8 EFFICIENCY IN COMPUTER SYSTEMS

8.1 Vocabulary

synonyms • nouns from verbs • paraphrasing

A Look at the pictures opposite.

1. Match pictures A–G with the appropriate labels 1–7.
2. What functions do the items in pictures A–F perform in the FuTek system in diagram G?

B Discuss the following questions.

1. What is meant by *efficiency* in computer systems?
2. What can be used to measure the *efficiency* of the items in box a?

C Look up each noun in box b in a dictionary.

1. Is it countable, uncountable or both?
2. What is its meaning in ICT?
3. What is a good synonym?
4. What useful grammatical information can you find?

D Study the two lists of verbs in box c.

1. Match the verbs with similar meanings.
2. Make nouns from the verbs if possible.

E Look at the Hadford University handout.

1. How does the writer restate each section heading in the paragraph?
2. Find synonyms for the blue words and phrases. Use a dictionary if necessary.
3. Rewrite each sentence to make paraphrases of the texts. Use:
   - synonyms you have found yourself
   - synonyms from Exercise C
   - the nouns you made in Exercise D
   - passives where possible
   - any other words that are necessary

   Example:
   Centralizing data-processing operations can play a role in developing efficient systems.

   ➔ *The centralization of data-processing operations can contribute to greater efficiency in a computer system.*

F Study the pictures of the computer system on the opposite page again.

1. What changes might improve the performance of the system?
2. What possible problems might result from these changes?

a

interface network processors
software storage support

b

cost data centre function
migration outage processor
task utilization

c

1	2
cluster	interrupt
consume	guarantee
convert	contribute (to)
disrupt	reduce
distribute	include
drive down	group
ensure	transform
incorporate	balance, share
mask	assess
measure	use
play a role in	hide

HADFORD *University*

Efficiency in systems development

A Data centre migration

Moving processing and storage operations to a centralized location can play a role in developing efficient systems. For example, by using multiple servers clustered together on one site, and software to distribute the processing load across them, higher utilization levels can be obtained. This drives down the cost of hardware, so systems using data centres can deliver services more cheaply.

B Capacity utilization

We can measure how well a system is using its resources (i.e., processor, memory) like this: actual usage divided by maximum potential usage times 100. All designers try to lower the cost of processing in a system. One way to do this is to use efficient software to minimize the amount of spare capacity.

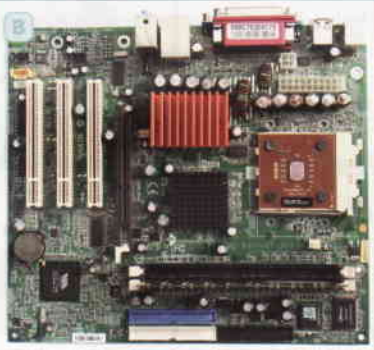
Parts of a system

FuTek Energy Efficient Hosting Solutions.com

Home | Web Hosting | Features | Why Us | Guarantees | Contact Us | Help Centre | Sign Up

