Hardware components with focus on servers

Resume: A local area network consists of several parts, with the server as the natural centre. All these parts play an important part, and are decisive for the network’s usability and effectiveness. In this lesson, we will especially look at the server and what is important to consider when specifying this.

Introduction

The starting point for this lesson is the famous saying: “A chain is only as strong as its weakest link.” When we are planning a local area network, it is very important to plan so that all parts work optimally together.

In the text book’s chapter 3 we look into several different hardware components, for example hardware for backup, work stations, network cards and cables. The whole chapter is important curriculum, but we do not go through all the different parts in this lesson.

In this lesson, we will especially focus on the server and what to consider when you are setting up a server for a small or medium-sized local area network. In this context, SCSI is an important example.

Server specifications

To set up a server is a different task. Servers are very critical parts in all networks. If the server fails, it will become very difficult and troublesome for nearly all users to carry out their job, and down time is very expensive.

A server is actually nothing more than an advanced and powerful PC. There are quite good competition between PC dealers and the prices on PC’s are relative low. There are many kinds of already set up servers. These are often more expensive than ordinary PC’s because this market is not that heavily pressed on prices as the PC market (which mainly direct against the private market). This means that you can often achieve a better price on a server specified with the basis of a PC than a set up server from the vendor. When there is low margins on the private market for PC’s, sellers often try to catch up the lost profit at those who can afford to pay a little higher prices, which means customers of server solutions.

What is the big difference from a server set up initially as a server and server based on an ordinary (but powerful) PC? The difference doesn’t need to be very big. We will look into some differences that play an important role here:
• A server must be less vulnerable than other units. This means that the components you put into a server must in general have better quality (higher stability) than the cheap components that often are put in a cheap PC. The main reason for this is that down time for a server is much more expensive than down time for an ordinary PC.

• Servers usually have very much in/out activity (we use to say that they have high I/O) and the disks are heavily used. You therefore have to choose components which optimise I/O. SCSI is an example of an important component providing this. We will come back to SCSI later in this lesson.

• Servers usually have many users, using the services simultaneously. This means that servers should have high efficiency. This can be achieved especially by two factors – memory (RAM) and processor. A server supposed to bear heavy load should therefore support several processors and much memory. The chipset and the main board decide the upper limit on this. Another important size of great importance is the processor cache. Such cache is very expensive.

• Servers are usually powered on 24 hours a day, 365 days per year. This means that cooling must be very effective. One should therefore choose a system case that gives good air flow, and preferably install extra fans in the server room. When you choose system case, you should also consider future growth of the server. It is important that you are able to use the server in future expansions of the network, and avoid buying a new server too early.

**Main board**

In this lesson, our starting point is that we do our own specification of the server, or at least monitor what the seller suggest. Then it is least likely that you buy something you don’t need or that you achieve a too high price.

In the specification of a computer, the main board is an important component. All the different parts of the computer are tied together on the main board. We will go into details on all characteristics of the main board, but look at some important factors. There are some guides on the Internet that are very detailed on this matter. The PC Guide is one such example ([http://www.pcguide.com](http://www.pcguide.com)).

The first we will examine is the form factor. The form factor has to do with the design and size of the main board to do. The most usual form factors are AT, Baby-AT, ATX, NLX and LPX.

