10.1 Configure Power Supply, Motherboard and System Devices, BIOS Settings, Input/Output Devices, UPS

A. Power Supply Unit (PSU)

- **Definition:** Converts AC (alternating current from wall outlet) to DC (direct current) required by computer components.
- **Key specifications:**
  - **Wattage (e.g., 500W, 750W):** Total power capacity
  - **Efficiency rating (80 Plus Bronze, Gold, Platinum):** How much power is wasted as heat
  - **Form factors:** ATX (most common), SFX (small form factor)

Connector Type	Purpose
24-pin ATX	Main motherboard power
4/8-pin EPS/CPU	CPU power
6/8-pin PCIe	Graphics card power
SATA power	Hard drives, SSDs, optical drives
Molex (4-pin)	Older drives, fans

Troubleshooting PSU:

- Computer won't turn on → Check power cable, switch on PSU, test with another PSU.
- Random shutdowns/restarts → PSU may be failing or underpowered.

B. Motherboard

- **Definition:** Main circuit board connecting all computer components (CPU, RAM, storage, expansion cards, peripherals).
- **Key components on motherboard:**

Component	Function
CPU socket	Holds the processor
RAM slots (DIMM)	Holds memory modules
Chipset (Northbridge/Southbridge)	Manages data between CPU, RAM, and peripherals
Expansion slots (PCIe, PCI)	For graphics cards, network cards, etc.

Component	Function
Storage connectors (SATA, M.2)	Connect hard drives, SSDs
CMOS battery	Powers BIOS memory when computer is off
I/O ports (rear panel)	USB, Ethernet, audio, video, etc.
Power connectors (24-pin, 4/8-pin)	From PSU

Form factors: ATX (full-size), Micro-ATX, Mini-ITX (small)

C. BIOS / UEFI (Basic Input/Output System)

- **Definition:** Firmware stored on a chip on the motherboard that initializes hardware and boots the operating system.
- **Modern version:** UEFI (Unified Extensible Firmware Interface) – replaces legacy BIOS.

How to access BIOS/UEFI: Press **Del, F2, F10, F12, or Esc** during startup (varies by manufacturer).

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Common BIOS settings (Exam Focus):

Setting	Purpose
Boot Order	Which device to boot from first (USB, DVD, hard drive)
Date and Time	System clock (when OS is not running)
CPU settings	Clock speed, virtualization (VT-x/AMD-V), core management
Memory (RAM) settings	Speed (XMP/DOCP), timings
Storage configuration	SATA mode (AHCI, RAID, IDE)
Secure Boot	Prevents unauthorized OS/bootloaders
TPM (Trusted Platform Module)	Hardware security for encryption (required for Windows 11)
Fan control	Speed profiles for cooling
Power management	Wake-on-LAN, sleep states
Reset to defaults	Load optimized/default settings
Update BIOS	Flash new firmware version

When to change BIOS settings:

- Installing OS from USB (change boot order)
- Enabling virtualization (for VMs)
- Troubleshooting boot problems (reset to defaults)

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D. Input Devices (Peripherals that send data to computer)

Device	Connection Types	Common Issues
Keyboard	USB, PS/2, wireless (Bluetooth/2.4GHz)	Keys not working, lag, not detected
Mouse	USB, PS/2, wireless	Cursor jumps, double-clicks, no movement
Scanner	USB, network	Not detected, poor scan quality, driver issues
Microphone	3.5mm jack, USB, Bluetooth	No sound, low volume
Webcam	USB	No image, driver issues

E. Output Devices (Peripherals that receive data from computer)

Device	Connection Types	Common Issues
Monitor	VGA, DVI, HDMI, DisplayPort, USB-C	No display, flickering, wrong resolution
Printer	USB, network (Ethernet/Wi-Fi)	Not printing, paper jam, offline
Speaker	3.5mm jack, USB, Bluetooth, HDMI	No sound, distorted audio, one channel only
Headphons	3.5mm jack, USB, Bluetooth	No sound, microphone not working

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F. UPS (Uninterruptible Power Supply)

