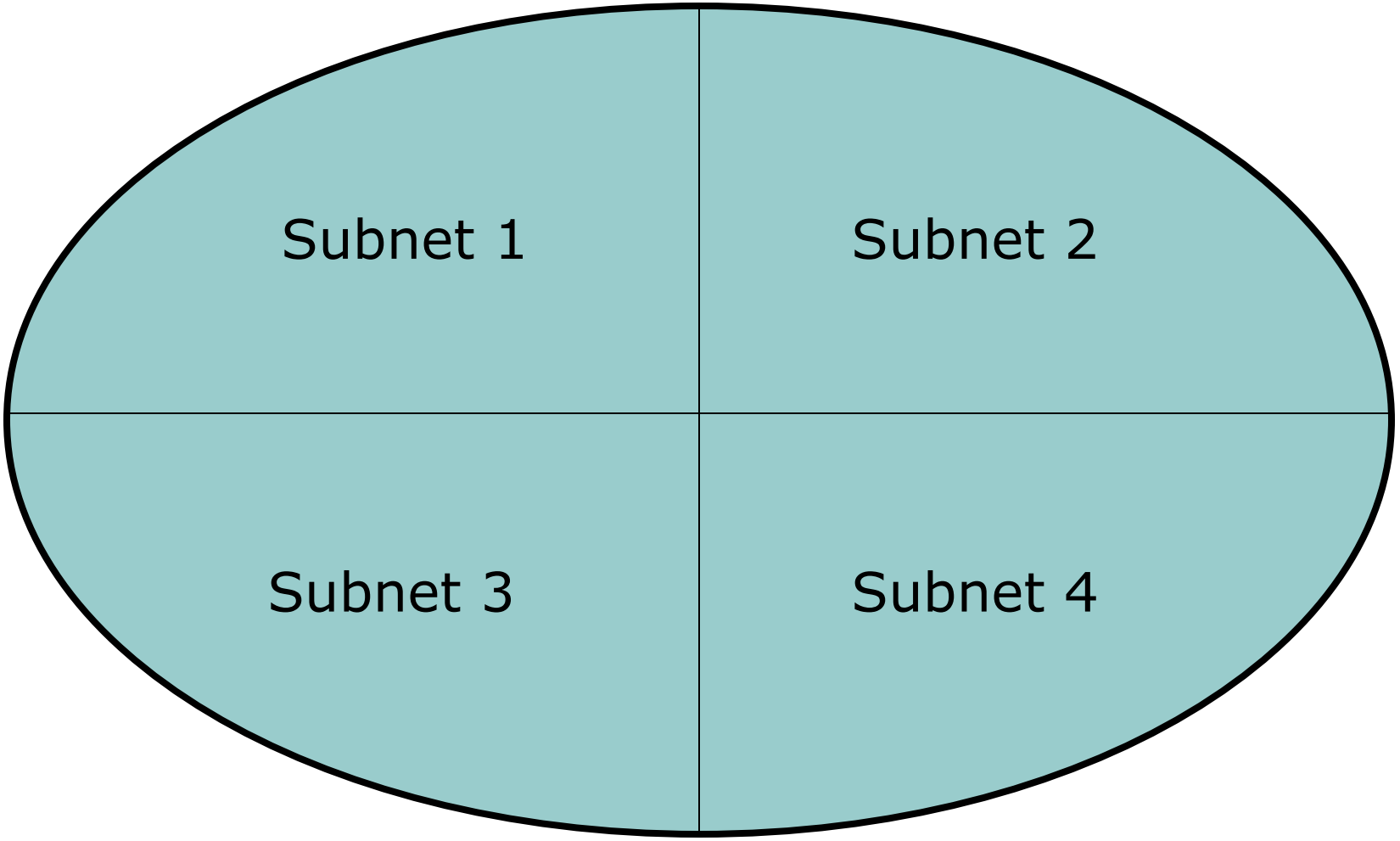
Subnets

Routing within an Organization

Subnet

- Subnets are a subset of the entire network
  - Networks can be divided into subnets
  - Subnets can be divided into subnets
- Each subnet is treated as a separate network
  - A subnet can be a WAN or LAN