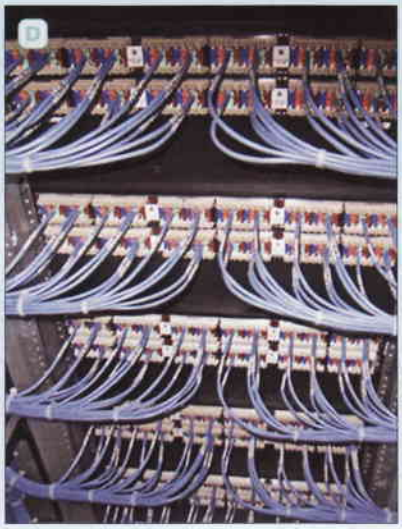
A

B



C

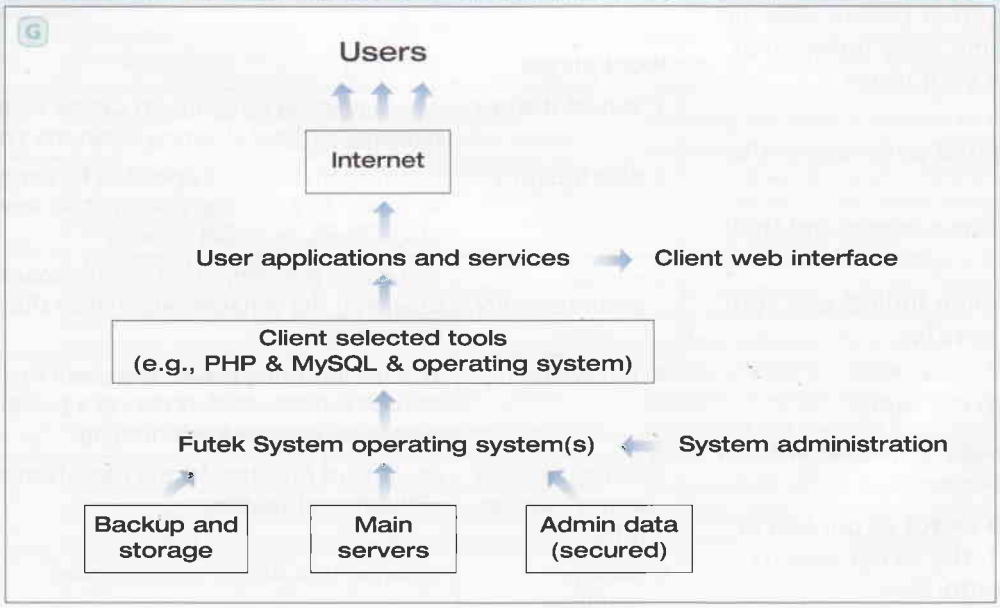
D



E

F

G



1 multiple operating systems
2 dedicated helplines
3 high-speed network connections
4 easy-to-use control panel
5 energy-efficient processors
6 low-cost data storage
7 system diagram

8.2 Reading

recognizing essay types • understanding complex sentences with passives • defining terms

A Look at the different examples of systems in the blue box.

1 What type of system is each one (e.g., e-mail = communication system)?

2 How could the performance of each system be improved?

3 What changes could be made to each system to bring about these improvements?

air traffic control e-mail
nuclear power plant patient record
search engine social networking

B Look at the four essay types on the right.

1 What should the writer do in each type?

2 Match each essay type with one of the questions below the slide (A–D).

3 What topics should be covered in each essay question?

There are four main essay types in ICT:

- descriptive
- analytical
- comparison/evaluation
- argument

C Read the title of the text on the opposite page and the first sentence of each paragraph.

1 What will the text be about?

2 Choose one of the essay questions in Exercise B. Write four research questions which will help you to find information for your essay.

A What are the advantages and disadvantages of virtualization for large commercial organizations?

B 'Virtualization answers all of the questions which system designers have to ask about hardware.' To what extent do you agree with this statement?

C Explain why reducing system energy consumption is essential to the success of virtualization.

D What questions do designers need to ask when considering the efficiency of their systems? Describe how two companies have found different answers to some of these questions.

D Read the text.

1 Using your own words, make notes from the text on information for your essay question.

2 Work with another person who has chosen the same essay question as you. Compare your notes.

E Study the highlighted sentences in the text.

1 Underline all the subjects and their verbs.

2 Which is the main subject and verb for each sentence?

F Study the table on the right.

1 Match each word or phrase with its meaning.

2 Underline the words or phrases in the text which the writer uses to give the definitions.

See *Vocabulary bank*

Word/phrase	Meaning
1 'out-of-the box'	where physical components can be added or removed without shutting down the system
2 data integrity	ensuring that devices operate efficiently whether they are idle, operating at lower usage levels, or at full capacity
3 energy proportionality	circuits on the computer's motherboard providing the voltages required by the microchips
4 'hot swapping'	systems supplying power with built in storage capacity so that during a power outage servers can keep running
5 uninterruptible power supplies (UPS)	equipment provided by the manufacturer without modification
6 voltage regulator circuitry	ensuring that data is not corrupted

'Hiding the hardware':

Using virtual machines to improve system efficiency

Good system design has always tried to balance performance and cost. For designers of generalized commercial systems, this has meant a careful analysis of the specifications of component parts, to ensure that they can provide the necessary functionality and reliability at the least possible cost. Where systems are a key element of commercial organizations, the level of system efficiency can mean the difference between success and failure for a company.

Here is a list of questions which have to be considered by systems designers:

- What can be done to minimize system hardware costs?
- What is the best balance between the level of specification of hardware components in a system, and their cost?
- What are the implications of these changes on the overall operation of the system?
- How easily will the system architecture 'scale up': that is, increase proportionally, if it needs to be expanded?
- How can systems be designed to minimize their effects on the environment?

