**Network Layer: Control Plane (Routing)**

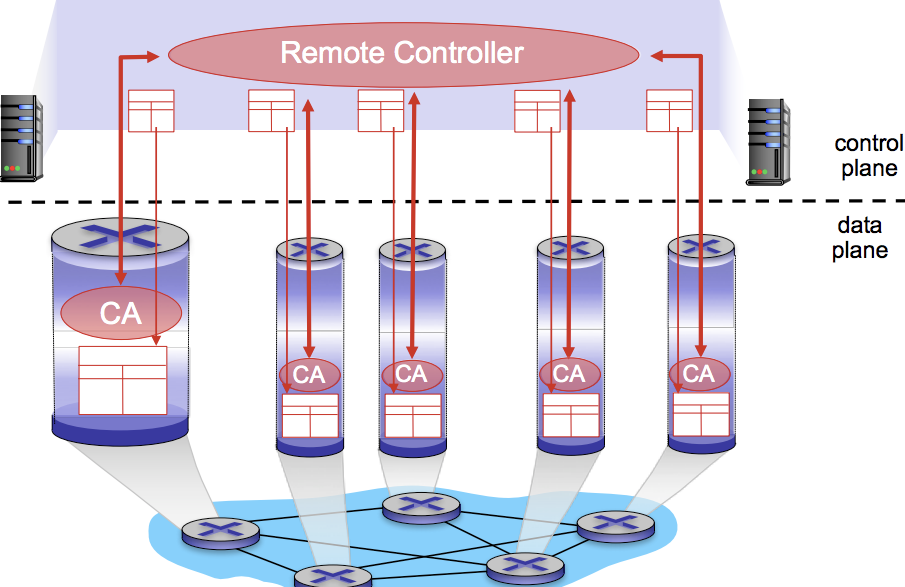
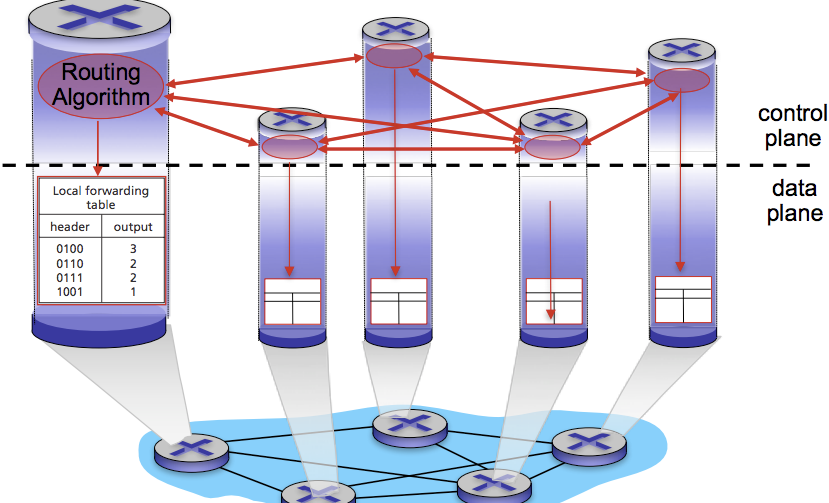
**Two Network Layer Functions**

**Forwarding**: Move packets from router’s input to appropriate router output (DATA PLANE)

**Routing**: Determine route taken by packets from source to dest (CONTROL PLANE)

Two approaches to structuring a network control plane:

* Per-router control (traditional) VS. Logically centralised control (software defined networking)



**Per-Router Control Plane**

Individual routing algo components in EVERY ROUTER interact w/ each other in the control plane to compute forwarding tables.

**Logically Centralised Control Plane**

A distinct (typically remote) controller interacts with local control agents (CA’s) in routers to compute forwarding tables.

**Interplay between Routing and Forwarding functions in the control / data plane**

* A routing algorithm determines the end-to-end path through the network.
* The forwarding table determines the local forwarding at this router.

**Autonomous System (AS)** or **Domain** is a region of a network under a single administrative authority.

The internet is partitioned into ASes such as Internet Service Providers (ISPs), each of which controls routes involving its network

* Internet Routing works at two levels:

1. **Intra-Domain Routing Protocol**: Each AS runs this protocol that establishes routes within its domain:
   1. Link State e.g. **Open Shortest Path First (OSPF)**
   2. Distance Vector e.g. **Routing Information Protocol (RIP)**
2. **Inter-Domain Routing Protocol**: AS’es participate in this protocol that establishes routes between domains:
   1. Path Vector e.g. **Border Gateway Protocol (BGP)**

**Graphs and Networks**

**Key Question**: What is the least-cost path between node X to node Y?

**Routing Algorithm**: Algorithm that finds the least-cost path between Router A to Router Z