The table below sum up the most important characteristics connected to each of them:
<table>
<thead>
<tr>
<th>Form factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>AT is the standard used in the first PC’s on the market (the AT’s). They are very large and not much in use in modern PCs.</td>
</tr>
<tr>
<td>Baby-AT</td>
<td>We often use the term AT about these also, and this causes some confusion. Baby-AT is a slimmer version of AT, and suits in an ordinary minitower case.</td>
</tr>
<tr>
<td>ATX</td>
<td>The most common form factor these days is ATX. Figure 1 shows a picture of an ATX main board. There is no big difference between a Baby-AT and an ATX main board. With ATX, some new features appeared in connection to power administration. It is possible to adjust the computer to “wake up” at occasions from a sleep mode, or over the network (Wake on LAN). There is also a variant of ATX that is called Micro-ATX. In this variant, some slots are taken away. This gives fewer possibilities for future growth.</td>
</tr>
<tr>
<td>MicroATX</td>
<td>As mentioned above, a Micro-ATX main board is a smaller version of the ATX board. Many producers of pre-built computers use this option. Since the card is small, it doesn’t use much space, and are therefore able to use smaller (and cheaper) cases.</td>
</tr>
<tr>
<td>LPX</td>
<td>LPX is made especially for desktop cases. This means computers meant for standing on the desk with the monitor on top. This gives some changes in requirements of the main board. The PCI slots are often positioned on a separate card, placed in a slot on the main board to save space. Computers as described here are not very often used in today’s PCs.</td>
</tr>
<tr>
<td>NLX</td>
<td>NLX is the successor of LPX. It gives better space to the big Pentium processors. NLX has also built in support USB, something LPX (or AT/Baby-AT) doesn’t have.</td>
</tr>
<tr>
<td>WTX</td>
<td>WTX is a new specification we haven’t much so far. The first version of the specifications was released in September 1998. WTX are developed especially for work stations in the middle class, and the goal for the main board of the WTX kind is to be able to deliver it with fairly low prices. This means the main board is not very suitable for servers as ATX.</td>
</tr>
</tbody>
</table>
## Hardware components with focus on servers

| FlexATX | The idea behind FlexATX (the name indicates that it is based on ATX) is to produce cheap computers. This does not work well with server, and we are not spending more space on this matter here. |
| BTX     | The most interesting that has happened lately in the form factor development is BTX. This will (in not a very long time) replace ATX as the main form factor. ATX is ready for change since processor speeds have increased a lot lately, which gives focus on noise and cooling. The form factor comes in three different kinds, BTX, MicroBTX and PicoBTX. The article on [http://www.pcquest.com/content/technology/2004/104040502.asp](http://www.pcquest.com/content/technology/2004/104040502.asp) gives a more thorough presentation of BTX. |

The conclusion to this presentation of form factors is that we usually choose ATX main boards for servers, since AT, Baby-AT and Micro-ATX often are not powerful or modern enough. LPX and NLX are first of all constructed for desktop models (and for that reason usually not have enough space for servers). WTX are constructed in order to lower the price for a standard workstation.

Lately, much development has happened on the BTX form factor. BTX is short for “Balanced Technology Extended”. It is expected that BTX will take over much of the market for the popular ATX form factor. Intel is behind the development of BTX (as well as ATX).

BTX main boards are made in three different versions (as mentioned in the table above), BTX, MicroBTX and PicoBTX. The largest version (BTX) is capable of housing seven extension cards, microBTX has room for four while there is one room for one on picoBTX. This may sounds too little, but we must remember that on today’s main boards, very many of the components that previously needed extension cards (like graphic boards or network interface cards) are today included in the main board.

We can list the following (large) changes with the BTX form factor:

- S-ATA disk standard (which also is usual on newer ATX boards) in stead of older IDE disks. This gives a more “clean” box, since the cables are much smaller.
- The graphical standard AGP is taken away (look at the next item).
- PCI-Express is the newest and fastest PCI standard. There are from one to three sockets for PCI-Express, and it can be used for graphic boards, video transmission or other communication that demands high speeds.
- Better fan – the fan is not a part of the main board, but cooling has become more important as the speed raise and heating raises. The BTX standard has made space for a better (and larger) fan, and the design takes into account that circulation of air must be in a way that all necessary components get the cooling the need.

It is expected that the BTX form factor will replace the widely used ATX during the next couple of years. Intel is behind the development of BTX (and also ATX). The last years’ development has shown that BTX hasn’t been adopted as fast as we expected some years ago. The number of cases and main boards supporting this form factor are very few, and this is mainly due to the fact that the producers haven’t seen the so many advantages with going from ATX to BTX.
Just to avoid being accused for serving errors, we state that there exist other form factors not mentioned here.

**Chipsets**

The presentation of chipsets is closely related to the main board. The chipset is an important part of a computer, and tells us a lot about possibilities for extensions. The text book presents the functions of the chipset on page 138–139. There are many updated lists of chipset available on different sites on the Internet. The text book present an example – Intel 450NX. This is a fairly powerful chipset with support for up to 8 GB memory (both SDRAM and EDO), but the chipset is quite old for today’s computers.