Subnets



Subnet Addresses

- Typical (classed) IP addresses (e.g. 137.207.32.2) have two parts:
  - A network ID (e.g. 137.207.0.0)
  - A host ID (e.g. 0.0.32.2)
- A subnetted network will divide the IP address differently
  - Part of the host ID will be used to specify the subnet number
  - The network ID and subnet portion of the host ID can be considered the subnet ID

Subnet Addresses

- For example, if we want to divide a network into 4 subnets, we can use the following scheme:
  - 4 subnets can be represented with 2 bits ($2^2 = 4$)
  - For a class B address, which already uses 16 bits for the network portion, the address would use 18 bits for the subnet portion

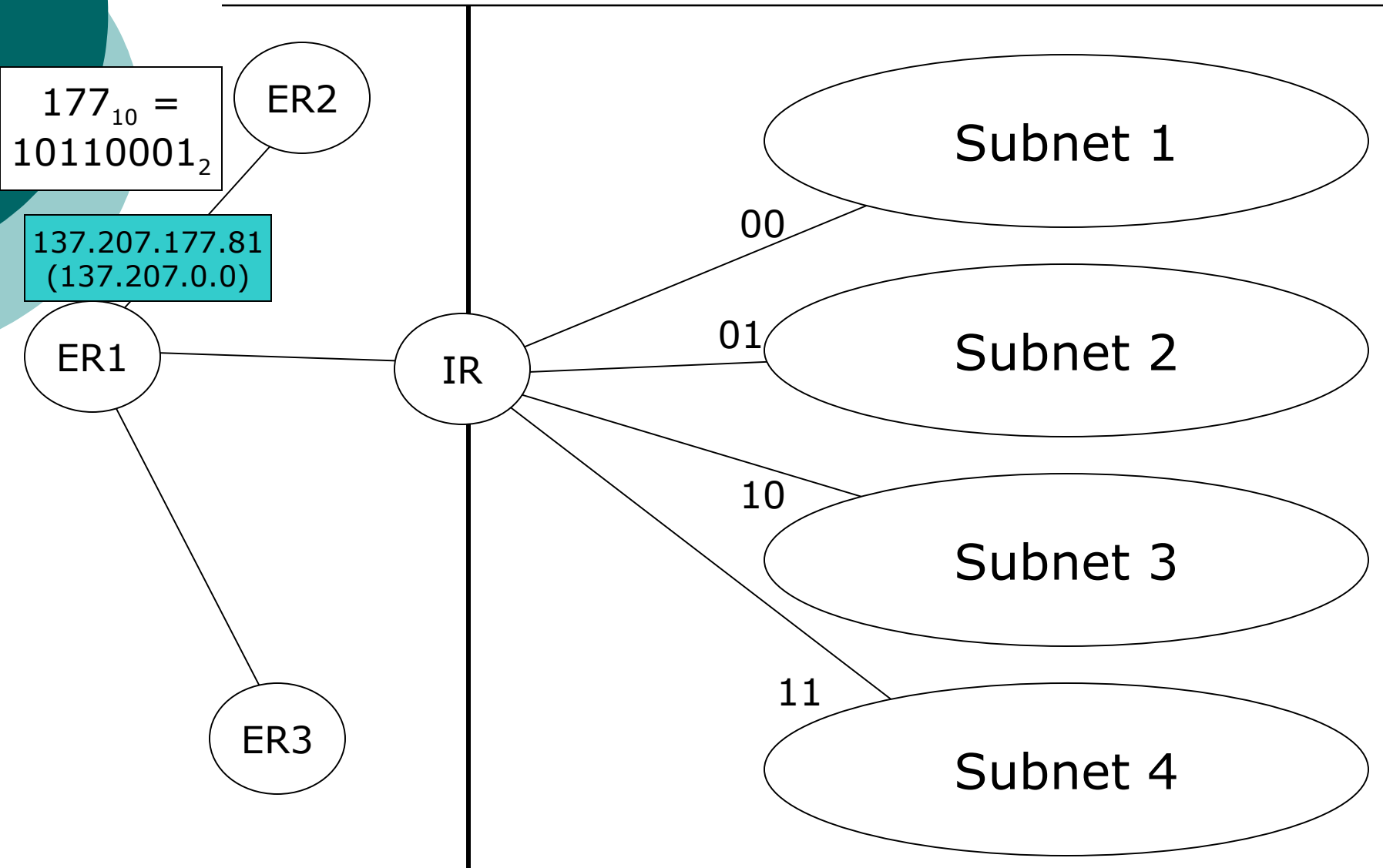
External Routing with Subnets

- Subnetting is transparent outside an organization
  - e.g. If subnetting is used in the University, routers outside the University will not consider subnetting at all
  - Thus, subnetting is only relevant within an organization

