by shutting down completely when unneeded), and being the single CPU that powers our cell phones, mobile devices, destkop PCs and servers.

Equipment used in server units

Rack units

A rack unit or U (less commonly RU) is a unit of measure used to describe the height of equipment intended for mounting in a 19-inch rack or a 23-inch rack (The dimension refers to the width of the equipment mounting frame in the rack i.e. the width of the equipment that can be mounted inside the rack). One rack unit is 1.75 inches (44.45 mm) high.

The size of a piece of rack-mounted equipment is frequently described as a number in "U". For example, one rack unit is often referred to as "1U", 2 rack units as "2U" and so on.

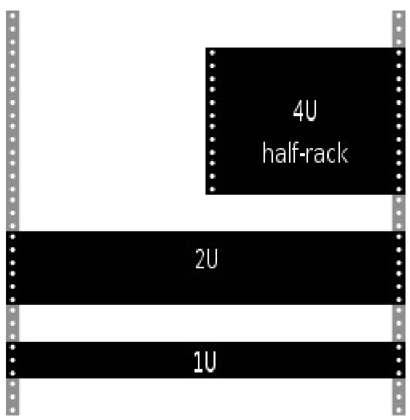
A typical full size rack is 42U, which means it holds just over 6 feet of equipment.

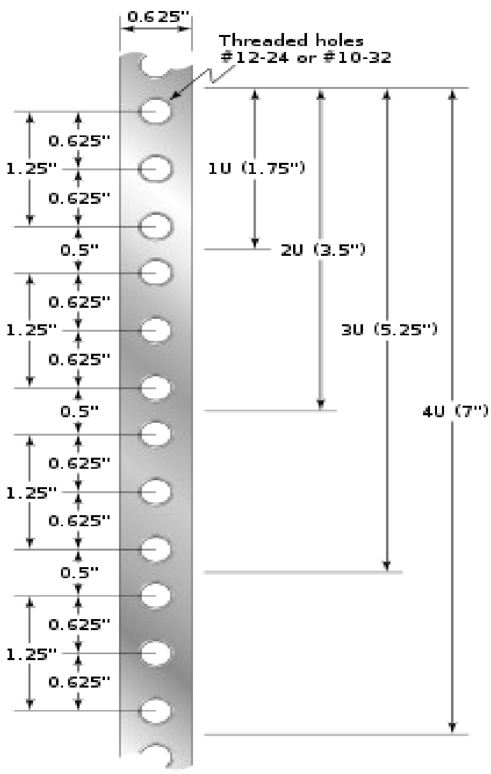
The term "half-rack" is used differently in computing and audio/video (AV) applications. In AV, half-rack units typically describe units that fit in a certain number of rack units, but occupy only half the width of a 19-inch rack (9.5 in or 241 mm). These are commonly used when a piece of equipment does not require full rack width, but may require more than 1U of height. For example, a "4U half-rack" DVCAM deck would occupy 4U (7 in) height × 9.5 in width, and in theory, two 4U half-rack decks could be mounted side by side and occupy the 4U space. In computing and information technology, however, "half-rack" typically describes a unit that is 1U high and half the depth of a 4-post rack (such as a network switch, router, KVM switch, or server), such that two units can be mounted in 1U of space (one mounted at the front of the rack and one at the rear).

A front panel or filler panel in a rack is not an exact multiple of 1.75 inches (44.45 mm). To allow space between adjacent rack-mounted components, a panel is 1⁄32 inch (0.031 inch or 0.79 mm) less in height than the full number of rack units would imply. Thus, a 1U front panel would be 1.719 inches (43.66 mm) high. If n is number of rack units, the formula for panel height is $h = (1.750n - 0.031)$ inch $= (44.45n - 0.79)$ mm.

Coincidentally, a rack unit is equal to a vershok, an obsolete Russian length unit.

The rack unit size is based on a standard rack specification as defined in EIA-310.





19-inch rack

A 19-inch rack is a standardized frame or enclosure for mounting multiple equipment modules. Each module has a front panel that is 19 inches (482.6 mm) wide, including edges or ears that protrude on each side which allow the module to be fastened to the rack frame with screws.

