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TRAINING & EDUCATION// DIVISION

NFT-101 · COURSE BRIEFING

# NETWORK FUNDAMENTALS

STANDBY// SESSION COMMENCES SHORTLY

CLASSIFICATION
RESTRICTED · TRAINING

DURATION
5 DAYS

NFT-101

# NETWORK FUNDAMENTALS

A defense-grade introduction to network architecture, protocols, addressing, and the addressing, and the operational security of connected systems.

| CLASSIFICATION | MODULE SET | DURATION | REVISION |
| --- | --- | --- | --- |
| RESTRICTED · TRAINING | 01 / 06 | 5 DAYS | V1.0 · 2026 |

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# WELCOME

Thank you for joining this programme. Across the course you can rely on three
three commitments from Red Irish Global Training & Education.

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01/

## CERTIFIED CADRE

Your instructor is a vetted technical and instructional expert
expert who meets ongoing certification and clearance
clearance requirements.

02/

## QUALITY ASSURED

Training is delivered to ISO-aligned standards. Complete the
Complete the end-of-course evaluation — we hold ourselves
ourselves accountable to it.

03/

## CERTIFICATION PATHWAY

On completion, pursue accredited certification to validate
validate your technical expertise and advance operational
operational readiness.

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# DAILY AGENDA

09:00 – 16:00 · 8 × 45-minute lessons · 1-hour lunch

| | | |
|---|---|---|
| **09:00** | **Lesson 1** | What is a Network? Hosts, Clients, Servers |
| **09:45** | **Lesson 2** | Peer-to-Peer vs. Client/Server Architecture |
| **10:30** | **Lesson 3** | LAN — Local Area Network & PAN |
| **11:15** | **Lesson 4** | MAN — Metropolitan Area Network & WAN |
| **12:00** | **Lunch** | Break — return at 13:00 |
| **13:00** | **Lesson 5** | The Internet & Data-Centre Fabrics |
| **13:45** | **Lesson 6** | Comparing Network Types — Guided Activity |
| **14:30** | **Lesson 7** | Real-World Scenarios & Group Discussion |
| **15:15** | **Lesson 8** | Review, Q&A & End-of-Day Assessment |

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SECTION 01

# INTRODUCTION TO NETWORKING

01

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# WHAT IS A NETWORK?

Devices + connections + protocols

A computer network is two or more devices connected together so they can share information and resources. Without a network, data can only be moved physically — for example, on a USB drive.

## NETWORKS LET US

- Share files, documents and databases instantly
- Send email and messages across the world
- Access websites, applications and cloud services
- Share hardware — printers, scanners, storage
- Make voice calls and hold video conferences

## PROTOCOLS — THE RULES OF COMMUNICATION

| PROTOCOL | NAME | FUNCTION |
|---|---|---|
| **IP** | Internet Protocol | Addresses devices, routes data |
| **TCP** | Transmission Control | Reliable, in-order delivery |
| **HTTP** | HyperText Transfer | Transfers web pages |
| **HTTPS** | HTTP Secure | Encrypted version of HTTP |
| **SMTP** | Simple Mail Transfer | Sends email between servers |
| **DNS** | Domain Name System | Translates names to IPs |

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# HOST · CLIENT · SERVER

Client asks. Server answers.

01

## HOST

Any device connected to a network with an IP address. The generic term — PCs, phones, IP cameras, VoIP phones, printers and servers are all hosts. A switch or router is NOT a host.

02

## CLIENT

A host that requests data or a service from another device — device — it initiates communication. A browser requesting a requesting a web page, or an email app fetching new messages.

03

## SERVER

A host that provides data or a service in response to a request. It waits for requests, then responds — web, file, file, mail, DNS, DHCP and database servers.

