

CSGE602055 Operating Systems

CSF2600505 Sistem Operasi

Week 01: Overview 2, Virtualization & Scripting

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<https://os.vlsm.org/>

Always check for the latest revision!

REV238 13-Sep-2020

Operating Systems 2020-2 – (A, I, M) from HOME

A/M [Tu 10-12, ZOOM] — I [Tu 08-10, ZOOM]

Week	Schedule	Topic	OSC10
Week 00	15 Sep - 21 Sep 2020	Overview 1, Virtualization & Scripting	Ch. 1, 2, 18.
Week 01	22 Sep - 28 Sep 2020	Overview 2, Virtualization & Scripting	Ch. 1, 2, 18.
Week 02	29 Sep - 05 Oct 2020	Security, Protection, Privacy, & C-language	Ch. 16, 17
Week 03	06 Oct - 12 Oct 2020	File System & FUSE	Ch. 13, 14, 15
Week 04	13 Oct - 19 Oct 2020	Addressing, Shared Lib, & Pointer	Ch. 9
Week 05	20 Oct - 26 Oct 2020	Virtual Memory	Ch. 10
Week 06	27 Oct - 16 Nov 2020 29 Oct 2020	Concurrency: Processes & Threads Maulid Nabi	Ch. 3, 4
Week 07	17 Nov - 23 Nov 2020	Synchronization & Deadlock	Ch. 6, 7, 8
Week 08	24 Nov - 30 Nov 2020	Scheduling + W06/W07	Ch. 5
Week 09	01 Dec - 07 Dec 2020	Storage, Firmware, Bootldr, & Systemd	Ch. 11
Week 10	08 Dec - 16 Dec 2020	I/O & Programming	Ch. 12
	09 Dec 2020	Pil Kada	

STARTING POINT — <https://os.vlsm.org/>

- **Text Book** — Any recent/decent OS book. Eg. (**OSC10**) Silberschatz et. al.: **Operating System Concepts**, 10th Edition, 2018. See also <http://codex.cs.yale.edu/avi/os-book/OS10/>.
- **Resources**
 - **Extra Scele from Home** — <https://scele.cs.ui.ac.id/course/view.php?id=3020>.
 - **Download Slides and Demos from GitHub.com** <https://github.com/UI-FASILKOM-OS/SistemOperasi/>
 - **Problems** — <https://rms46.vlsm.org/2/>:
195.pdf (W00), 196.pdf (W01), 197.pdf (W02), 198.pdf (W03),
199.pdf (W04), 200.pdf (W05), 201.pdf (W06), 202.pdf (W07),
203.pdf (W08), 204.pdf (W09), 205.pdf (W10).
- **Build your own Virtual Guest**
<https://osp4diss.vlsm.org/>

Agenda

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- 7 Software Licenses
- 8 Potpourri
- 9 Scripting
- 10 Some Essential Commands

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13 sed

14 awk

15 Demo

16 Week 01: Summary

17 Week 01: Check List

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Week 01 Overview II: Topics¹

- Types of virtualization (including Hardware/Software, OS, Server, Service, Network)
- Paging and virtual memory
- Virtual file systems
- Hypervisors
- Portable and cost of virtualization; emulation vs. isolation
- Cloud services: IAAS, PAAS and Platform APIs, SAAS
- Introduction to Scripting and REGEX.

¹Source: ACM IEEE CS Curricula 2013

Week 01 Overview II: Learning Outcomes¹

- Explain the concept of virtual memory and how it is realized in hardware and software. [Familiarity]
- Discuss hypervisors and the need for them in conjunction with different types of hypervisors. [Usage]
- Differentiate emulation and isolation. [Familiarity]
- Evaluate virtualization trade-offs. [Assessment]
- Discuss the importance of elasticity and resource management in cloud computing. [Familiarity]
- Explain the advantages and disadvantages of using virtualized infrastructure. [Familiarity]