Equipment mounting

Fastening

Originally, the mounting holes were tapped to receive a particular type of threaded bolt. This is still frequently used in some government and military applications, often in conjunction with slide rails for ease of maintenance. However, it is no longer typical for frequently changed server racks, due to the possibility for the threads to become damaged or for a bolt to bind and break off, rendering the mounting hole unusable. Tapped-hole racks are still used for hardware that rarely changes, such as phone , network cabling panels, TV broadcasting facilities, studios and relay racks.

The tapped-hole rack was first replaced by clearance-hole racks. The holes are large enough to permit a bolt to be freely inserted through without binding, and bolts are fastened in place using cage nuts. A cage nut consists of a spring steel cage, designed to clip onto the open mounting hole, within which is a captive nut. In the event of a nut being stripped out or a bolt breaking, the nut can be easily removed and replaced with a new one. Production of clearance-hole racks is less expensive because tapping the holes is eliminated and replaced with fewer, less expensive, cage nuts.

The next innovation in rack design has been the square-hole rack. Square-hole racks allow boltless mounting, such that the rack-mount equipment only needs to insert through and hook down into the lip of the square hole. Installation and removal of hardware in a square hole rack is very easy and boltless, where the weight of the equipment and small retention clips are all that is necessary to hold the equipment in place. Older equipment meant for round-hole or tapped-hole racks can still be used, with the use of cage nuts made for square-hole racks.

Structural support

Rack-mountable equipment is mounted by bolting or clipping its front panel to the rack. One weakness of this system is that all the structural support is at one edge of the equipment, so heavier equipment is designed to use a second pair of mounting posts located at the back of the equipment. Various spacings between the front and rear posts are used; 31.5 inches (800 mm) is typical , and equipment is often designed to handle a range of rack depths. Depth of 39.4 inches (1,000 mm) is becoming increasingly common ; more depth allows for more space to route cables at the back.

The strength required of the mounting posts means they are invariably not merely flat strips but actually a wider folded strip arranged around the corner of the rack. The posts are usually made of steel of around 2 mm thickness (the official standard recommends a minimum of 1.9 mm), or of slightly thicker aluminum.

Racks, especially two-post racks, are often secured to the floor or adjacent building structure so as not to fall over. This is usually required by local building codes in seismic zones. According to Telcordia Technologies Generic Requirements document GR-63-CORE, during an earthquake, telecommunications equipment is subjected to motions that can over-stress equipment framework, circuit boards, and connectors. The amount of motion and resulting stress depends on the structural characteristics of the building and framework in which the equipment is contained, and the severity of the earthquake. Seismic racks rated according to Telcordia GR-63-CORE are available, with Zone 4 representing the most demanding environment. Telcordia GR-3108-CORE specifies the usable opening of seismic-compliant 19-inch racks.

Rails (slides)

Heavy equipment or equipment which is commonly accessed for servicing, for which attaching or detaching at all four corners simultaneously would pose a problem, is often not mounted directly onto the rack but instead is mounted via rails (or slides). A pair of rails is mounted directly onto the rack, and the equipment then slides into the rack along the rails, which support it. When in place, the equipment may also then be bolted to the rack. The rails may also be able to fully support the equipment in a position where it has been slid clear of the rack; this is useful for inspection or maintenance of equipment which will then be slid back into the rack.

Slides or rails for computers and other data processing equipment such as disk arrays or routers often need to be purchased directly from the equipment manufacturer, as there is no standardization on such equipment's thickness (measurement from the side of the rack to the equipment) or means for mounting to the rail.

Computer mounting

Computer servers designed for rack-mounting can include a number of extra features to make the server easy to use in the rack:

- The sliding rails can lock in various extended positions to prevent the equipment from moving when extended out from the rack for service.
- The server itself might have locking pins on the sides that just drop into slots on the extended rail assembly, in a manner similar to a removable kitchen drawer. This permits a very easy server installation and removal since there is no need for the server to be held in midair while someone fastens each rail to the sides of the server with screws.
- Some manufacturers of rack-mount hardware include a folding cable tray behind the server, so that the cables are held into a neat and tidy folded channel when inside the rack, but can unfold out into a long strip when pulled out of the rack, allowing the server to continue to be plugged in and operating normally even while fully extended and hanging in midair in front of the rack. This piece of equipment thus simplifies maintenance, but at the cost of providing a restriction to airflow.
- Rack-optimized servers might duplicate indicator lights on the front and rear of the rack to help identify a machine needing attention, or provide a separate "identify" LED indicators on both sides of the server (which can be turned on in software or by pushing an associated button). Since some configurations permit over fifty 1U servers in a single rack, this provides a simple method to determine exactly which machine is having a problem when at the rear of the rack.
- A handle may be provided at the rear of the server rails, to help pull or push the server without having to pull on the cables.