### COMMON SERVER TYPES

| SERVER | PROVIDES | EXAMPLE |
|---|---|---|
| **Web Server** | Web pages (HTTP/HTTPS) | Apache hosting a website |
| **File Server** | Shared file storage | A NAS drive in an office |
| **DNS Server** | Translates domain names to IPs | 8.8.8.8 (Google DNS) |
| **DHCP Server** | Assigns IP addresses automatically | Your home router |

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# P2P vs. CLIENT/SERVER

Two fundamental ways to organise a network

## PEER-TO-PEER

All devices are equal. No dedicated server — every peer can both request and provide services.

## CLIENT/SERVER

Devices have dedicated roles. Servers run 24/7 waiting for requests; clients connect as needed.

### COMPARISON

| CRITERION | PEER-TO-PEER | CLIENT/SERVER |
|---|---|---|
| **Setup complexity** | Low | Higher |
| **Cost** | Low | Higher (server hardware) |
| **Scale** | Small (2–10 devices) | Large (10 – thousands) |
| **Central management** | No | Yes |
| **Data backup** | Difficult | Easy (back up the server) |
| **Security control** | Weak | Strong (centralised) |
| **Single point of failure** | No | Yes (mitigated by redundancy) |

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# LAN & PAN

Your building · your personal space

## LAN Local Area Network

One building, floor or campus, owned and managed by a single organisation. Fast, private, fully under your control.

| CHARACTERISTIC | DETAIL |
|---|---|
| **Coverage** | One building / floor / campus |
| **Typical size** | Up to a few kilometres |
| **Speed** | 100 Mbps – 10 Gbps (Ethernet) |
| **Ownership** | Single organisation |
| **Technology** | Ethernet 802.3 · Wi-Fi 802.11 |
| **Medium** | Cat5e/Cat6 copper or fibre |

## PAN Personal Area Network

The smallest network — the ~10 metre space around one person, connecting their personal devices. Bluetooth is the most common technology.

| CHARACTERISTIC | DETAIL |
|---|---|
| **Coverage** | Around one person (~10 m) |
| **Purpose** | Connect personal devices |
| **Technologies** | Bluetooth, USB, NFC, Wi-Fi Direct |
| **Ownership** | A single individual |
| **Example** | Smartphone ↔ wireless earbuds |
| **Example** | Smartwatch ↔ phone sync |

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# MAN & WAN

One city · across countries and continents

## MAN Metropolitan Area Network

Covers a single city or large town — larger than a LAN, smaller than a WAN. Usually managed by an ISP or city authority; it connects the city's LANs.

| CHARACTERISTIC | DETAIL |
|---|---|
| **Coverage** | One city / metro area (~50 km) |
| **Speed** | High-speed fibre backbone |
| **Ownership** | ISP, city authority or telecom |
| **Technologies** | Fibre ring, metro Ethernet, MPLS |
| **Purpose** | Connects multiple LANs in a city |

## WAN Wide Area Network

Spans cities, countries or continents, connecting LANs and MANs. Links are leased from telecom providers. The Internet is the world's largest WAN.

| CHARACTERISTIC | DETAIL |
|---|---|
| **Coverage** | Cities, countries — global |
| **Speed** | Lower (distance, shared infra) |
| **Ownership** | Multi-org; telecoms own links |
| **Technologies** | MPLS, SD-WAN, satellite, subsea |
| **Example** | The Internet; corporate WAN |

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# THE FOUR NETWORK TYPES

Scale order: PAN < LAN < MAN < WAN

| TYPE | FULL NAME | COVERAGE | SPEED | OWNER | EXAMPLE |
|---|---|---|---|---|---|
| **PAN** | Personal Area Network | ~10 metres | Moderate | Individual | Phone + earbuds |
| **LAN** | Local Area Network | Building / campus | Very high | Organisation | Office network |
| **MAN** | Metropolitan Area Net. | One city | High | ISP / city | City campus links |
| **WAN** | Wide Area Network | Country / global | Variable | Telco / multi-org | The Internet |

*Each step up in scale adds more complexity, more parties, and usually lower per-link speed relative to a local connection.*

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# THE INTERNET & DATA CENTRES