There are many producers of chipset, with Intel as the most famous one. Intel’s alternatives are good, even if many PC producers think that Intel has the best qualifications to make chipsets that suits their own processors (which likely is true in many ways). In this presentation, we stick to Intel’s alternatives. This gives us an easier angle to the presentation.

We don’t want to spend pages on details around chipsets. The chipset producers’ web pages are of course a good alternative for those of you who want to dig deeply in the details. There are many articles, both in Norwegian, Swedish and English, presenting tests and the newest chipsets. Tom’s Hardware is such a place. We can for example consider the news article on [http://www.tomshardware.com/2007/09/26/intel_x38_chipset/](http://www.tomshardware.com/2007/09/26/intel_x38_chipset/) as an example. A rather new chipset (X38) from Intel is presented in this article. The Norwegian site Digi.no also has an interesting article (from June 2007) presenting a chipset series from Intel (where X38 belongs): [http://www.digi.no/php/art.php?id=384849](http://www.digi.no/php/art.php?id=384849).

These articles are not presenting the newest technology on chipsets. It could be a nice student assignment to ask you to find newer articles on chipsets and upload them on the course forum.

The reason why we present Internet articles about chipset is to emphasize that such sites contain the most updated and best source of fresh information concerning this kind of hardware (of course with the chipset producers as the ultimate source). The best way of learning about chipsets is perhaps to perform a net survey where you collaborate to search for the best choice of chipset for a server under given conditions?

It is well worth investigating which chipset to buy when considering upgrading of the server at a later stage.

A nice overview of the topic chipset could be found at Intel at [http://www.intel.com/products/chipsets/](http://www.intel.com/products/chipsets/). Here, you find a list of chipsets for various use cases, for example servers as one option. This overview shows for example that the following chipsets could be a good choice for servers:


All these examples have support for several parallel processors, and these parallell processors also have multiple cores (dual- or quad core). At the links above, you can find brochures and more detailed descriptions about these chipsets. Look closer at the "Product brief” for each of them. They give a lot of information about their capabilities.
**Northbridge and southbridge**

When we read literature about chipsets, we meet the concepts “Northbridge” and “Southbridge” quite soon. This is the two parts a modern chipset consists of.

This is not supposed to be a detailed course about computer hardware, but we nevertheless give a short description of these concepts here, since you so soon meet them.

We can consider the northbridge and the southbridge as a crossing on the main board, where the traffic between the different parts is controlled by defined (programmed) rules, like every large road crossing. We can imagine that data is sent from the memory to a hard disk. This traffic then has to go through the chipset, which routes the data to the correct destination.

We can set up the following figure that could explain the purpose with this divide:

![Figure 2 – Northbridge og southbridge](image)

The figure above shows the processor, standing in direct connection with the northbridge. We find the southbridge below this. The figure also shows why it is called north- and southbridge. We can consider it as a map with the processor to the “north” on the map.

The northbridge is closest to the processor and is the most important part of the chipset. This is the component that handles the fastest communication and is directly connected with RAM, AGP and PCI Express. It also communicates with the southbridge. The northbridge is thus responsible for administering the processor bus and the memory bus. The reason why we claim that this is the most important of the two chipset components is first of all since it puts the limits for the fastest components, and therefore decides how many processors the chipset can handle or how RAM it supports.

The southbridge (some times called ICH (I/O Controller Hub)) is responsible for communicating with the slower components, like PCI (traditional), USB, integrated hard disk controllers, PS/2 keyboard and mouse, parallel- and serial port and integrated sound- and network controllers.

If we try to guess for the future, many claim that the chipset will die in a while. Higher demands are put on the memory and the other extremely speed critical components. There is a tendency that these components are integrated in the processor in stead.
The chipset should ensure a highest possible up-time. The chipset on the figure below should take care of that.😊

![Figure 3 – Viagra brikkesett](image)

### The processor

The processor market is not as easy to get an overview over as it was some years ago. Then we only had one producer of processors (Intel), and it was sufficient to keep track of what was released from that company. It would be a too big task to give a complete overview over details in all the producer’s processor alternatives and their structure. In general, we can say that you should choose a processor that is powerful enough to bear the load that the network (server) is expected to meet. What is “powerful enough” is very little concrete, but the usage areas of networks and servers vary heavily.