When there are a large number of computers in a single rack, it is impractical for each one to have its own separate keyboard, mouse, and monitor. Instead, a KVM switch or LOM software is used to share a single keyboard/video/mouse set amongst many different computers.

Since the mounting hole arrangement is vertically symmetric, it is possible to mount rack-mountable equipment upside-down. However, not all equipment is suitable for this type of mounting. For instance, mostoptical disc players will not work upside-down because the driving motor mechanism does not grip the disc.

Four- and two-post racks

Racks are available with either four or two vertical posts. Four-post racks allow for mounting rails to support the equipment at the front and rear. These racks may be open in construction (similar to the traditional open-style two-post racks), or may be enclosed by front and/or rear doors, side panels, or tops. Two-post racks provide just two vertical posts; a piece of equipment can be mounted either via its front panel holes, or close to its center of gravity (to minimize load on its front panel), depending on the design of the rack. Two-post racks are most often used for telecommunication installations.

Specifications

Computer keyboard and monitor mounted on a sliding tray in a rack

The formal standards for a 19-inch (482.6 mm) rack are available from the following:

- Electronic Industries Alliance EIA-310-D, Cabinets, Racks, Panels, and Associated Equipment, dated September 1992. (Latest Standard Now REV E 1996)
- Consumer Electronics Association CEA-310-E design requirements for Cabinets, Panels, Racks and Subracks., dated December 14, 2005
- International Electrotechnical Commission Multiple documents in available in French and English

versions.

- IEC 60297 Mechanical structures for electronic equipment - Dimensions of mechanical structures of the 482,6 mm (19 in) series
    - IEC 60297-1 Replaced by IEC 60297-3-100
    - IEC 60297-2 Replaced by IEC 60297-3-100
    - IEC 60297-3-100 Part 3-100: Basic dimensions of front panels, subracks, chassis, racks and cabinets
    - IEC 60297-3-101 Part 3-101: Subracks and associated plug-in units
    - IEC 60297-3-102 Part 3-102: Injector/extractor handle
    - IEC 60297-3-102 Part 3-103: Keying and alignment pin
    - IEC 60297-3-104 Part 3-104: Connector dependent interface dimensions of subracks and plug-in units
    - IEC 60297-3-105 Part 3-105: Dimensions and design aspects for 1U chassis
    - IEC 60297-4 Replaced by IEC 60297-3-102
    - IEC 60297-5 Multiple documents, -100, 101, 102, ... 107, replaced by IEC 60297-3-101
- Deutsches Institut für Normung DIN 41494 - Multiple documents in German but some documents are available in English.
    - DIN 4149 Equipment practices for electronic equipment; mechanical structures of the 482,6 mm (19 inch) series
        - DIN 41494-7 Dimensions of cabinets and suites of racks.
        - DIN 41494-8 Components on front panels; mounting conditions, dimensions
        - DIN IEC 60297-3-100 (see above in IEC section)

A rack's mounting fixture consists of two parallel metal strips (also referred to as "posts" or "panel mounts") standing vertically. The posts are each 0.625 inches (15.88 mm) wide, and are separated by a gap of 17.75 inches (450.85 mm), giving an overall rack width of 19 inches (482.60 mm). The posts have holes in them at regular intervals, with both posts matching, so that each hole is part of a horizontal pair with a center-to-center distance of 18.312 inches (465.12 mm).

The holes in the posts are arranged vertically in repeating sets of three, with center-to-center separations of 0.5 inches (12.70 mm), 0.625 inches (15.88 mm), 0.625 inches (15.88 mm). The hole pattern thus repeats every 1.75 inches (44.45 mm). Racks are divided into regions, 1.75 inches (44.45 mm) in height, within which there are three complete hole pairs in a vertically symmetric pattern, the holes being centered 0.25 inches (6.35 mm), 0.875 inches (22.23 mm), and 1.5 inches (38.10 mm) from the top or bottom of the region. Such a region is commonly known as a "U", for "unit", and heights within racks are measured by this unit. Rack-mountable equipment is usually designed to occupy some integer number of U. For example, an oscilloscopemight be 4U high, and rack-mountable computers are most often 1U or 2U high. A blade server enclosure might require 10U. Occasionally, one may see fractional U devices such as a 1.5U server, but these are much less common.