¹Source: ACM IEEE CS Curricula 2013

Week 01: Review 2 & Scripting

- Pengenalan Lisensi Perangkat Lunak Bebas:
<https://rms46.vlsm.org/1/70.pdf>
- The Minix3 Notes: <https://rms46.vlsm.org/2/166.pdf>
- Linux Help: <https://www.mediacollege.com/linux/>
- Intellectual Property Right (IPR)
- Operating System Services
- User Operating System Interface
- System Calls
- Types of System Calls
- System Programs
- Operating System Design and Implementation
- Operating System Structure

Intellectual Property Right (IPR)

- Rahasia Dagang (*Trade Sceret*) — UU no. 30/2000.
- Desain Industri (*Industrial Design*) — UU no. 31/2000.
- Desain Tata Letak Sirkuit Terpadu (*Integrated Circuit Layout Design*) — UU no. 32/2000.
- Paten (*Patent*) — UU no. 14/2001.
- Hak Cipta (*Copyright*) — UU no. 19/2002.
- Konsekuensi HKI
- HKI Perangkat Lunak
- Lisensi Perangkat Lunak: GNU GPL, EULA. Public Domain, Apache, Microsoft Public License.

Is this a Software Patent or Not?

The AV1 Video Codec

Timothy B. Terriberry

LINUX.CONF.AU
21-25 January
2019

EUROPEAN PATENT SPECIFICATION



(11)

EP 0 460 751 B1

Date of filing: 03.06.1991

**Method of transmitting audio
and/or video signals**

1

EP 0 460 751 B1

Description

The invention relates to a method of transmitting audio and/or video signals *via* some transmission medium. More particularly the transmission medium is constituted by an optically readable disc. However, the transmission medium may also be a magnetic tape or disc or a direct connection between a transmitter and a receiver. The invention also relates to the transmission medium on which the audio and/or video signals are recorded, to an encoding apparatus for transmitting the audio and/or video signals, and to a decoding apparatus for receiving these signals.

The Codec Mess



Courtesy of
Jonatan Samuelsson
Divideon
Co-founder and CEO

Alliance for Open Media



**ALLIANCE FOR
OPEN MEDIA**

FOUNDING MEMBERS

amazon

Apple

arm

CISCO

facebook

Google

IBM

intel

Microsoft

mozilla

NETFLIX

NVIDIA

PROMOTER MEMBERS

Adobe

Alibaba Group

ALLEGRO

AMD

Video

vimeo

Almlogic

ARGON DESIGN

Centame

BBC
R&D

优酷
Youku

XILINX

金山云

BITMOVIN

BROADCOM

CableLabs

优酷
Youku

Chips Media

gfycat

hulu

Ittiam

优酷
Youku

iQIYI 爱奇艺

INGCODEC

Polycom

REALTEK

socionext

V-SILICON

Ven Silicon

Vidyo

Source (per 18-Feb-19): <https://aomedia.org/membership/members/>

- Free Software Definition (FSF)

- ① The freedom to run the program as you wish, for any purpose (freedom 0).
- ① The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- ② The freedom to redistribute copies so you can help your neighbor (freedom 2).
- ③ The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

- Free Software vs. Open Source Software.

- Copyleft Software.

Software Licenses

- 3-clause BSD license and 2-clause BSD license (BSD-X-Clause)
- Apache License 2.0 (Apache-2.0)
- Artistic License 2.0 (ArtisticLicense2)
- Common Development and Distribution License (CDDL-1.0)
- Eclipse Public License (EPL-1.0)
- Educational Community License 2.0 (ECL2.0)
- Expat License (Expat) aka. MIT license (MIT)
- GNU Affero General Public License v3 (AGPL-3.0)
- GNU All-Permissive License (GNUAllPermissive)
- GNU General Public License (GPL)
- GNU Lesser General Public License (LGPL)
- Microsoft Public License (MS-PL)
- Mozilla Public License 2.0 (MPL-2.0)
- "Public Domain" (PublicDomain)
- X11 License (X11License)

- Mobile/Distributed/Client-Server/Peer-to-Peer Computing.
- Real-Time Computing: Hard Real-Time vs. Soft Real-Time.
- Operating System Comparison: Android, *BSD, GNU/Linux, iOS, Mac OS, Windows.
- Operating System Services: UI (GUI, CLI); Program Executing; I/O Operations; File Systems Manipulation; Communication; Error Detection; Resource Allocation; Accounting; Protection & Security.
- System Calls: Process Control; File Management; Device Management; Information Maintenance; Communications; Protection.
- Application Programming Interface (API)
- Standard C Library.
- System Programs.
- Microkernel System Structure.
- Loadable Kernel Modules.
- Virtualization and Cloud System.