Some answers to the above questions have been provided by *virtualization*. A key concept of virtualization is *clustering*, which means locating the hardware elements of the system together in a data centre or server farm. This makes it easier to provide an optimal environment for the hardware to work in. System maintenance is also simplified by clustering, as it makes components easily accessible for repair or replacement. Another concept is *masking*, which involves making the physical components of the system appear as one virtual device to system administrators. This makes it easier for them to manage the system. Virtualization can be used for servers, storage and networking. A key benefit of virtualization is that physical components can be added or removed without shutting down the system (this is known as '*hot swapping*'). This provides great flexibility for system designers as it means that processing, networking or storage capacity can be scaled up or down very quickly in response to changes in the business environment.

In addition to flexibility in system size, virtualization allows flexibility in terms of the specification of system components which can be used, although there are limitations. The system developer's choice of components is limited by the level of reliability required by the system. For example, 'out-of-the-box' servers, which are those purchased from manufacturers without modification, are typically both expensive and high specification. They are ideal for e-commerce companies such as Amazon which require very high levels of reliability and data integrity (ensuring that data is not corrupted). For others, such as Google, reliability is less important than cost because the amount of revenue which they obtain from each search is so small. For this reason, they have used enormous numbers of low-cost, low-specification PCs. These are less reliable, but using virtualization means that the failure of a component, such as a motherboard, will not disrupt the service overall. Any loss of data will only affect transactions taking place at the time. For search engine systems such as Google, this may simply mean users not getting the optimum search results. For other types of systems, the effects may be more damaging.

Large amounts of power are required to cool data centres, which has led to a widespread recognition of the impact of virtualization on global warming. The size of this impact can be seen in a 2006 US EPA (Environmental Protection Agency) report. This stated that data centres accounted for 1.5 % of all US electricity consumption, and that the technology they used had to be improved if their rate of growth was to be sustained. For example, most data centres use *chillers*, which are elaborate water-based cooling systems, to maintain an appropriate temperature for the hardware. However, some companies, such as Google, have begun an initiative to avoid the use of chillers and to reduce power consumption by relying on innovative data centre design. One approach is to use only DC current in the centres, avoiding conversion losses from standard AC current. By using higher specification voltage regulator circuitry – circuits on the computer's motherboard providing the voltages required by the microchips – more power savings can be made. In fact, all server components are designed to have a property called *energy proportionality*, which ensures that they operate efficiently whether they are idle (not doing any active work), operating at lower usage levels, or at full capacity. By giving each server its own battery, Google avoids using *uninterruptible power supplies* (UPS), a term used for giant batteries which ensure that servers keep running if there is a power outage. These consume large amounts of energy. While Google has long been recognized as a leader in data centre energy efficiency, Yahoo is catching up. By 2014, Yahoo plans to have data centres which will be more energy efficient than those currently used by Google, according to a Yahoo corporate blog on 30th June 2009.

8.3 Extending skills

passives in dependent clauses • essay plans

A Find the words in the blue box in the text in Lesson 8.2.

1 What part of speech is each word?

2 Think of another word which could be used in place of the word in the text. Use your dictionary if necessary.

component reliability scale up
key environment
transactions widespread
impact chillers appropriate
initiative motherboard

B Study sentences A–D which relate to the text in Lesson 8.2.

1 Identify the dependent clause.

2 Copy the table under the sentences and write the parts of each dependent clause in the table.

3 Rewrite the sentence using an active construction.

Example:
Here is a list of questions which systems designers have to consider.

A Here is a list of questions which have to be considered by systems designers.

B Google has designed innovative systems in which power consumption is reduced.

C Energy costs are high when data centres are cooled by chillers.

D Amazon uses thousands of servers which are provided by a number of different manufacturers.

Subject	Verb	By whom/what
(questions) which	have to be considered	systems designers

C Read the essay plans and extracts on the opposite page.

1 Match each plan with an essay title in Lesson 8.2.

2 Which essay is each extract from?

3 Which part of the plan is each extract from?

D Work with a partner.

1 Write another paragraph for one of the plans.

2 Exchange paragraphs with another pair. Can they identify where it comes from?

8.4 Extending skills

writing complex sentences • writing essay plans • writing essays

A Make complete sentences from these notes. Add words as necessary.