The height of a rack can vary from a few inches, such as in a broadcast console, to a floor mounted rack whose interior is 78.75 inches (200 cm) (45 rack units) high. Many wall-mounted industrial equipment enclosures have 19-inch rack rails to support mounting of equipment.

GENERAL INFORMATIONS FOR ISPs & SERVERS

ISP (Internet Service Provider) Route Test or Connection Test Tools

ISP (Internet Service Provider) Route Test or Connection Test Tools use Internet Control Message Protocol (ICMP) with low Time To Live (TTL) values to find and get ping responses from each router or hop between two end points in the Internet. The purpose of these Tools is to detect each router or hop between the two end points and to record the round trip time it takes packets to go to each hop and return.

Route Test Tools gather the collected data into a report. These reports can be used for locating sources of packet loss and latency in an Internet connection. The most effective of these tools, gather data over an extended period of time and detect which hops belong to the ISP servicing the Internet connection. This article explains how to interpret the data to find the source of latency or delay within an Internet connection.

In the test report, look for a column titled "Delay", "Average Delay" or "ms". "ms" stands for milliseconds. These reports record round trip times to each hop in milliseconds. Study the Average Delay/ms column for hops where the delay increases significantly compared to the other hops and the delay seems to affect all other hops greater in value. Any change in average delay greater than 5ms is usually significant.

An example would be a report where the average delay jumps from 15ms to 35ms from hops 14 to 15. All hops 16 and above are approximately 35ms or greater. This means a significant delay is induced between hops 14 and 15. Because hops 16 and above stay in the 35ms or greater range, it suggests the increase delay from hops 14 to 15 was not caused by the router's response to a ping packet. If one of the problems with the Internet connection is delay or latency, then this could be a contributing source.

The purpose of the Time To Live (TTL) value in Internet Protocol (IP) packets is to prevent packets from cycling through the Internet in an endless loop. If router A sends a packet to router B and, through an error in programming, B sends the packet back to A, then that packet can get stuck in an endless loop. Packets in an endless loop will consume bandwidth and eventually cause a network to fail.

Each router within the Internet must subtract 1 from the TTL value before passing a packet on to the next router. If the TTL value goes to zero, the router cannot forward the packet and instead sends an error message back to the packet's originating IP address giving details of the packet's demise. This is how route tests and trace routes work.

Some routers take longer to send the error message than to simply forward a packet to the next destination. The reason hop 9 may have a greater delay than say hop 12 in a report is this extra time. For a specific hop to be inducing latency on a route, all hops to follow must have increased round trip times similar to the specific hop in question.

An ISP provider that offers child filters for the internet are great if you have children. Check around because often times ISP providers offer games for kids, links to homework sites, or links to kid friendly fun sites. You should also try to look at one that does not only block sites dangerous to your kids, but also one that has a good SPAM and virus blocker on it. That will save you both time and irritation from SPAM and perhaps loss of files with a virus.

Look for an ISP provider that offers you unlimited usage. It is rare to find ISP providers that limit access today, but they are out there and you want to know what you are getting into before you sign up. Always check out the usage agreements. With email, online shopping , and research a family is likely online enough to justify a monthly unlimited access fee.

You will probably want to pay attention to price as well. ISP providers vary in price, but they also vary in services they provide. So although you will want to consider price, you may want to avoid making it the primary factor in your decision. Just make sure it connects at the speed you want and loads websites quickly and efficiently.