One important factor in connection with the choice of processors for servers is the cache that is on the processor. Processor cache is presented in the text book on page 134. There are often two levels of cache on a processor, 1st and 2nd level cache. First level cache is quicker than second level cache. Today, it is rather usual with 512 Kb on the second level. Servers often have much more cache. First level is much more expensive, and a size of 16 kb is quite usual. The amount of first level cache is not always very accessible on sales brochures – you usually have to look into processor specifications to find this.

On the Norwegian site hardware.no, there is an nice article presenting many of the relevant processors, and it says something about where they are suitable. This is an interesting article that gives an overview and is recommended (to reader that is able to read a bit Norwegian). The original article is not completely new, but is kept updated. Look at [http://www.hardware.no/artikkel/4975](http://www.hardware.no/artikkel/4975). Notice especially the change Intel has done during 2006, where Intel Core is a new kind of processors.

Which processor you should to different purposes is very difficult to say. In general, we can say that it is quite usual to choose processors a little stronger than your needs.

It’s a demanding task to stay update on everything that is happening within the processor market. Many have expected that we will soon meet an upper limit about how high processor speeds are possible to achieve. But it appears that the development in processor technology
takes new steps and the market is more than willing to put in newer functionality which sets out new needs for further development. Today (2008), for example Intel Core 2 Extreme QX6700 (which is a relative powerful processor) has more than 500 million transistors. This is so unbelievable many transistors on a small surface that it is almost impossible to understand what this implies. One transistor is around 65 nm (nanometer – nano means $10^{-9}$ which means one billionth of a meter), while sizes down to 45 nm is underway. One hair is approximately 0,1 mm, which is 100.000 nm. This means that one hair has the space of more than 1500 transistors of 65 nm size.

Ordinary processors today appear with speed up to about 4 GHz. Intel predicts speeds on 10 GHz within a three year period. Further on, they predict that we have 40 GHz processors within less than 10 years. The film industry in Hollywood follows this development closely and produces many films what happens when computers are given so much power that they may pass our brain’s capacity.

**Dual/quad core**

We have not experienced such a tremendous development in the processor speed as we could have expected during the recent years. Priority has been put on integrating more in the already achieved speed. It is almost like saying that the cars runs fast enough on our motor-ways, and we must in stead build them broader in order to get more traffic to the destinations.

Dual core or quad core are examples on this. A” dual core” processor means that we take to (more or less) independant processors and integrates them in a package (in one integrated circuit). This also make some communication and co-operation possible between the two kernels. Quad core means that four processors are integrated in one circuit.


A visit at Intel’s web site shows that they have many alternatives that use this technology. The Intel Core family comes in three versions for desktop PCs: Intel Core 2 Extreme, Intel Core 2 Quad and Intel Core 2 Duo.

The server processor Xeon also comes in dual core and quad core versions.

We will look at an example of Dell’s servers. Dell’s web pages are interesting in relation to this lesson because we can configure servers as we wish, and see what impact changes will have on these changes.

We will look at Dell Poweredge 2900 III (image to the right), which can be used as a file server. If we look at the Swedish pages (since all the students are Swedes), the price examples will (of course) come out in SEK. Dell has parallel web pages in many languages. The price of the server (configured as default) is (per 20th January 2009) SEK 11.899 (excl. moms). The server is capable of having two parallel Dual Core or Quad Core Xeon processors (which is a good and often used processor for servers), but the price above includes one Quad Core Intel Xeon E5410 processor. It is
equipped with 2 GB DDR SDRAM, and can be raised to 4 GB for the price of 200,- extra. It is equipped with two 146GB SAS disks. The server is default set up with a RAID\(^1\) controller, but the server is not configured to use RAID.

**What is the best alternative– Intel or AMD?**

Many years ago, Intel was the only producer of processors on the market. After a while, many competitors appeared, among them were AMD. The competition became quite hard, and today there are only to serious players left; Intel and AMD. AMD has been a tough competitor for the giant company Intel through many years. This competition has been very good for us customers. Both product and prices have become better.