- Readings (do Google!)
 - Machtelt Garrels: Bash Guide for Beginners.
 - Mendel Cooper: An in-depth exploration of the art of shell scripting — Advanced Bash-Scripting Guide.
 - Jan Goyvaerts: Regular Expressions — The Complete Tutorial.
- The ATM Way (Amati, Tiru, Modifikasi)¹.
 - *Clone Demo*
<https://github.com/UI-FASILKOM-OS/SistemOperasi.git>
 - **GSGS** — **ATM**: Google Sana, Google Sini: Amati, Tiru, Modifikasi!
 - Medium: badak.cs.ui.ac.id
 - Opsi: BYOD, WSL (Windows 10), CYGWIN.
 - Belajar **login** dan **logout** dengan ssh atau putty².
 - Belajar editor yang bagus punya buatan (**vi**).
- Belajar beberapa perintah **Command-Line Interface (CLI)**.
 - shell (Bash)
 - basic CLI: cat, cd, cp, ls, man, more, mv, rm, touch, wc.
 - vi, sed, awk, git.

¹Romi Satria Wahono sudah menggunakan istilah ini sejak tahun 2007 (Google).

²Sesuai dengan keyakinan dan kepercayaan masing-masing.

- Linux Resources:
<http://www.mediacollege.com/linux/>
- Tutorial:
<https://www.mediacollege.com/linux/command-tutorial/>
- Commands:
<https://www.mediacollege.com/linux/command/linux-command.html>
- Shell:
<https://www.mediacollege.com/linux/command/shell-command.html>
- Regular Expression (REGEX):
- REGEX Tester:
<https://regex101.com/>

Some Essential Command Line Commands part 1

man	manual. Eg. "man man"
passwd	changes passwords.
ls	list directory contents. Eg. "ls -al"
cd	change the working directory. Eg. "cd /tmp"
cp	copy file(s). Eg. "cp SOURCE DEST"
rm	remove file(s). Eg. "rm AFILE"
mv	move files(s). Eg. "mv FROMFILE TOFILE"
mkdir	make directories(s). Eg. "mkdir ADIRECTORY"
rmdir	remove directories(s). Eg. "rmdir ADIRECTORY"
cat	read file(s) Eg. "cat AFILE"
more	read file(s) per screen Eg. "more AFILE"
ln	make a link of a file. Eg. "ln -s file sfile"
grep	search string aword inside file. Eg. "grep aword file"
sort	sort lines of text files. Eg. "sort file1.txt"
top	display systems task. Eg. "top"
find	Eg. "find / -name minix3.iso -print". Find from "/".

Some Essential Command Line Commands part 2

chmod	Eg. "chmod 755 file". Change file with access mode 755.
chown	Eg. "chown user file". Change owner file to user.
chgrp	Eg. "chgrp other file". Change group file to other.
tar	tape archive file. Eg. "tar cf /tmp/tfile.tar dir/". Archive "dir/" into tfile.tar. "tar tf /tmp/tfile.tar". List tfile.tar. "tar xf /tmp/tfile.tar". Extract tfile.tar.
date	print or set the system date and time. Eg. "date +%Y"
tee	read from standard input and write to standard output and files. Eg. "ls -al tee listing.txt"
diff	compare files line by line. Eg. "diff file1.txt file2.txt"
wc	print newline, word, and byte counts for each file. Eg. "wc file.txt"

Regex: Regular Expressions

- to search patterns
- BRE (Basic Regular Expression) vs ERE (Extended Regular Expression)
- Flavors: Grep, Java, JavaScript, PHP, POSIX, Python, sed, XML, . . .