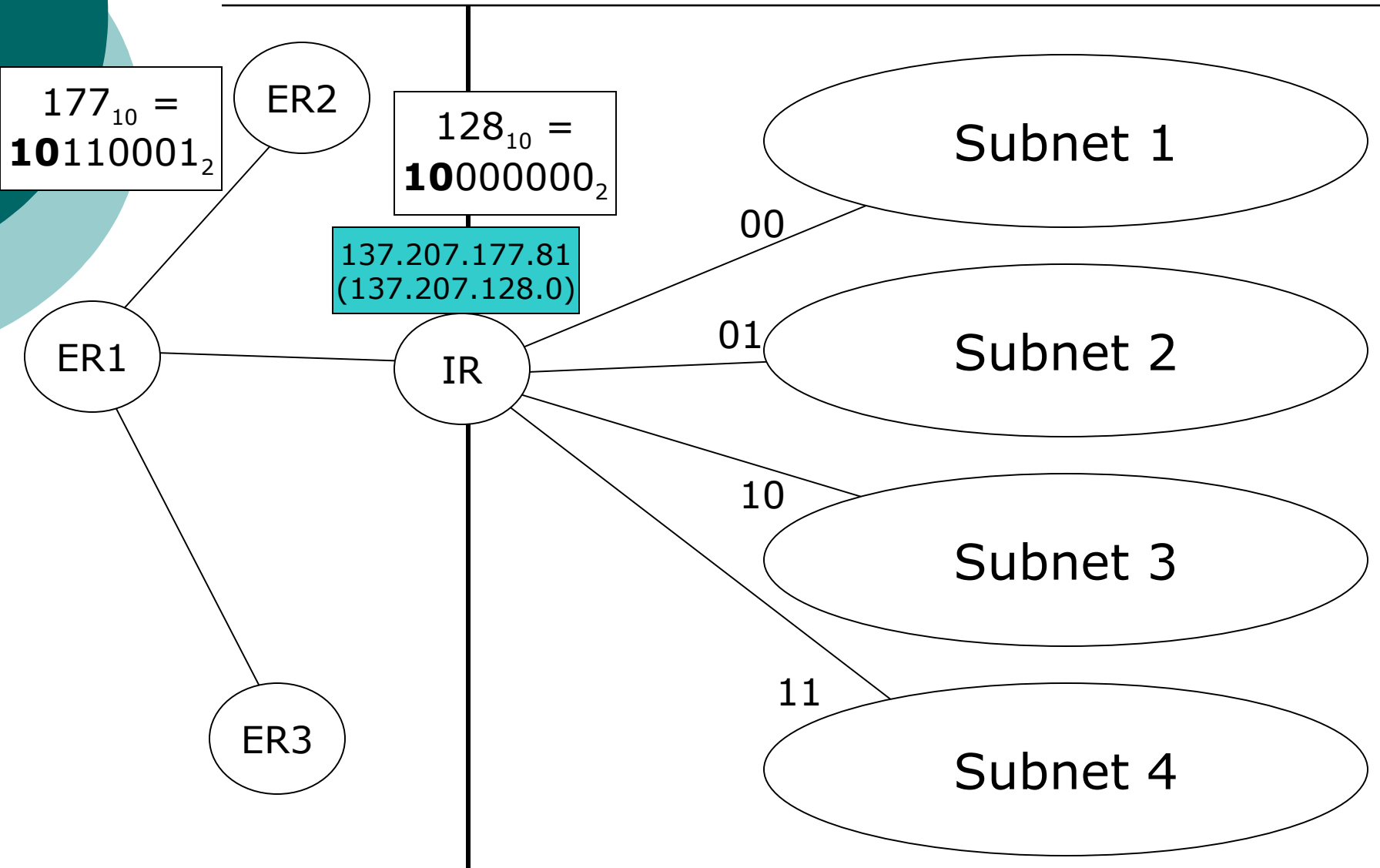
Internal Routing with Subnets

- When a packet enters a network with subnetting, the routers will behave differently
  - A route may use the subnet ID (network portion + subnet portion, followed by zeroes) to determine which route to take