AMD has many times shown very good results on measures of processing power (sysmarks), and has beaten Intel’s comparative products. When AMD seldom are used in servers, is often the following reason given:

- The main boards that have been produced to AMD’s processors have often appeared to have slightly lower quality than Intel’s alternatives. This is not AMD’s fault, but they certainly suffer from it.
- AMD has a rumour that the processors are more unstable then Intel’s alternatives. Lack of stability is not good for servers. This rumour is often not true, but AMD also suffer from this.
- Overheating has been a problem for AMD as long as they have produced processors. This is a big challenge for all that is making processors. This is not difficult to imagine when you know that over 50 million transistors are put into one small circuit. For this reason, there is a great need of cooling the processor. As a curiosity – one webpage that has been quite famous (and perhaps harmful to AMD), is the recipe of how you can fry eggs on the processor. You take an AMD processor as a frying pan and so on. Look at the picture below.

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\(^1\) RAID (Redundant Array of Inexpensive Disks) is not curriculum in this lesson, but central in this context. Students that are not familiar with the term can wait to lesson 4 when RAID will be presented.
**Pentium 4**

The Pentium 4 processor was released in the autumn 2000. There are only minor differences on the last year’s Pentium processors (in the architecture). When we come to Pentium 4, the changes are highly noticeable. While Pentium III comes with bus speeds up to 133 MHz, Pentium 4 comes with speeds on 400, 500 or 800 MHz (among other dependant on which chipset that is going to be used). What regards processor speed, Pentium 4 was released with the speeds of 1.4 and 1.5 GHz. Today, there are P4 processors up to 3.8 GHz.

Pentium 4 supports (at least some chipsets connected with P4) a new memory technology, RDRAM (also called Rambus RAM). This technology is shortly described in the text book on page 145, and can be studied in great details pm several web sites. Intel has been very active in the development of Rambus RAM and had planned that this technology should use this kind of memory as standard. After a while, it appeared that DDR SDRAM have become much more popular in the market (an important reason for this is the price development), and Intel has therefore given up their battle. The newest server chipsets from Intel only support DDR SDRAM.

During the last year, prices on Pentium 4 based computers have become low. It is possible to buy a P4 computer today below € 800 plus VAT (no monitor). There is hardly anyone today who builds a computer with a Pentium III processor. If you are supposed to have other processors (than P4 or Xeon), you rather go to AMD’s alternatives.

**64 bits alternatives**

There has been released a series of 64 bits processors the recent years. We have mentioned some of these above. A couple of years ago, the effects of 64 bits processing were minimal, since operating systems were not made for this, but for 32 bits processors.

In recent years, support for 64 bits processors has come in many operating systems. Windows Server 2003 has 64 bits versions of the two most powerful versions (Enterprise and Datacenter Edition).

There are especially two big advantages connected with 64 bits processing:

1) A broader bus makes naturally possible to do more on each clock frequency. A process can handle twice as large amount of data per clock frequency. This does not mean that it only goes twice as quickly, but many operations can work much more effective since they can handle larger amounts of data.

2) One also achieves to be able to address more memory. 32 bits processors have a limit on 4GB, while a 64 bits processor practically can address unlimited amounts of memory. Itanium 2 are capable of handling up to 1 petabyte which equals 1000 terabytes (one terabyte is 1000 Gigabyte).

Especially servers that are particularly memory demanding will have big advantages of using this.

All large processor producers have 64 bits versions. Intel has its Itanium (Itanium 2 is the latest version). In addition, they have a version of the Xeon MP processor which has 64 bits processing. Both are suitable for servers, and the purpose of these processors are mainly this market. AMD has its Opteron, which also has been a success, and also a 64 bits version of the Athlon processor. In addition, we have the old Alpha which has been available for very many years (mainly used in Linux systems).
I expect that we will see that the use of 64 bits processors in servers will raise the coming years, like we have seen also the recent years.

**Recent memory (RAM) development**

The text book presents the last year’s development of RAM on page 128-132. When the market changes as quickly as it does now (especially when look at speeds), it becomes important that the memory technology manage to follow the pace. Otherwise, memory becomes a bottle neck, and the high processor speeds can not be utilised.