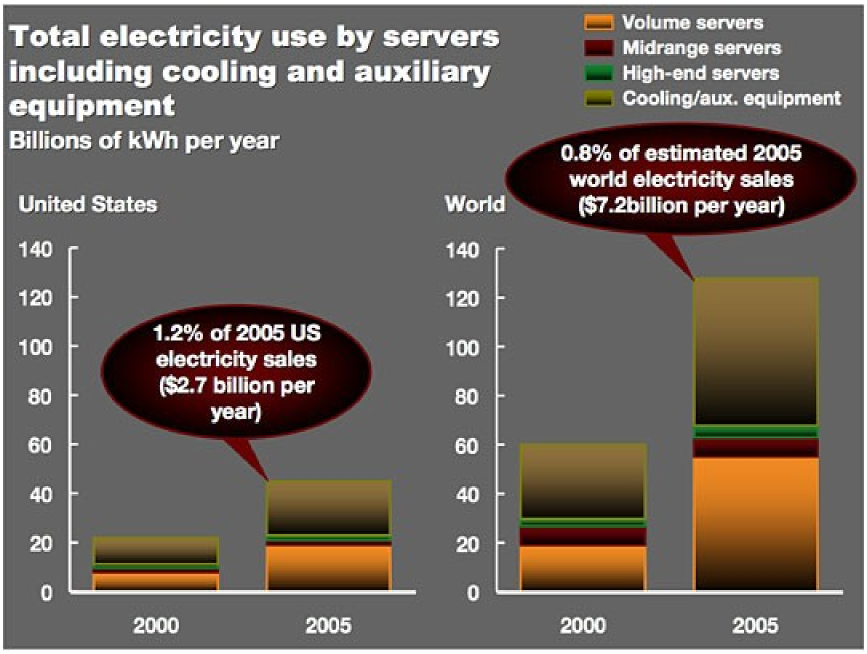
Energy consumption from server farms

US servers now use more electricity than color TVs

Anyone paying attention to recent technology headlines knows that buying servers is just one part of the total cost. It costs power to run them, and power to cool them, and power costs money. AMD has just sponsored a study by Lawrence Berkeley National Laboratory staff scientist Jonathan Koomey that tries to answer the question: just how much power do US servers slurp down each year?

Koomey, who is also a consulting professor at Stanford, claims that his analysis is the most comprehensive to date and is based on the best available data from IDC. He concludes that in 2005, the total power consumption of US servers was 0.6 percent of overall US electricity consumption. When cooling equipment is added, that number doubles to 1.2 percent—the same amount used by color televisions.

Between 2000 and 2005, server electricity use grew at a rate of 14 percent each year, meaning that it more than doubled in five years. The 2005 estimate shows that servers and associated equipment burned through 5 million kW of power, which cost US businesses roughly $2.7 billion.



Koomey notes that this represents the output of five 1 GW power plants. Or, to put it another way, it's 25 percent more than the total possible output from the Chernobyl plant, back when it was actually churning out power and not sitting there, radiating the area.

If current trends continue, server electricity usage will jump 40 percent by 2010, driven in part by the rise of cheap blade servers, which increase overall power use faster than larger ones. Koomey notes that virtualization and consolidation of servers will work against this trend, though, and it's difficult to predict what will happen as data centers increasingly standardize on power-efficient chips.

Server power usage has become a big enough issue to interest the Environmental Protection Agency. Andrew Fanara, who heads the team that develops the Energy Star specifications, applauded the new research and expressed hope that it would spur changes in the industry. "The Environmental Protection Agency (EPA) applauds AMD and this latest benchmarking effort to better understand the global impact data centers have on energy consumption," he said. "We are looking forward to continuing our work with the IT industry to forge new, energy-efficient solutions that benefit both consumers and our global environment."

AMD hopes that these energy-efficient solutions will include their chips, and they now feature an entire line ofefficient processors. They've even gone so far as to develop a ticker that shows the worldwide cost of not using AMD servers—an amount that currently stands at $1 billion.

Not that Intel has been sitting still. The rollout of the Core platform has shown what the chip giant can do when it sets its collective mind to dealing with power-per-watt concerns, and Intel has been aggressively trumpeting the efficiency of its chips in speeches and through whitepapers for more than a year.

It's hard to find any downside to the current focus on efficiency, unless you happen to be the CEO of Exelon. It's become so popular to "go green" (and save money) that the SPEC benchmarking consortium has evendrawn up a metric for measuring power efficiency.

Saving money and lessening the Internet's environmental impact should please both baby seals and corporate suits, something that's tough to do, so more power to those working to use less.

Is Your ISP Throttling Your Internet Connection?

Think your Internet Service Provider (ISP) is messing with your connection performance? Now you can find out, with Google's new online tools that will diagnose your network connection. Here's a quick walkthrough on how to make the best of them.

Google's broadband test tools are located at Measurementlab.net. On that page, you'll see an first icon that says "Users: Test Your Internet Connection". Click that, and then you'll be taken to a page where there are three tests available, and two more listed as coming soon. However, out of the three available tests, only one of them is fully automated and easy to use.