- **Definition:** A device that provides **emergency backup power** when mains power fails. Also conditions power (surge protection, voltage regulation).
- **Types of UPS:**

Type	Description	Best for
Standby (Offline)	Switches to battery when power fails; small delay	Home, basic office
Line-interactive	Regulates voltage without switching to battery; faster response	Small business, servers
Online (Double-conversion)	Always runs on battery (AC → DC → AC); zero transfer time	Data centers, critical equipment

Key UPS specifications:

Term	Meaning
VA (Volt-Ampere) / Watt rating	How much load it can support
Runtime	How long it can power devices (minutes)
Transfer time	Time to switch to battery (measured in milliseconds)
Surge protection	Protects against voltage spikes
AVR (Automatic Voltage Regulation)	Corrects brownouts/overvoltages without battery

Troubleshooting UPS:

- UPS beeping continuously → Battery low or overloaded.
- No backup power → Battery dead (replace every 3-5 years).
- Computer shuts down immediately on power loss → UPS too small or battery worn.

10.2 Types and Features of Display Devices
Comparison Table (CRT, LCD, LED, Plasma)

Feature	CRT	LCD	LED	Plasma
Full form	Cathode Ray Tube	Liquid Crystal Display	Light Emitting Diode	(Gas plasma cells)
Technology	Electron beam hits phosphor	Liquid crystals block/allow backlight	LEDs as backlight (or per pixel)	Gas cells emit UV light
Thickness	Very thick (large rear)	Thin	Very thin (very thin)	Thin
Weight	Very heavy	Light	Light	Medium-heavy
Power consumption	Very high	Moderate	Low	High
Image quality	Good contrast, deep blacks	Good, but poorer blacks	Excellent, deep blacks	Excellent, vibrant colors
Viewing angle	Excellent (up to 180°)	Narrow (off-angle colors wash out)	Wide (especially IPS panels)	Excellent
Response time	Very fast	Slower (motion blur)	Very fast	Very fast
Burn-in risk	Yes (static images)	No	Minimal (OLED only)	Yes
Lifespan	Moderate	Long	Longest	Moderate
Current status	Obsolete (rare)	Still used (budget)	Most common (LED-backlit LCD)	Discontinued (2014+)

Important note for exam: Most "LED monitors" today are actually **LED-backlit LCD** monitors (not true per-pixel LED like OLED). True OLED (Organic LED) is premium.

Display connectors (what they carry):

Connector	Video	Audio	Max Resolution
VGA (analog)	Yes	No	1920x1080 (limited)
DVI (digital)	Yes	No	2560x1600
HDMI	Yes	Yes	4K, 8K
DisplayPort	Yes	Yes	8K+

10.3 Connector Types (BNC, RJ45, HDMI) and Associated Cables

A. BNC (Bayonet Neill–Concelman)

Feature	Detail
Used with	Coaxial cable (RG-58, RG-59)
Connection type	Bayonet (push and twist)
Primary use	Older networks (10BASE2 - Thinnet), analog video (CCTV), test equipment
Speed	Up to 10 Mbps (network)
Current status	Mostly obsolete for networking; still used in some CCTV and RF applications

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B. RJ45 (Registered Jack 45)

Feature	Detail
Used with	Twisted pair cable (UTP/STP) - Cat5, Cat5e, Cat6, Cat6a, Cat7
Connection type	Modular plug (latching clip)
Primary use	Ethernet networking (10/100/1000 Mbps to 10 Gbps)
Wiring standards	T568A and T568B (straight-through vs crossover)
Most common in:	Office LANs, home networks, government buildings

C. HDMI (High-Definition Multimedia Interface)

Feature	Detail
Used with	HDMI cable (19 pins, shielded)
Connection type	Push-in (friction fit, no latch)
Primary use	Audio + video from computer to monitor/TV/projector
Versions:	1.4 (1080p/4K 30Hz), 2.0 (4K 60Hz), 2.1 (8K 60Hz, 4K 120Hz)
Carries:	Digital video, digital audio, Ethernet (some versions), CEC (control)