Computers are today almost always delivered with DDR SDRAM. In March 2003 was the next generation of DDR SDRAM delivered, specified by JEDEC (Joint Electronic Device Engineering – [http://www.jedec.org](http://www.jedec.org)). This standard has been named DDR-II SDRAM. The speed of this memory module is 4264 Mbps against a typical speed of 2000 Mbps on a DDR-1 module.

JEDEC and Intel have worked together on a new standard for the next generation of DDR RAM, which has been given the natural name DDR-III. The specifications were ready in the first half of 2007. All PC- and server shops deliver DDR3 chips of various speeds today.

There is a memory standard for graphic interface cards, called GDDR3 (it is used in Playstation 3), and this standard must not be mixed up with the RAM standard DDR3.

There is a lot of information about DDR3 on [http://en.wikipedia.org/wiki/DDR3_SDRAM](http://en.wikipedia.org/wiki/DDR3_SDRAM).

**System case**

The case is also a very important detail when you are going to specify a server. It is of course important to choose a case that suits the mother board, and since we already practically have chosen ATX as the main board form factor, the “case question” becomes a bit easier.

The text book present important considerations to be done when choosing system case for a server on page 139-140. Figure 4 shows some examples of case models.

![Figure 4 – Case models](image-url)
Racks

Servers are often mounted in racks. A rack is (as the starting point) an empty closet with possibilities to mount in components of various thicknesses. This is most of all done in order to have a clear server room. By having standardised sizes and rack mounted components can we combine different kinds of components, for example UPS, many servers, storage units, switches and hubs in the same rack.

Rack usually come in 19” width (which is the industry standard for such racks). The heights of the components are measured in standard units, called U (for Unit size). The slimmest servers are only 1U, but there are servers in many different sizes – 4U is rather common, but 7U is considered as a big (physically) server. 1U correspond to 1.75”.

Rack mounted servers become more and more popular, most of all because it gives us a clearer server room. Large server dealers (like DELL, Compaq, HP and similar companies) have their own product categories with rack mounted servers. These fits in a 19” rack.

Figure 5 shows an image of a rack, and a Dell Rack server (Poweredge 6650, which is a 4U server).

![Figure 5 – Rack and a rack server](image)

Lately, a new version of system cases has appeared which changes the view of an ordinary PC dramatically. This is Shuttle. Figure 6 shows an image of a Shuttle PC. This PC is mainly a computer for the home market. Since the computer is very small, it suits well in the kitchen or in the living room, but is not working well as a server.

![Figure 6 – Shuttle PC](image)
Blade server

The most recent technology within server technology and architecture is the Blade Server model. You can almost locate an entire server room (with many different servers and switches) in one single box. The advantages are obvious – they use less space and it becomes cheaper because you are able to spend less money on what actually enhance the speed, and less on (useless – when it comes to processing power) components like power supplies and fans. Some network experts claim that up to half of the costs of some servers are connected to power supplies, fans and chassis.

Wikipedia defines blade servers the following way:

> A blade server is essentially a computer on a motherboard, including: one or more processors, memory, storage, and network connections. The idea behind blade servers is that many such blades can be added in space-saving racks, thus providing compact and powerful computing solutions that are less expensive than traditional solutions (such as mainframes).

> Blade servers are ideal for specific purposes such as web hosting and cluster computing. Individual blades are typically hot-swappable.

> Although blade server technology allows for open, cross-vendor solutions, for the time being, users experience fewer problems when keeping with blades, racks and blade management tools from the same vendor. Eventual standardisation of the technology will hopefully result in more choices for consumers; increasing numbers of third-party software vendors are now entering this growing field.


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**Figure 7 – Blade servers, chassis**

The idea behind IBM’s blade concept has been to develop an industry standard that other producers of servers and equipment can add units to. This development has been quite fast, and the blade model is already in sale at many large server suppliers (try for example Dell’s web pages).

Figure 8 shows an image of a chassis of IBM blade server. A server is now inserted in to the chassis as a server card (or a blade). The image below shows an example of such a blade server. This server has one or two Xeon processors, up to 8 G RAM and all other specifications like an ordinary tower or rack server has. The chassis shown on the image above can contain up to 14 servers, four switches and two administrational modules. A full chassis will have a weight of more than hundred kilos.
Blade servers use how swap technology all over. This means that if you have started a blade system, there is no good reason for shutting it down. You can draw out one of the servers or insert a new one while the rest of the system is running.