A suggested – virtualization – answer – all key questions – systems designers – ask – systems hardware

B virtualization – provide answer – many – not all – questions– ask – systems designers

C ease – maintenance – ability – system – respond – change – among – questions – answered – virtualization

D addressing question – key task – determine – questions virtualization answers – whether questions – doesn't answer

E virtualization – process – physical hardware components – clustered – combined – create – virtual machine

F questions – virtualization not answer – concern specification – components – reliability – issues relating – energy consumption

B The sentences in Exercise A are topic sentences for paragraphs in essay B in Lesson 8.2. Put them in the best order for the essay. What is the main topic for each paragraph?

C Look at the essay question on the right.

1 What kind of essay is this?

2 Do some research and make a plan.

3 Write the essay.

See Skills bank

Essay question

Yahoo aims to overtake Google in energy efficiency in its data centres. Describe the steps that Yahoo will need to take in order to make this happen.

Essay plans

A

1 Introduction: importance of system efficiency; aims of essay.
2 Define system efficiency.
3 Some questions to be considered: hardware cost v. need for reliability, minimizing effect on environment.
4 Examples: Google using low-spec. PCs to minimize hardware cost, Amazon high-spec. to ensure data integrity. Economic implications in terms of transactions.
5 Conclusion: different company requirements will mean different answers to some of these questions.

B

1 Introduction: importance of energy saving; give essay aims.
2 Definition of virtualization.
3 Widespread recognition of the impact of virtualization on global warming: levels of energy use, clustering of hardware in data centres, use of chillers for cooling.
4 Innovative techniques to improve efficiency: use of batteries to replace UPS, higher-spec. components for energy saving, use of DC power as standard.
5 Increasing importance of global warming as political issue. Need for energy savings where possible.
6 Conclusion: without energy saving, likely limitations on growth of virtualization.

Essay extracts

1

It is important to acknowledge that there has been widespread recognition of the impact of virtualization on global warming. As a 2006 US EPA report pointed out, at the time, data centres were using 1.5% of the electricity produced in the United States. The report also recommended that the technology used by the data centres needed to be improved if their growth was to continue at the same pace. However, because virtualization requires large amounts of hardware to be clustered together, it would appear that some means of cooling is necessary. Currently, a high proportion of data centres use chillers – elaborate water-based cooling systems – to maintain an appropriate temperature for the hardware. The evidence suggests that these are not always required, as the example of Google has shown.

2

In considering these questions, it is worth looking at the way in which Google has minimized hardware costs by using low-cost PCs rather than 'out-of-the-box' servers. Because of the low revenue per search received by Google, it is essential that the cost of each transaction is kept as low as possible. The effect of a loss of data from component failure is relatively limited. At worst, it may mean that the user has to re-run a search.

Understanding new words: using definitions

You will often find new words in academic texts. Sometimes you will not be able to understand the text unless you look the word up in a dictionary, but often a technical term will be defined or explained immediately or later in the text.

Look for these indicators:

is or *are*	*'Virtualization' is basically about ...*
brackets	*... its data centre (server farms).*
or	*... most data centres use chillers, or water-based cooling systems, to ...*
which	*... 'out-of-the-box' servers, which are those purchased from manufacturers without modification ...*
a comma or a dash (–) immediately after the word or phrase	*... uninterruptible power supplies (UPS) – giant batteries which ...*
phrases such *as that is, in other words*	*... component load rates: that is, the work performed by each system component. In other words, how often the components ...*

Remember!

When you write assignments, you may want to define words yourself. Learn to use the methods above to give variety to your written work.

Understanding direction verbs in essay titles

Special verbs called **direction verbs** are used in essay titles. Each direction verb indicates a type of essay. You must understand the meaning of these words so you can choose the correct writing plan.

Kind of essay	Direction verbs
Descriptive	*State ... Say ... Outline ... Describe ... Summarize ... What is/are ...?*
Analytical	*Analyze ... Explain ... Comment on ... Examine ... Give reasons for ... Why ...? How ...?*
Comparison/ Evaluation	*Compare (and contrast) ... Distinguish between ... Evaluate ... What are the advantages and/or disadvantages of ...?*
Argument	*Discuss ... Consider ... (Critically) evaluate ... To what extent ...? How far ...?*