Vishwakarma Institute of Technology, Pune-37

Department Of Artificial Intelligence and Data Science

COMPUTER NETWORK
Activity 4

Class: - SY BTECH

Branch: - AIDS

Batch 1- Group 4

23. Avishkar Ghodke

26. Jineshwari Bagul

40. Devang Deshpande

55. Anuj Gosavi

57. Hardik Rokde

1. Difference between Network Device Drivers & Software Drivers

Network Device Drivers	Software Drivers
Facilitates the network device communication specifically with network interface cards.	Controls software part of the device functionalities.
Hardware devices must be highly compatible with each other.	It can handle a wider range of peripheral devices.
Plays a critical role in network security.	More adaptive installation procedure.
Communication through specific network protocols(TCP/IP).	It supports various communication protocols.
It requires system integration at kernel-level.	Flexible in terms of operation (can operate either at application or at system level).
The performance has a direct impact over the network transmission.	It is not that critical for core system operations.
It has a very complex configuration of hardware which is necessary for internet 7 network communication..	It is easily updatable as per requirements and can even be replaced.

2. Which programming Language is used to develop network device drivers.

C Programming Language for Building Network Device Drivers
Network device drivers are specific applications that facilitate communication between an operating system and network hardware, like Ethernet or Wi-Fi adapters. These are low-level drivers that interact directly with hardware components to manage data efficiently.

The primary language used to develop network device drivers is C.

- **Access to Hardware Resources**

Network drivers need to interact with hardware components like Network Interface Cards (NICs).
C provides direct access to memory addresses and hardware registers, which is essential for configuring network devices.

- **High Performance & Efficiency**

Since network drivers operate in real-time environments, they must be highly optimized for speed and minimal processing delays.
C is a compiled language that produces fast and efficient machine code, making it ideal for such tasks.

- **Operating System & Kernel Compatibility**

Most operating systems, including Linux, Windows, and macOS, use C for kernel and driver development.
The Linux Kernel (which powers many networking applications) is written in C, and network drivers must be compatible with it.
Windows uses frameworks like Windows Driver Model (WDM) and Windows Driver Framework (WDF), where C is commonly used.

- **Portability Across Platforms**

C enables a programmer to write code that easily adapts to various network hardware with minimal modification.
This is important because network devices are used on many architectures.

- **Direct Memory Manipulation**

Network drivers must manage buffer memory, interrupts, and hardware queues. This necessitates direct control over memory.
C provides pointer arithmetic and other low-level features that can handle these efficiently.

3. Observe which network configuration assembly is essential to configure network device drivers.

1. Network Interface Configuration (NIC):

Responsible for establishing the device's identity on a network.

- **IP Address:**
  - **Static IP:** Manually assigned, ideal for servers and devices requiring a fixed address.
  - **Dynamic IP (DHCP):** Automatically assigned by a DHCP server, common in most networks.
- **Subnet Mask:** Defines the network and host portions of an IP address, helping devices determine if others are on the same network.
- **Default Gateway:** Routes traffic from the local network to external networks like the internet.

- **DNS Servers:** Convert domain names (like google.com) into IP addresses.

2. Device Drivers:

Software that allows the OS to communicate with the network hardware.

- **Network Adapter Drivers:** Required for Ethernet/Wi-Fi functionality.
- **Driver Updates:** Ensure compatibility, security, and performance improvements.
- **Firmware:** Sometimes updated to fix hardware-level network issues

3. Configuration Files: (Vary by OS)

These files store network settings and instructions for managing connections.

- **Linux:**
  - `/etc/network/interfaces` (older systems)
  - `/etc/netplan/*.yaml` (newer systems using Netplan)
  - NetworkManager for GUI-based management
- **Windows:**
  - Network settings managed via Control Panel or **PowerShell** using `Get-NetAdapter`, `Set-NetIPInterface` commands.

4. Network Protocol Stack:

The framework that handles data transmission over networks.

TCP/IP Model: Acts as the core framework for both internet and local network communications.

- **TCP (Transmission Control Protocol):** Responsible for delivering data accurately and in the correct sequence.
- **IP (Internet Protocol):** Manages device addressing and determines the path data packets take across networks.