It is also possible to insert other units than ordinary servers or switches. The disk capacity can for example be increased by a BladeCenter SCSI Storage Expansion Unit.

There will also be different administrational modules in a BladeCenter. The different servers are of course situated in networks, and must be configured with IP (or given IP by DHCP). The switches must also be administered. All administration is done by web interface from a connected client.

The costs associated with a Blade Center are interesting to have a look at. The Blade server model works best in large networks (not surprisingly), since the chassis with the connected equipment is quite expensive. But with many servers, it becomes more and more profitable, just because each of the blade servers is less expensive than their corresponding tower- or rack models. According to IBM, a BladeCenter will be economically interesting when you are passing six blade servers, compared with IU servers in racks. A system case of a blade server with fans and power supplies cost approximately € 3000,-.

Figure 9 shows an image of an Intel blade server, with specifications of where the different parts of the server are. Such a blade server have the measures 24.5 x 44.6 x 2.9 cm, and weighs a bit below 7 kilo.
Figure 9 – Intel Blade server

Figure 10 shows an example of an HP Blade Server (HP BladeSystem c-Class), which is a fairly new series. You can find more information about this series on http://h18002.www1.hp.com/products/blades/components/c-class-components.html.

Figure 10 – Intel Blade server

Until recent time, blade servers have been used mostly in large networks. A development has occurred that makes this technology more available also for smaller networks. The above mentioned c-class technology from HP is constructed for networks down to 50 users.
Power supply

Power supplies are presented on page 140 in the text book.

It is common that a computer is equipped with power supplies that match the case size. A slimline case usually has power supplies from 100W to 200W, while a full tower case often has supplies from 250W and up. I large server cases, you often have several power supplies.

**SCSI (Small Computer System Interface)**

A server and a workstation don’t use exactly the same kinds of components. One component that we often use in servers (and not that often in servers) is SCSI. We will look at SCSI in more detail in lesson 4 (about LAN operating systems). Servers work for a great deal with in/out operations (I/O). If we are able to optimise these tasks, the server will work more effectively. SCSI is an important factor in this matter.

SCSI is examined in the text book on page 115-121. SCSI is a bus standard that is used in order to interconnect several I/O units, for example disks, CD-ROM, DVD-ROM, scanners and tape stations. A SCSI system consists of a SCSI controller and wires. There are both internal and external SCSI units. Internal SCSI units are located inside the computer case, and are interconnected with a drop cable. This is a flat cable with many outlets (“drops”). The cable looks quite similar to an IDE cable (those for example disks are connected to the main board with), but are slightly wider. The IDE cable has 40 lines while the SCSI cable typically has 50 or 68 lines (dependant of which SCSI standard that is used). There are pictures of both internal and external cables in the text book’s figure 8 (the internal cable end contact is in the bottom of the picture to the left).

SCSI gives a more effective system if you have several units (which is the main reason with SCSI). You can send several commands simultaneously on the bus (in contradiction to IDE). This gives faster access to each unit.

SCSI has become much cheaper lately (as many other kinds of IT equipment nowadays). This has done SCSI more available for “ordinary” people. In a server, though, there should be SCSI equipment, no matter what!

**Standards**

SCSI is not just SCSI. There are many different standards. The standards are listed in the text book on page 116-117. The book is a couple of years old, and meanwhile, there has been developed a new standard recently. This has happened under the SCSI-3 specifications. In order to present a complete picture of the standard, we will look briefly at all standards, and focus especially on the most recent standards.

**SCSI-3**

- Ultra SCSI – eight bits data bus, 20 MHz clock frequency, 160 Mbps
- Ultra Wide SCSI – as the Ultra variant, but with a 16 bits data bus, 320 Mbps
- Ultra 2 SCSI – as Ultra, but with double clock frequency (40 MHz), 320 Mbps
- Wide Ultra 2 SCSI – as Ultra 2, but 16 bits data bus, 640 Mbps
- Ultra 3 SCSI – as Wide Ultra 2, but now the clock frequency are doubled once again (80
MHz), 1280 Mbps. This standard is also called Ultra 160 (160 Mega bytes per second = 1280 Mbps).

