Network Topology/STP

- Spanning Tree Information
- How does the Network work?

Spanning Tree Information

What is STP (Spanning Tree Protocol)?

Why Do Business Networks Need STP?

Modern networks often contain multiple switches connected together. This provides resilience, allowing the network to continue operating if a cable or switch fails.

However, connecting switches together incorrectly can create a **network loop**, which can bring an entire network down in seconds.

STP (Spanning Tree Protocol) is a safety mechanism designed to prevent this from happening.

Imagine a Road Network

Imagine travelling from London to Manchester.

There may be several different routes available:

- Motorway route
- A-road route
- Diversion route

Having multiple routes is useful if one road is closed.

Computer networks work in exactly the same way.

Multiple paths between switches provide resilience, but if all routes remain active simultaneously, traffic can end up travelling in circles forever.

What Happens Without STP?

Without STP:

1. Switch A sends data.
2. Switch B receives it and forwards it.
3. Switch C receives it and forwards it.
4. The data returns to Switch A.
5. The cycle repeats indefinitely.

This is known as a:

Network Loop

The result can be:

- Extremely slow network performance
- Cameras disconnecting
- Phones dropping calls
- Wi-Fi becoming unreliable
- Complete network outages

In severe cases, the network can become unusable within seconds.

How STP Prevents This

STP continuously monitors the network and identifies all available paths between switches.

If it detects multiple routes to the same destination, it will:

✓ Keep the best path active
✓ Place redundant paths into standby mode
✓ Automatically reactivate backup paths if a failure occurs

Think of it as a traffic controller ensuring vehicles only use one route at a time while keeping alternatives available if needed.

Example

Without STP

Switch A ←→ Switch B
↑ ↓
Switch D ←→ Switch C

Traffic can circulate endlessly around the square.

With STP

Switch A ←→ Switch B
↑ X
Switch D ←→ Switch C

STP blocks one connection (shown as X).

The loop is removed, but a backup route still exists.

If a cable fails, STP can automatically reopen the blocked connection to maintain service.

Why Is STP Important for CCTV and Smart Homes?

Modern properties often have:

- Multiple network switches
- Wi-Fi access points
- Security cameras
- Door access systems
- Smart home controllers
- Audio/video systems

These systems are increasingly connected using multiple network paths to improve reliability.

STP ensures that:

✓ Cameras remain online
✓ Access control continues operating
✓ Wi-Fi remains stable
✓ Smart home systems remain responsive
✓ Redundant links can be used safely

Without STP, a single incorrectly connected cable can affect the entire property.

STP in UniFi Networks

UniFi systems use Rapid Spanning Tree Protocol (RSTP), which is a faster and more modern version of STP.

RSTP can:

- Detect loops quickly
- Recover from failures rapidly
- Automatically select the best route
- Protect the network from accidental cabling mistakes

This is one of the reasons professionally designed UniFi networks remain stable even when multiple switches and buildings are connected together.

In Simple Terms

STP is a safety system for your network.

It prevents data from travelling in circles, protects against cabling mistakes, and allows backup network routes to exist without causing outages.

Without STP, a single network loop can bring an entire property offline.

With STP, the network automatically keeps traffic flowing along the safest and most efficient route.

How does the Network work?

Understanding Network Topology

How Does a Modern Network Work?

Whether it's a home, office, farm, hotel or large estate, most networks follow the same basic structure.

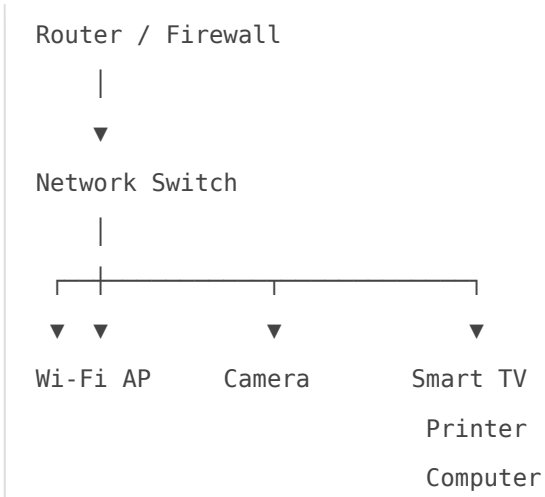
Think of your network like a water system:

- The internet is the water supply.
- The router is the main stopcock.
- Switches are the pipework.
- Wireless access points are taps around the building.
- Devices are the people using the water.