Glasnost , second on the list, will check whether your ISP is slowing down (like Comcast) or blockingPeer2Peer (P2P) downloads from software such as BitTorrent. P2P apps are commonly used for downloading illegal software and media content like movies and music, but also are used for legal purposes as well, such as distributing large software packages to many users at once.

To use the measurement tool, you will be redirected to the Glasnost site. You'll need the latest version of Java installed, and you should stop any large downloads that you may have running before you begin the test. If you're on a Mac, a popup message will prompt you to trust the site's Java applet.

When you're ready to start, you can choose whether you want to run a full test (approximately 7 minutes long) or a simple test (4 minutes long). When I tried to test my connection, Glasnost's measurement servers were overloaded and an alternative server was offered, but that was overloaded as well. After a short while I was able to run the test.

In the tests of my connection (my provider is Vodafone At Home, in the UK) all results indicated that BitTorrent traffic is not blocked or throttled. But I'm looking forward to hearing from you in the comments how your ISP performed in Glasnost's diagnostics. Meanwhile, make sure you keep an eye on the other tests that will be available soon from Measurementlab.net.

Server Farms

Another more relevant factor contributing to the growth of server farms is the revolution currently taking place in the $120 billion software industry. Software that traditionally has been installed on personal computers – from word processing and e-mail to heavy duty accounting applications – is going online. Google in 2006 released an online spreadsheet and purchased a web-based word-processing program called Writely. In order to support these commitments, companies are investing heavily in server farms. Analysts say the three companies: Microsoft, Google, and Yahoo combined will invest approximately $4.7 billion dollars to capital expenditures (Mehta 2006).

Low cost and high value contributed to establishing server farms as the industry standard for web based information processing. The startup costs to establish a small server farm are relatively low. Servers nowadays are so inexpensive (about $7,000 for basic model and higher up to $20,000 depending on functions) that they can be acquired with discretionary petty cash in company departments (Morgan 2005). Phil Nail AISO.net co-founder said that establishing a small data center with zero energy bills cost about $100,000 (Woody 2007). Mainframes have a reputation for reliability and stability, but due to the high start up cost most companies aren't interested. The minimum list price for just a mainframe Integrated Facility for Linux (IFL) is $95,000 per central processor. For many mainframe models, the IFL is priced at $125,000 per processor dedicated to Linux. In addition, there are on-going ancillary costs associated with this purchase that are unappealing for companies such as server subscription costs.
The downside to this technology is that server farms consume an enormous amount of energy. The total energy consumed by the Internet information technology sector--from silicon manufacturing to wireless networks, cooling systems, desktop PCs and server farms--is an estimated 8 percent to 13 percent of the nation's electricity, according to data from the Energy Information Administration. This data may be based on server farms operating 24 hours a day at a constant temperature of about 68 degrees at full capacity. But servers do not always run at full capacity because they are frequently idle. Therefore, the estimated 8-13 percent figure may not be entirely accurate (Konrad 2001).

The enormous amounts of energy used to operate server farms, translates into significant operating costs for businesses. And it's not only businesses that deal with the energy issues. Server farms are in nearly every sector of the economy: everything from business to academia to every level of government. A data centre power consumption study by technology analysts IDC suggests that for each dollar spent on hardware, another 50 cents is spent on energy costs. By 2001, that ratio will rise to 71 cents per dollar (Harvey 2008).
Most communities can't cope with the infrastructure demands of a massive server farm. The local utility just doesn't have enough surplus power to give these facilities. Power consumption on that level is like supplying power to a city within the city, they just don't have the resources for that. The infrastructure demand as well as the energy cost is driving Microsoft and others to resource rich areas like eastern Washington where hydro electricity is plentiful. Municipalities aren't exactly welcoming these large server farms into their communities. Server farms just don't generate a lot of jobs. They are designed to operate with a minimum of personnel. Google's super server farm in Oregon is only expected to add 50 to 100 jobs to the local economy, according to press reports (Mehta 2006).

A byproduct of the growth of server farms is that the environment is impacted by the increasing number of server farms. Studies show that between 2002 and 2006, carbon emissions from data farms doubled. This may be due in small part to the emergency backup power –usually diesel generators, but is more likely a result of the power they draw from the local utilities. Essentially, the reduction of data centers would decrease air pollution and waste (Konrad 2001). Vendors such as HP and IBM have spent more than $1-billion each to consolidate their data centers. HP went from 85 data centers globally to 6. IBM cut 150 centers down to 12.