More Regex (1)

- `<<^$>>` — matches a beginning-of-line + end-of-line (empty line).
 - `<<^>>` — matches a beginning-of-line (meaningless).
 - `<<^hello$>>` — matches just "hello" in a line.
- `<<.>>` — matches any character.
 - `<<hell.>>` — matches "hellA", "hella", "hellB", "hellb", ...
- `<<[AB]>>` — matches "A" or "B" only.
 - `<<[0-3]>>` — matches "0", "1", "2", or "3" only.
 - `<<[^4-9]>>` — not match "4", "5", "6", "7", "8", or "9".
- `<<?>>` — matches preceding zero or one time.
 - `<<a?b>>` — matches "b" or "ab" only.
- `<<*>>` — matches preceding zero or more times.
 - `<<a*b>>` — matches "b" or "ab" or "aab" or ...
 - `<<A.*Z>>` — matches "AZ" or "AaZ" or "AabZ" or ...
- `<<+>>` — matches preceding one or more times.
 - `<<a+b>>` — matches "ab", "aab", "aaab", ...
- `<<{ }>>` — matches numbers in `{ }`.
 - `<<a{2}>>` — matches "aa".
 - `<<a{2,5}>>` — matches "aa", "aaa", "aaaa", and "aaaaa".
 - `<<a{2,}>>` — matches "aa", "aaa", "aaaa", "aaaaa", ...

More Regex (2)

- `<<\>>` — escape character.
- `<<\0>>` — NULL.
- `<<\b>>` — word boundary.
- `<<\B>>` — non-word boundary.
- `<<\d>>` — any digit. Eg. `<<\d{1,3}>>` = 0 - 999.
- `<<\D>>` — any non-digit.
- `<<\n>>` — new line.
- `<<\t>>` — tab.
- `<<\s>>` — white space character.
- `<<\S>>` — non white space character.

More Regex (3)

- `<<(...)>>` — group.
 - `<<(?: ...)>>` — pasive group.
 - `<<(regex)|(regex)>>` — matches left regex or right regex.
 - `<<(a|b)>>` — matches either a or b.
 - `<<^(From|To):>>` — matches either `<<^From:>>` or `<<^To:>>`.
- `<<[0-9]{10}>>` — 10 digits.
- `<<0[0-9]|1[0-9]|2[0-3]):[0-5][0-9]>>` — 00:00–23:59.
- `<<([0-9]|0[0-9]|1[0-9]|2[0-3]):[0-5][0-9]>>` — (0)0:00–23:59.

More Regex (4)

- `<<[:alnum:]>>` — alpha-numerics.
- `<<[:alpha:]>>` — alphabets
- `<<[:blank:]>>` — spaces and tabs.
- `<<[:digit:]>>` — digits.
- `<<[:lower:]>>` — lower case.
- `<<[:space:]>>` — spaces.
- `<<[:upper:]>>` — upper case.
- `<<[:xdigit:]>>` — hexadecimal digits.
- `<<[:punct:]>>` — punctuation.
- `<<[:cntrl:]>>` — control characters.
- `<<[:graph:]>>` — printed characters.
- `<<[:print:]>>` — printed and spaces.
- `<<[:word:]>>` — alpha-numerics and underscore.

Regex101.com: IPv4 Address

`\b(?: (?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?) \.) {3} (?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?) \b`

▼ / `\b(?: (?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?) \.) {3} (?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?) \b` / gm

`\b` assert position at a word boundary: `(^ | \w | \w : $ | \w : \w | \w \w)`

▼ Non-capturing group `(?: (?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?) \.) {3}`

`{3}` Quantifier — Matches exactly 3 times

▼ Non-capturing group `(?: 25 [0-5] | 2 [0-4] \d | [01] ? \d \d ?)`

▼ 1st Alternative `25 [0-5]`

25 matches the characters 25 literally (case sensitive)

▼ Match a single character present in the list below `[0-5]`

0-5 a single character in the range between 0 (index 48) and 5 (index 53) (case sensitive)

▼ 2nd Alternative `2 [0-4] \d`

2 matches the character 2 literally (case sensitive)

▼ Match a single character present in the list below `[0-4]`

0-4 a single character in the range between 0 (index 48) and 4 (index 52) (case sensitive)

`\d` matches a digit (equal to `[0-9]`)