ARP (Address Resolution Protocol): Connects IP addresses to corresponding MAC (Media Access Control) addresses within a local network.

ICMP (Internet Control Message Protocol): Facilitates network diagnostics and troubleshooting, commonly used in tools like `ping`.

5. Network Services:

Essential services that support dynamic and secure networking.

- **DHCP (Dynamic Host Configuration Protocol):** Automatically assigns IPs, gateways, and DNS settings.
- **DNS (Domain Name System):** Converts website names into numerical IP addresses, enabling browsers to load internet resources..
- **NTP (Network Time Protocol):** Maintains accurate time synchronization across devices within a network.

6. Routing Configuration:

Directs data packets between networks.

- **Static Routing:** Manually defined routes; stable but requires manual management.
- **Dynamic Routing:** Uses protocols like OSPF (Open Shortest Path First) or BGP (Border Gateway Protocol) to adapt to network changes automatically.
- **Routing Tables:** Stored in the OS to determine the best path for data packets.

7. Security Settings:

Protect the device and data during transmission.

- **VPN (Virtual Private Network):** Secures data over public networks through encryption..
- **Firewall:** Acts as a security barrier, regulating the flow of incoming and outgoing network traffic based on predefined rules.
- **ACL (Access Control List):** Defines rules to control which devices or users can access specific network resources based on IP addresses, protocols, or ports.

4.Real time applications of usage of Installation of network device drivers.

1.Enterprise Network Management
IT departments frequently install network device drivers during infrastructure upgrades, enabling seamless connectivity for new switches, routers, and wireless access points. Proper driver installation ensures optimal performance and compatibility across corporate networks.

2.Telecommunications Infrastructure
Telecom companies rely on precise network device driver installations when deploying or maintaining cellular towers, network switches, and communication equipment. Accurate driver configuration prevents service disruptions and maintains critical communication infrastructure.

3.Data Center Scalability
Cloud service providers and large-scale data centers continuously install and update network device drivers to support expanding hardware infrastructure. These installations enable efficient server interconnectivity, bandwidth management, and network segmentation.

4.Industrial Control Systems
Manufacturing and industrial environments use network device drivers to integrate complex machinery, sensors, and communication systems. Proper driver installation ensures real-time data transmission, equipment monitoring, and seamless communication between industrial networks.

5.Healthcare Information Systems
Hospitals and medical facilities require precise network device driver installations to maintain secure, high-performance medical imaging systems, patient management networks, and interconnected medical equipment. Reliable driver configurations support critical healthcare communication and data exchange.

Research Papers
1) [Nooks: An Architecture for Reliable Device Drivers](#)

2) https://www.researchgate.net/profile/Robert-Cannistra/publication/261087470_Dynamic_software-defined_service_provider_network_infrastructure_and_cloud_drivers_for_SDN_adoption/links/5c81cd2892851c6950609d1c/Dynamic-software-defined-service-provider-network-infrastructure-and-cloud-drivers-for-SDN-adoption.pdf

3) https://www.researchgate.net/profile/Yubin-Xia/publication/266661462_Building_trusted_path_on_untrusted_device_drivers_for_mobile_devices/links/54d9c90d0cf24647581f71fa/Building-trusted-path-on-untrusted-device-drivers-for-mobile-devices.pdf

4) https://d1wqtxts1xzle7.cloudfront.net/41899801/SoftCOM2000-CameraReady-libre.pdf?1454446614=&response-content-disposition=inline%3B+filename%3DComponent_frame

Software device drivers

5) https://kartikgopalan.github.io/publications/lewandowski07modeling.pdf

6) https://www.researchgate.net/profile/Juan-Navas-5/publication/220775440_Efficient_and
_Adapted_Component-Based_Strategies_for_Embedded_Software_Device_Drivers_De
velopment/links/563148b408ae13bc6c35766d/Efficient-and-Adapted-Component-Based-
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Avishkar Ghodke

CN Tutorial 4

Vishwakarma Group of Institutions

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5) https://kartikgopalan.github.io/publications/lewandowski07modeling.pdf

6) https://www.researchgate.net/profile/Juan-Navas-5/publication/220775440_Efficient_and
_Adapted_Component-Based_Strategies_for_Embedded_Software_Device_Drivers_De
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