Each component has a specific role.

A Typical Network Layout

```
Internet
    |
    ▼
Modem / ONT
    |
    ▼
```



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1. Internet Connection

The internet connection enters the property through a service provided by:

- Openreach
- CityFibre
- Virgin Media
- Starlink
- Mobile Broadband

This is simply the connection between your property and the outside world.

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2. Modem or ONT

The modem or ONT converts the provider's signal into a standard network connection.

Examples:

- Openreach Fibre → ONT
- Virgin Media → Cable Modem
- Starlink → Starlink Router/Adapter

The ONT does **not** manage your network.

Its job is simply to hand over the internet connection.

Think of it as the water meter outside your house.

3. Router / Firewall

The router is the brains of the network.

Its responsibilities include:

✓ Connecting your network to the internet
✓ Providing security and firewall protection
✓ Managing IP addresses
✓ Controlling traffic between devices
✓ Managing VLANs and network segregation

Without a router, devices cannot communicate with the internet.

Examples:

- UniFi Dream Machine
- DrayTek Router
- Firewalla
- pfSense
- ISP Router

Think of the router as the receptionist controlling who enters and leaves the building.

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4. Network Switch

A switch expands the number of available network connections.

For example:

A router may have 4 ports.

A switch may provide:

- 8 ports
- 16 ports
- 24 ports
- 48 ports

Switches allow multiple devices to communicate simultaneously.

Typical devices connected to switches:

- Computers
- Cameras
- Wi-Fi Access Points
- Printers
- Smart TVs
- Door Access Systems

Think of the switch as a distribution hub.

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5. Wireless Access Points

Access Points provide wireless coverage.

Many people mistakenly call these "routers".

A Wi-Fi Access Point:

✓ Provides wireless coverage
✓ Connects wireless devices to the network

A Wi-Fi Access Point does **not**:

✗ Provide internet by itself
✗ Manage security
✗ Perform routing

Examples:

- UniFi U7 Pro
- UniFi U7 Outdoor
- UniFi U6 Mesh
- Aruba Access Points
- Cisco Access Points

Think of access points as Wi-Fi transmitters.

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6. End Devices

These are the devices that actually use the network.

Examples:

- Phones
- Tablets
- Laptops
- Smart TVs
- CCTV Cameras
- Printers
- Gate Controllers
- Smart Home Systems

Each device receives an IP address from the router and communicates through the switch and access points.

Example: Viewing a Camera on Your Phone

When viewing a security camera:

```
Phone
  |
Wi-Fi Access Point
  |
Network Switch
  |
Network Video Recorder
```

The traffic never needs to leave your property.

The router is not heavily involved because everything is local.

Example: Watching Netflix

```
Netflix
   |
Internet
   |
ONT
   |
Router
   |
Switch
   |
Wi-Fi Access Point
   |
TV
```

The router manages the connection between your property and Netflix.

What About Large Properties?

Modern estates often use multiple switches and access points.

```
Internet
    |
Router
    |
Core Switch
  ┌─┼──────┬──────────┐
  | |      |          |
  | |      |          |
AP Switch CCTV Switch Gate Switch
  |          |          |
APs      Cameras    Access Control
```

This is known as a hierarchical network design.

Benefits:

✓ Better performance
✓ Easier troubleshooting
✓ Greater reliability

✓ Easier expansion

The Automated Integrations Approach

For reliability and future growth, we typically design networks using:

1. ISP Connection / ONT
2. Enterprise Router (UniFi Dream Machine)
3. Core Managed Switch
4. Dedicated PoE Switching
5. Multiple Access Points
6. Structured Cabling
7. CCTV & Access Control Integration

This ensures every device has a clear path through the network while maintaining security, performance and reliability.

In Simple Terms

A modern network usually follows this path:

```
Internet
    |
Modem / ONT
    |
Router
    |
Switch
    |
Wi-Fi Access Point
    |
Device
```

Each component performs a different job, and together they create a fast, secure and reliable network for all devices within the property.