Bill Dupley, HP Canada's IT strategist, says based on HP's own experience in consolidation, reorganizing a database should be recognized as smart business, not as an IT project. “We promised a 43-per-cent annual return on an investment of $1-billion,” he says, adding that it was those upfront numbers that got the project fast-tracked. “We delivered $300-million right off the top in lower network costs. The rest will come over three years in terms of needing 50 per cent fewer staff and savings in power consumption and cooling costs (Harvey 2008).”

The current trend in server farms is to go green. The rapid growth of server farms established by major corporations such as Microsoft, Google, and Yahoo is tempered by the high operating cost from powering these server farms as well as a growing consciousness of its negative effect on the environment. In large part this is due to businesses trying to increase their gross margin and perhaps to a lesser extent to gain public favor. As a result, businesses have sought ways recently to pare down their racks of servers, trim power consumption and reduce carbon footprints – and at the same time increase the efficiency of their servers so they can accommodate the neverending stream of data.

The high energy costs of running a server farm isn’t just from powering the servers. Almost half the energy cost of operating a server farm is from cooling the equipment. Vericenter, an operator of data centers, says a rack of "blade" servers can get as hot as a seven-foot tower of toaster ovens. It gets hot enough that for every dollar a company spends to power a typical server, it spends another dollar on a/c to keep it cool (Mehta 2006).

The hardware approach to this problem is to produce devices for servers that emit less heat and use less energy. Hardware manufacturers from microchips to disk-drive are producing products that are energy efficient. A server blade is a server that fits on a single circuit board, including CPU, memory, and perhaps a local hard disk. It requires less floor space and electricity than a typical server (Wood 2002). Server racks with cold water running through its frame to cool the servers have been considered as a possible solution. Advanced Micro Devices, is heavily promoting its Opteron chips as an energy-efficient solution for data centers. It is even appealing to the green factor with billboards in Times Square and Silicon Valley as an environmentally friendly company.

The software approach is to maximize the use of servers when it is in an idle state, thereby using fewer servers and consequently decrease energy costs. Virtualization software is used to create virtual storage partitions on a single machine. Users can install programs on each partition, including operating systems, and run several different processes concurrently. So instead of using four different machines to perform four different tasks (and running at barely 15 or 20 per cent efficiency), businesses can run all four tasks on a single machine (Harvey 2008).
Another innovative approach which may be effective for small server farms is through a combination of the above with energy efficient infrastructures. A small server-farm company called AISO.net (for "affordable Internet services online") dropped its $3,000 a month electric bill to zero. Its server farm is located inside a 2,000-square-foot building. AISO.net has two banks of ground-mounted solar panels, which generate 12 kilowatts of electricity. Batteries store the juice for nighttime operation. AISO.net switched from 120 individual servers to four IBM blades running virtualization software. The air conditioner only operates for about 10 minutes an hour. When the external temperature drops to 60 degrees, air is sucked into the building to cool the servers. Solar tubes built into the roof illuminate the facility's interior.
Larger data centers can't reduce costs so drastically using the above methods; however, as mentioned previously, businesses with multiple server farms can reduce the number by consolidation. Sun Microsystems recently slashed power consumption by 61% through consolidating its Silicon Valley servers into a single state-of-the-art facility (Woody 2007).
The final approach to reduce energy costs is to build server farms in cheap abundant energy locations. Yahoo, Google, and Microsoft are building their server farms in the Pacific Northwest, near hydroelectric power plants selling cheap electricity. "If I saved just $10 in the operation of each of those servers, that's $10 million per year," says Greg Papadopolous, chief technology officer of Sun Microsystems. "So how much would you be willing to invest in order to save $10 per server? This is exactly the discussion companies had around the time of the Industrial

Revolution (Mehta 2006)"

The greatest weakness to this technology is the high cost to power and cool down all the servers as well as the carbon byproduct from the backup generators. However, technology is rapidly advancing to meet this challenge through improved hardware and software innovations.
Businesses are rapidly developing strategies and implementing plans to cut costs and reduce its impact on the environment. The adoption of the server farm as the preferred technology by software giants such as Microsoft, Google, and Yahoo bodes well for the future of this technology…at least until the next emerging technology comes along to supplant it

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