D. Other Connectors (For comparison/knowledge)

Connector	Used with	Primary use
VGA (DE-15)	VGA cable (analog)	Older monitors/projectors
DVI (Digital Visual Interface)	DVI cable	Digital monitors (pre-HDMI)
DisplayPort	DisplayPort cable	Modern monitors (competes with HDMI)

Connector	Used with	Primary use
USB Type-A	USB cable	Peripherals, storage, some displays
USB Type-C	USB-C cable	Modern laptops, docks, displays (can carry DisplayPort/HDMI alt mode)
3.5mm audio jack	Audio cable	Headphones, speakers, microphone
PS/2	PS/2 cable (round, 6-pin)	Old keyboards/mice (obsolete)
Lightning	Lightning cable	Apple devices (iPhones, iPads before USB-C)

10.4 Troubleshooting of Computer and Its Peripherals

A. General Troubleshooting Approach (Systematic Method)

1. **Identify the problem** (What exactly is wrong?)
2. **Check simple things first** (Power? Cables? Restarted?)
3. **Isolate the cause** (Swap with known-good part)
4. **Fix or replace** (Update driver, replace cable, swap device)
5. **Test to confirm** (Problem gone? No new problems?)

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B. Computer (Desktop/Laptop) Troubleshooting

Symptom	Possible Causes	Solutions
Won't power on (no lights, no fan)	Power cable unplugged, PSU switch off, dead PSU, dead motherboard	Check outlet, check PSU switch, test with known-good PSU
Turns on but no display	Loose monitor cable, bad GPU, RAM issue, motherboard issue	Reseat RAM, check cable, test with different monitor
Beeps on startup	POST error codes (hardware failure)	Count beeps → consult motherboard manual (e.g., 3 beeps = RAM problem)
Slow performance	Too many programs, low RAM, malware, failing hard drive	Close programs, scan for malware, upgrade RAM, check disk health
Random shutdowns / restarts	Overheating, failing PSU, driver crash	Clean fans, monitor CPU temp, test PSU
Blue Screen of Death (BSOD)	Driver error, RAM corruption, hard drive failure, Windows corruption	Note error code, run memory test, check disk, update drivers
Peripheral not detected	Driver missing, bad USB port, device faulty	Check Device Manager, try different port, reinstall driver

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C. Keyboard Troubleshooting

Symptom	Solutions
Some keys not working	Clean under keys (dust/crumbs), replace keyboard if liquid damage
All keys not working	Check connection (USB/PS2/wireless), try different port, restart computer
Typing wrong characters	Check language/keyboard layout (US vs UK vs Devanagari), NumLock on?
Sticky or slow keys	Clean with compressed air, enable/disable Filter Keys in Windows

D. Mouse Troubleshooting

Symptom	Solutions
Cursor doesn't move	Check connection, clean sensor (optical), try different surface, replace batteries
Cursor jumps erratically	Clean sensor, use mousepad, check for hair/dust in sensor
Double-click instead of single-click	Switch double-click speed in settings, replace mouse (switch worn out)
Scroll wheel not working	Clean around wheel, replace mouse

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E. Printer Troubleshooting

Symptom	Solutions
Doesn't print	Check power, check USB/network connection, check paper, check ink/toner, clear print queue, set as default printer
Paper jam	Gently remove paper (follow printer guide), check for torn pieces
Poor print quality (streaks, faded)	Run head cleaning (inkjet), replace toner cartridge (laser), align print heads
Printer offline	Check "Use Printer Offline" setting (Windows), restart print spooler service, check network
Spooler error	Restart Print Spooler service (services.msc), clear C:\Windows\System32\spool\PRINTERS

F. Scanner Troubleshooting

Symptom	Solutions
Not detected	Check USB, reinstall driver, try different software (Windows Scan app)
Scanned image has lines	Clean scanner glass (dust/smudges), replace lamp (old scanners)
Scanned image is blank	Document placed wrong side (facing glass), scanner lamp failed
Scan takes very long	Lower DPI setting, close other programs, check USB speed

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G. Speaker Troubleshooting

Symptom	Solutions
No sound	Check volume (hardware and Windows), check mute, check speaker power, check audio output device (HDMI vs speakers)
Sound distorted	Lower volume, check speaker connections, test with headphones to isolate (sound card vs speakers)
Only one channel works	Check balance settings, check cable (partially broken), speaker itself failed
Crackling / popping	Loose cable, interference (keep audio cable away from power cables), driver issue

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10.5 Troubleshooting of Connectivity (Cables, Network, etc.)