Ultra 320 SCSI was presented of the SCSI Trade Association in 2001. In this standard, the clock frequency are doubled again (to 160 MHz), which gives us a capacity of 2560 Mbps. Notice that the naming of the last two standards has changed. From naming it Ultra, Ultra 2 and Ultra 3, they now use the standard’s capacity as the basis for the naming. Ultra 320 tells us that it’s capacity is 320 mega bytes per second, i.e. 2560 mega bits per second (320 * 8)

Table 1 – SCSI 3 specifications

When you are going to choose a SCSI variant, you need a controller for the chosen standard. If you buy an Ultra Wide SCSI hard disk, you need an Ultra Wide SCSI controller. Please notice that these standards are backward compatible. This means that if you choose one standard, you can normally use units of previous (lower) standards together with this controller (you can for example use an Ultra SCSI disk on a Wide Ultra 2 SCSI controller). If the plugs doesn’t fit, you can normally use adapters which makes interconnection possible.
### Table 2 – Overview over often used SCSI plugs

<table>
<thead>
<tr>
<th>Plug</th>
<th>Description</th>
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<tr>
<td>DB25, external</td>
<td>This is a 25 pins plug for external units. This plug is for example used for simple external units, like zip drives or scanners.</td>
</tr>
<tr>
<td>Low-Density, 50 pins, external</td>
<td>This plug reminds us about the printer port on a computer (parallel port).</td>
</tr>
<tr>
<td>Hi-Density, 50 pins, external</td>
<td>Notice the difference on the Hi- and Low-Density on the images. Hi-Density is more used than Low-Density on newer devices (external). Other names on this plug type are Micro DB50 and Mini DB50. This kind of plug is used in most SCSI 2 and some earlier standards.</td>
</tr>
<tr>
<td>Low-Density, 50 pins, internal</td>
<td>It is more common to use Low-Density cables on internal units for the &quot;narrow&quot; kind (50 pins). This image is from an ordinary &quot;narrow&quot; internal cable. &quot;Wide&quot; SCSI standards often use plugs of this kind. Other names on this plug are Micro/Mini DB68. The internal variant of the 68 pins plug is very similar to the 50 pins variant, but this is usually Hi-Density.</td>
</tr>
<tr>
<td>Hi-Density, 68 pins, external</td>
<td>This kind of plug is used in most SCSI 2 and some earlier standards.</td>
</tr>
<tr>
<td>Hi-Density, 68 pins, internal</td>
<td>This kind of plug is used in most SCSI 2 and some earlier standards.</td>
</tr>
</tbody>
</table>

SCSI controllers cost from around 60 € for the cheapest kinds and up (I found an Ultra 320 controller for the price of 310 € plus VAT – look at the image below). External cables are quite expensive – they often cost from 25 € to 80 € per piece.

![Figure 11 – Ultra 320 SCSI controller and a 68 pins internal cable](image)

### SCSI ID and termination

Since it is possible to have many devices connected to a SCSI controller (in some standards, you can have 16 units), each device are designated an ID. Together with this ID, priority is set and used when there are heavy traffic.

The bus must be terminated in the end of the bus in both ends.

You can find more about ID and termination in the text book on page 119-120.
Summing up

We have now looked at hardware components for local area networks, with a special focus on the server. This is a very large topic, and it is very difficult to keep oneself up to date on an area where so many things change.

We have looked at the server’s main board, chipset, processor and case. All these combinations exist in all PCs. We have also looked at SCSI which is an important part of (nearly) all servers. We have looked at different standards, and connected them to plugs and cables for SCSI. There are very many different standards in SCSI.

One component that we have not examined in this lesson, but that certainly belongs in every server of a certain size is the RAID (Redundant Array of Independent Disks) technology. RAID gives high capacity and read speed from the disks, at the same time as we achieve better security (higher fault tolerance). We will come back to RAID (described on page 213-218) in lesson 4.

This week’s curriculum mainly consists of chapter 3 in the text book. This chapter is quite detailed on hardware components, also on other components than specification of servers. Not all of the pages are presented in this lesson. Disks, workstations, cables and backup hardware are presented in the text book, and not here. This does not mean that these issues are not important material.
# Content

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