▼ 3rd Alternative `[01] ? \d \d ?`

▼ Match a single character present in the list below `[01] ?`

`?` Quantifier — Matches between zero and one times, as many times as possible, giving back as needed (greedy)

01 matches a single character in the list 01 (case sensitive)

`\d` matches a digit (equal to `[0-9]`)

▶ `\d ?` matches a digit (equal to `[0-9]`)

`\.` matches the character . literally (case sensitive)

```
\b(?: (?:25[0-5] | 2[0-4]\d | [01]?\d\d?)\.){3}  
(?:25[0-5] | 2[0-4]\d | [01]?\d\d?)\b
```

▼ Non-capturing group `(?:25[0-5] | 2[0-4]\d | [01]?\d\d?)`

▼ 1st Alternative `25[0-5]`

25 matches the characters 25 literally (case sensitive)

▼ Match a single character present in the list below `[0-5]`

0-5 a single character in the range between 0 (index 48) and 5 (index 53) (case sensitive)

▼ 2nd Alternative `2[0-4]\d`

2 matches the character 2 literally (case sensitive)

▼ Match a single character present in the list below `[0-4]`

0-4 a single character in the range between 0 (index 48) and 4 (index 52) (case sensitive)

`\d` matches a digit (equal to `[0-9]`)

▼ 3rd Alternative `[01]?\d\d?`

▼ Match a single character present in the list below `[01]?`

? Quantifier — Matches between zero and one times, as many times as possible, giving back as needed (greedy)

01 matches a single character in the list 01 (case sensitive)

`\d` matches a digit (equal to `[0-9]`)

▼ `\d?` matches a digit (equal to `[0-9]`)

? Quantifier — Matches between zero and one times, as many times as possible, giving back as needed (greedy)

`\b` assert position at a word boundary: `(?:\W|\w|$|\W|\w|\W|\w)`

▼ Global pattern flags

g modifier: global. All matches (don't return after first match)

m modifier: multi line. Causes ^ and \$ to match the begin/end of each line (not only begin/end of string)

The "vi" editor

Basics		More Commands	
i	insert mode	d^	delete from ^ (beginning) to the cursor
a	append mode	d\$	delete from the cursor to \$ (end)
<ESC>	escape mode	dd	delete the whole line
q!	quit	5dd	delete 5 lines
wq!	write and quit	yy	yank (copy) the line
ZZ	write and quit	p	put (paste) the line
h j k l	move [left, down, up, right]	J	join current and next line
r	replace a character	:r file.txt	read (insert) file.txt
d	delete a character	:w! file.txt	write into file.txt
u	undo	:1,8 w! file.txt	write line 1 to 8 into file.txt

sed — the stream editor

- `sed 'G' file.txt` — double space.
- `sed 'G;G' file.txt` — triple space.
- `sed -n '4,6p' file.txt` — show only line 4 to 6.
- `sed -n '4,6p' file.txt > newfile.txt` — write line 4 to 6 to newfile.txt.
- `sed '/[0-9]\{2\}/p' file.txt` — show only lines with two digits.
- `sed '4,6d' file.txt` — show all except line 4 to 6.
- `sed '$d' file.txt` — show all except last line.
- `sed '5,/HABATS/d'` — show all except from line 5 to a line with HABATS.
- `sed 's/Joko/Bowo/' file.txt` — replace Joko with Bowo.
- `sed 's/Joko/Bowo/2' file.txt` — replace the second Joko with Bowo.
- `sed 's/Joko/Bowo/g' file.txt` — replace every Joko with Bowo.
- `sed 's/Bowo|bowo/Joko/g' file.txt` — replace every Bowo or bowo with Joko.

- `awk '{print "Hello awk!"}' file.txt` — print "Hello awk!" for every file.txt line.
- `awk '{print $0}' file.txt` — print every file.txt line.
- `awk '{print $1}' file.txt` — print first field of every file.txt line.
- `awk '{print $2}' file.txt` — print second field of every file.txt line.