A. Cable Troubleshooting

Symptom	Possible Cause	Solution
No network connection	Cable unplugged, bad cable, wrong port	Check LED on NIC/switch, try different cable
Intermittent connection	Damaged cable (bent, crushed), loose connector	Replace cable, re-terminate connector
Link light on but no data	Wrong cable type (crossover vs straight-through)	Use correct cable (auto-MDI/X on modern switches may fix)
Slow network	Bad cable causing CRC errors, long cable length (>100m for UTP)	Test cable, replace, add repeater/switch

B. Network Troubleshooting (Beyond cable)

Symptom	Command/Tool	Solution
No internet	ping 8.8.8.8	If fails → check gateway, router, ISP
Can ping IP but not name	nslookup google.com	DNS problem (check DNS server)
High latency	tracert google.com	Find slow hop, contact ISP or network admin
IP address 169.254.x.x	ipconfig	DHCP failed (computer assigned APIPA) → run ipconfig /renew
Duplicate IP address	ping + ARP	Conflict error → release/renew or set static IP carefully
Wi-Fi connected but no internet	Check default gateway, DNS	Restart router, check ISP status

C. Connectivity Troubleshooting Steps (Logical Order)

1. **Check physical layer:** Cables connected? Link lights on?
2. **Check IP configuration:** ipconfig (do you have a valid IP?)
3. **Ping localhost:** ping 127.0.0.1 (TCP/IP stack working?)
4. **Ping default gateway:** Can you reach your router?
5. **Ping external IP:** ping 8.8.8.8 (internet reachable?)
6. **Ping external name:** ping google.com (DNS working?)
7. **Trace route:** tracert to find where it fails.

10.6 Installation and Troubleshooting of Operating Systems (Windows, Linux)

A. Operating System Installation (General Steps)

1. **Prepare bootable media:** USB drive (8GB+) or DVD with OS installer.
2. **Back up data** (if existing OS).
3. **Enter BIOS/UEFI** → Set boot order to USB/DVD first.
4. **Boot from media** → Start installer.
5. **Partition disk:** Create/delete partitions, format (NTFS for Windows, ext4 for Linux).
6. **Install OS:** Copy files, configure settings (region, keyboard, user account).
7. **Install drivers** (especially network, graphics, chipset).
8. **Install updates** (Windows Update, apt update for Linux).
9. **Install applications.**

B. Windows Installation Types

Type	Description
Clean install	Format drive, fresh OS (removes everything)
Upgrade	Keep files and apps (Windows 10 → 11)
Dual boot	Two OS on same computer (Windows + Linux)

C. Troubleshooting OS Problems

Windows-Specific Issues

Symptom	Solutions
Won't boot (black screen)	Try Safe Mode (F8), Startup Repair, System Restore, Bootrec commands
Boot loop	Advanced Startup → Safe Mode → Uninstall recent updates/drivers
DLL missing error	Run [redacted] (System File Checker), reinstall application
Registry error	System Restore, last known good configuration
Windows Update stuck	Run Windows Update Troubleshooter, stop Windows Update service, clear [redacted]
Blue Screen (BSOD)	Note stop code (e.g., [redacted]), update drivers, run memory test

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Important Windows recovery commands (run from Command Prompt in recovery environment):

Command	Purpose
sfc /scannow	Scans and repairs system files
chkdsk C: /f /r	Checks disk for errors and bad sectors
bootrec /fixmbr	Repairs Master Boot Record
bootrec /fixboot	Repairs boot sector
bootrec /rebuildbcd	Rebuilds Boot Configuration Data
dism /online /cleanup-image /restorehealth	Repairs Windows image

Linux-Specific Issues

Symptom	Solutions
Won't boot (grub rescue)	Reinstall GRUB: grub-install, update-grub
Forgot root password	Boot into single-user/recovery mode, passwd command
Package manager errors	sudo apt update, sudo apt --fix-broken install (Debian/Ubuntu)
Permission denied	Use sudo, check file ownership (chown), check permissions (chmod)
Service not starting	systemctl status servicename, journalctl -xe to see logs

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10.7 Installation of Device Drivers, Configuration and Installation of Application Programs and System Restore

A. Device Drivers

- **Definition:** Software that allows the operating system to communicate with hardware devices.
- **Why needed:** OS does not natively know how to control every printer, graphics card, or network adapter.