A network of networks · the facilities behind the cloud

## HOW THE INTERNET IS STRUCTURED

- A global system of independently-operated networks all using TCP/IP
- Divided into Autonomous Systems (AS) — each manages its own routing
- Connected at Internet Exchange Points (IXPs) where networks interconnect
- Tier 1 providers form the backbone, often over undersea fibre cables
- Tier 2 / Tier 3 ISPs resell bandwidth to businesses and consumers

## INSIDE A DATA CENTRE

| COMPONENT | PURPOSE |
|---|---|
| **Servers (compute)** | Run apps, VMs, databases |
| **Storage (SAN/NAS)** | Store vast data reliably |
| **Switches & routers** | Connect servers & outside world |
| **Load balancers** | Distribute requests across servers |
| **Firewalls** | Protect against attack |
| **Power & cooling** | Keep equipment running safely |

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# DATA-CENTRE FABRICS

Spine-and-leaf — built for massive east-west traffic

## SPINE-AND-LEAF TOPOLOGY

- Leaf switches connect directly to servers (one per rack)
- Spine switches sit above — every leaf connects to every spine
- No leaf-to-leaf links; all inter-rack traffic crosses the spine
- No spine-to-spine links
- Result: consistent 2-hop latency between any two servers

## TRADITIONAL LAN vs. SPINE-AND-LEAF

| PROPERTY | 3-TIER LAN | SPINE-LEAF |
|---|---|---|
| **Design** | Core→Dist→Access | Spine→Leaf |
| **Scale** | Hundreds | Tens of thousands |
| **Latency** | Variable | Consistent (2 hops) |
| **Bandwidth** | Oversubscribed | Non-blocking |
| **Expansion** | Complex | Add a leaf switch |

*East-west (server-to-server) traffic now dominates the data centre — spine-and-leaf is optimised for exactly this.*

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# Comparing Network Types

**Activity:** For each scenario, identify:

- Network Type (PAN, LAN, MAN, WAN)
- Architecture (P2P or Client/Server)

**Examples:**

**Key Idea:** Use coverage area and communication method to identify the correct network type.

| Scenario | Type | Architecture |
|---|---|---|
| Phone → Phone (Bluetooth) | PAN | P2P |
| School File Server | LAN | Client/Server |
| Offices in Different Cities | WAN | Client/Server |
| Smartwatch → Phone | PAN | P2P |

*East-west (server-to-server) traffic now dominates the data centre — spine-and-leaf is optimised for exactly this.*

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# Company Network Example

A company has:

- Offices in Nairobi and Mombasa
- Cloud HR system in Johannesburg
- Employees use laptops and Bluetooth mice

**Network Types Used**

- Laptop → Office Network = **LAN**
- Nairobi ↔ Mombasa = **WAN**
- Office ↔ Cloud = **WAN**
- Mouse ↔ Laptop = **PAN**

**Architecture**

- **Client/Server**
  - Laptops = Clients
  - HR System = Server

**Key Takeaway:** Real environments often use **multiple network types at the same time**.

*East-west (server-to-server) traffic now dominates the data centre — spine-and-leaf is optimised for exactly this.*

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# DAY 1 — KEY CONCEPTS

Your complete reference

| | |
|---|---|
| **NETWORK** | Devices + connections + protocols to share resources |
| **HOST** | Any device on a network with an IP address |
| **CLIENT** | A host that requests data or services |
| **SERVER** | A host that provides data or services |
| **PROTOCOL** | Agreed rules for sending and receiving data |
| **P2P** | All devices equal — simple, hard to scale |
| **CLIENT/SERVER** | Dedicated roles — scalable, secure, centralised |

| | |
|---|---|
| **PAN** | ~10 m around one person · Bluetooth |
| **LAN** | One building/campus · Ethernet & Wi-Fi |
| **MAN** | One city · connects LANs · ISP-run |
| **WAN** | Cities/countries · the Internet is the largest |
| **INTERNET** | A global WAN — network of networks on TCP/IP |
| **DATA CENTRE** | Facility housing thousands of servers |
| **SPINE-AND-LEAF** | DC fabric · consistent 2-hop latency |