Login into BADAk.cs.ui.ac.id

```
demo@badak:~$ PS1=">>>> $ "
```

```
>>>> $ git clone https://github.com/UI-FASILKOM-OS/SistemOperasi.git
Cloning into 'SistemOperasi'...
remote: Enumerating objects: 51, done.
remote: Counting objects: 100% (51/51), done.
remote: Compressing objects: 100% (23/23), done.
remote: Total 972 (delta 29), reused 34 (delta 27), pack-reused 921
Receiving objects: 100% (972/972), 24.63 MiB | 4.65 MiB/s, done.
Resolving deltas: 100% (637/637), done.
```

```
>>>> $ ls -F SistemOperasi/
CNAME _config.yml demos/ LICENSE OLDREADME.md pdf/ README.md
```

```
>>>> $ ls -al SistemOperasi/demos/
total 56
drwxr-xr-x 14 demo demo 4096 Jan 16 14:24 .
drwxr-xr-x  5 demo demo 4096 Jan 16 14:24 ..
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week00
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week01
drwxr-xr-x  4 demo demo 4096 Jan 16 14:24 Week02
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week03
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week04
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week05
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week06
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week07
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week08
drwxr-xr-x  4 demo demo 4096 Jan 16 14:24 Week09
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 Week10
drwxr-xr-x  2 demo demo 4096 Jan 16 14:24 WeekTMP
>>>> $
```

Inside the "week01-scripting" folder

```
>>>> $ pwd
/home/demo/mydemo/W01-demos

>>>> $ ls -al
total 96
drwxr-xr-x  2 demo demo 4096 Jan 23 18:38 .
drwx----- 14 demo demo 4096 Jan 23 18:38 ..
-rw-r--r--  1 demo demo 1797 Jan 23 18:38 1-READ-THIS-FIRST.txt
-rw-r--r--  1 demo demo 4880 Jan 23 18:38 a01-READ-ME
-rw-r--r--  1 demo demo 5644 Jan 23 18:38 a02-sort-n-prepare
-rw-r--r--  1 demo demo 4644 Jan 23 18:38 a03-command-lines-demo
-rw-r--r--  1 demo demo 1193 Jan 23 18:38 a04-does-it-exist
-rw-r--r--  1 demo demo 1204 Jan 23 18:38 a05-finding-EXIST
-rw-r--r--  1 demo demo 1114 Jan 23 18:38 a06-loop
-rw-r--r--  1 demo demo 1518 Jan 23 18:38 a07-tester
-rw-r--r--  1 demo demo 1577 Jan 23 18:38 a08-append-a-file
-rw-r--r--  1 demo demo 1168 Jan 23 18:38 a09-add-numbers
-rw-r--r--  1 demo demo 1569 Jan 23 18:38 a10-mysha1
-rw-r--r--  1 demo demo 2271 Jan 23 18:38 a11-banding
-rw-r--r--  1 demo demo 2110 Jan 23 18:38 a12-fixfs
-rw-r--r--  1 demo demo 1576 Jan 23 18:38 a13-last
-rw-r--r--  1 demo demo  752 Jan 23 18:38 a14-absen
-rw-r--r--  1 demo demo 1187 Jan 23 18:38 a15-uts171
-rw-r--r--  1 demo demo  522 Jan 23 18:38 a16-uts181
-rw-r--r--  1 demo demo  536 Jan 23 18:38 a17-uts182
-rw-r--r--  1 demo demo  404 Jan 23 18:38 .head
>>>> $
```

Demo Files(1)

- 000-READ-THIS-FIRST.txt
- a01-SCREEN-CHECK: if the screen is at least 80 x 23.
- a02-sort-n-prepare: folder sorting; preparing and deleting folders.
- a03-command-lines-demo: CLI demo.
- a04-does-it-exist
- a05-finding-EXIST
- a06-loop
- a07-tester
- a08-append-a-file
- a09-add-numbers
- a10-mysha1

Demo Files(2)

- a11-banding
- a12-fixfs
- a13-last
- a14-absen
- a15-uts171
- a16-uts181
- a17-uts182
- a18-uts191
- a19-uts192
- a20-uts201

- Reference: (OSC10 chapter 1 + chapter 2 + chapter 18)

- ☐ **How to improve this document?**

The End

- ☐ This is the end of the presentation.
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