Types of drivers:

Driver	For
Chipset driver	Motherboard (USB, PCIe, SATA controllers)
Graphics driver	GPU (NVIDIA, AMD, Intel)
Network driver	Ethernet, Wi-Fi
Audio driver	Sound card, onboard audio
Printer/scanner driver	Specific models
Storage driver	RAID controllers, NVMe

Where to get drivers:

1. Manufacturer's website (best source – e.g., Dell, HP, Lenovo)
2. Component manufacturer (Intel, NVIDIA, Realtek)
3. Windows Update (basic drivers)
4. **Avoid:** "Driver updater" software (often malware or unnecessary)

Driver installation methods:

Method	Description
Automatic (Windows Update)	Windows finds and installs basic drivers
Installer (.exe/.msi)	Run setup from manufacturer
Manual (INF file)	Update Driver → Browse → Select INF file
Device Manager	Right-click device → Update driver

Troubleshooting drivers:

Symptom	Solution
Device has yellow exclamation in Device Manager	Driver missing or corrupted → reinstall driver
New driver causes problems	Roll back driver (Device Manager → Properties → Driver → Roll Back)
After hardware change, device not working	Uninstall old driver, install new one

B. Configuration and Installation of Application Programs

Installation methods:

Method	Example	Notes
Executable installer	setup.exe, install.msi	Most common (Windows)
Package manager	apt install, yum install	Linux
App store	Microsoft Store, Mac App Store	Sandboxed, auto-update
Portable	.exe that runs without install	No registry changes
Script/archive	Extract ZIP, run script	For developers

Installation best practices:

- Download from **official sources only** (avoid malware).
- **Custom install** (not "Express") → remove unwanted bundled software.
- Check **system requirements** before installing.
- **Close other programs** during installation.
- **Restart** if prompted.

Application troubleshooting:

Symptom	Solution
Won't install	Run as administrator, disable antivirus temporarily, free disk space
Crash on launch	Reinstall, update, check for missing DLLs (install Visual C++ runtimes)
Program not responding	End task (Task Manager), restart program
Settings resetting	Check permissions on config files, run as admin

C. System Restore (Windows Feature)

- **Definition:** A recovery tool that **reverts system files, registry settings, and installed programs** to a previous state without affecting personal files (documents, photos, email).
- **Requires:** System Restore must be enabled, and restore points must exist.

How it works:

1. Windows automatically creates restore points before major changes (driver installs, Windows updates, software installs).
2. User can manually create a restore point.
3. If problem occurs, restore to a point **before** the problem started.

Steps to perform System Restore:

1. Control Panel → Recovery → Open System Restore
2. Or type [redacted] in Run (Win+R)
3. Choose a restore point (date/time)
4. Confirm and restart (undoes changes since that point)

What System Restore does NOT affect:

- Personal files (documents, photos, videos, emails)
- User passwords

When to use System Restore:

- After installing a bad driver
- After software caused system instability
- Before uninstalling something that might break system

Limitations:

- Does not protect against hard drive failure or malware that infects personal files.
- Restore points can be deleted (disk space limits).

Alternative (stronger) recovery options:

Tool	What it does
Reset this PC (Windows)	Reinstalls Windows while keeping or removing personal files
System Image Backup	Complete snapshot of entire drive (requires external drive)
Backup and Restore (Windows 7)	Old tool; still available for file backups

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10.8 Data Backup: Concept and Methods

A. What is Data Backup?

- **Definition:** The process of **copying data** from a primary location (computer, server) to a **secondary location** (external drive, cloud, tape) to protect against data loss.

B. Why Backup? (Common causes of data loss)

Cause	Example
Hardware failure	Hard drive crash, SSD failure
Accidental deletion	User deletes wrong file or folder
Malware/Ransomware	Files encrypted or deleted
Natural disaster	Fire, flood, earthquake
Theft	Laptop or desktop stolen
Software corruption	OS or application corrupts data
Power surge	Destroys storage device

C. Backup Methods

Method	Description	Speed	Best for
Full backup	Copies all selected data every time	Slowest, largest	Weekly or monthly backup
Incremental backup	Copies only data changed since **last backup (any type)**	Fastest, smallest	Daily backup (most efficient)
Differential backup	Copies data changed since **last full backup**	Medium size, medium speed	Simpler restore than incremental

Example (to understand difference):

- **Monday:** Full backup (100 GB)
- **Tuesday:** Incremental = only changes since Monday (1 GB)
- **Wednesday:** Incremental = only changes since Tuesday (0.5 GB)
- **Thursday:** Differential = all changes since Monday (1.5 GB)

Restore complexity:

- **Full + Incremental:** Need Monday + Tuesday + Wednesday full chain.
- **Full + Differential:** Need Monday + Thursday (easier).

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D. Backup Media / Destinations

Media	Pros	Cons	Use case
External HDD/SSD	Fast, large capacity, inexpensive	Physical theft/damage risk, must be connected	Home/small office
USB flash drive	Portable, cheap	Small capacity, unreliable for long-term	Small documents only
Network Attached Storage (NAS)	Centralized, multiple computers, RAID protection	Expensive, requires network	Business, government office
Cloud backup (Google Drive, Dropbox, Backblaze, etc.)	Offsite, automatic, accessible anywhere	Requires internet, monthly cost	Personal and business
Tape (LTO)	Very long lifespan (30+ years), cheap per GB	Slow, requires tape drive	Archival (banks, government records)
Optical (DVD/Blu-ray)	Cheap, readable on many devices	Small capacity, slow, degrades over time	Small archives

E. Backup Strategies (Important for Government Context)

3-2-1 Backup Rule (Gold Standard):

Number	Meaning
3	Keep **three copies** of data (1 primary + 2 backups)
2	Store on **two different media types** (e.g., external HDD + cloud)
1	Keep **one copy offsite** (different building or cloud)

Example 3-2-1 implementation for government office:

- Copy 1: Original data on computer/server
- Copy 2: External HDD in same office (different device)
- Copy 3: Cloud backup or tape stored in another location

F. Types of Backup (By Scope)

Type	What it backs up	Use
Full system backup	Entire drive (OS, apps, settings, data)	Disaster recovery (restore whole computer)
File-level backup	Selected files and folders	Daily document backup
Database backup	Database contents (e.g., SQL dump)	Server applications
Image backup	Exact sector-by-sector copy	Quick restore of identical system

G. Backup Scheduling (Example for Office)

Frequency	What to back up	Method
Daily	Changed files (documents, spreadsheets, databases)	Incremental
Weekly	Full backup of critical data	Full
Monthly	Full system image (OS + apps)	Full
Quarterly	Offsite archive (tape or cloud)	Full

H. Backup Verification (Critical but often skipped)

- **Definition:** Testing that a backup can actually be restored.
- **Why important:** Many backups fail silently (bad media, corrupted files). First time you discover a bad backup is when you need it most.
- **How to verify:**
  - Periodic test restore (restore one file or folder)
  - Backup software verification feature
  - Checksum/hash validation

I. Common Backup Software/Tools (For exam knowledge)

Tool	Platform	Type
Windows Backup (File History)	Windows	File backup
Windows System Image Backup	Windows	Full system backup
rsync	Linux, macOS, Windows (WSL)	Command-line file sync
Timeshift	Linux	System snapshot (like System Restore)
Veeam, Acronis, Macrium	Windows	Third-party (advanced)
Cloud sync apps	Cross-platform	Google Drive, Dropbox, OneDrive (sync, not true versioned backup unless using their backup features)

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