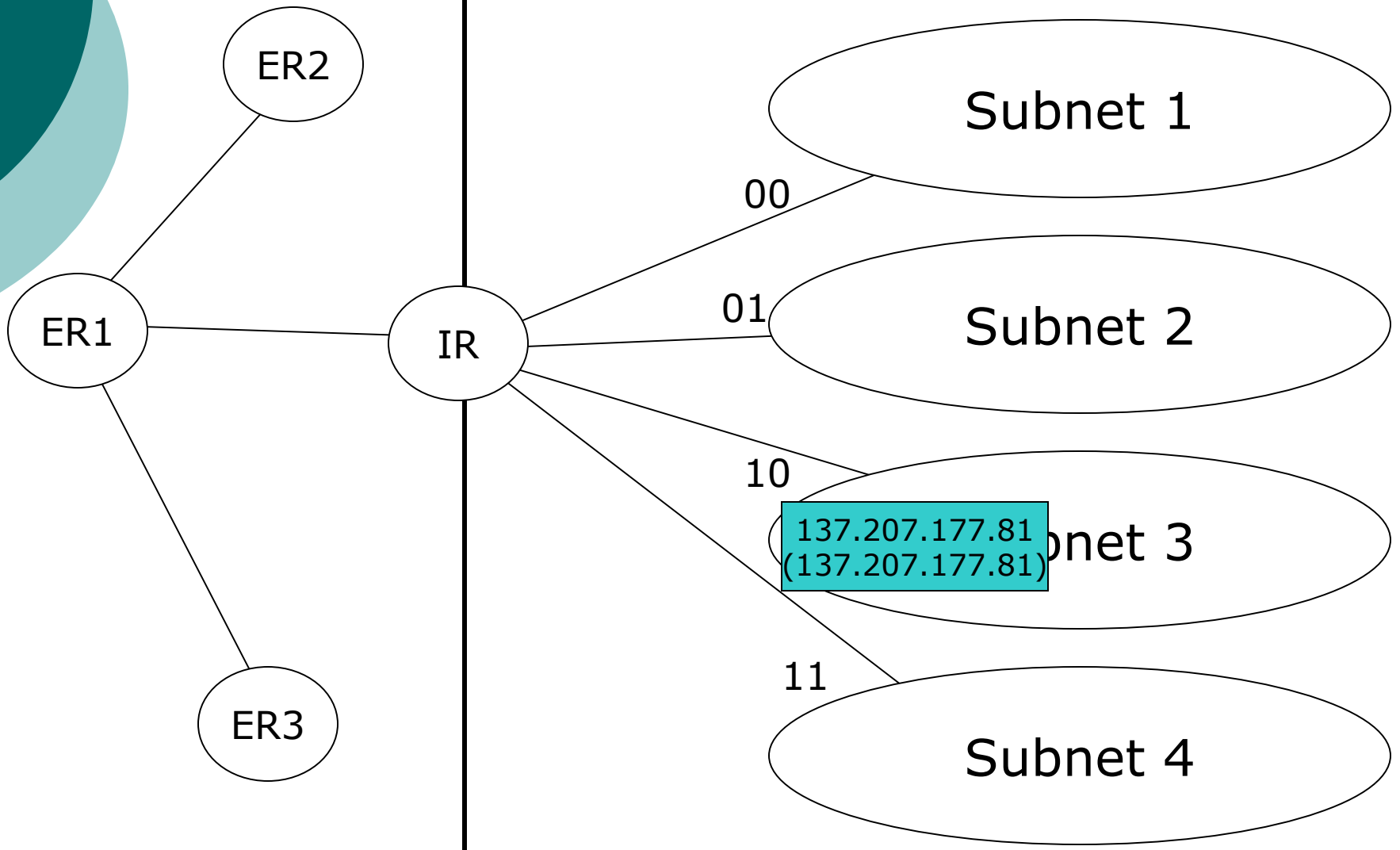
Routing with Subnets



Routing with Subnets



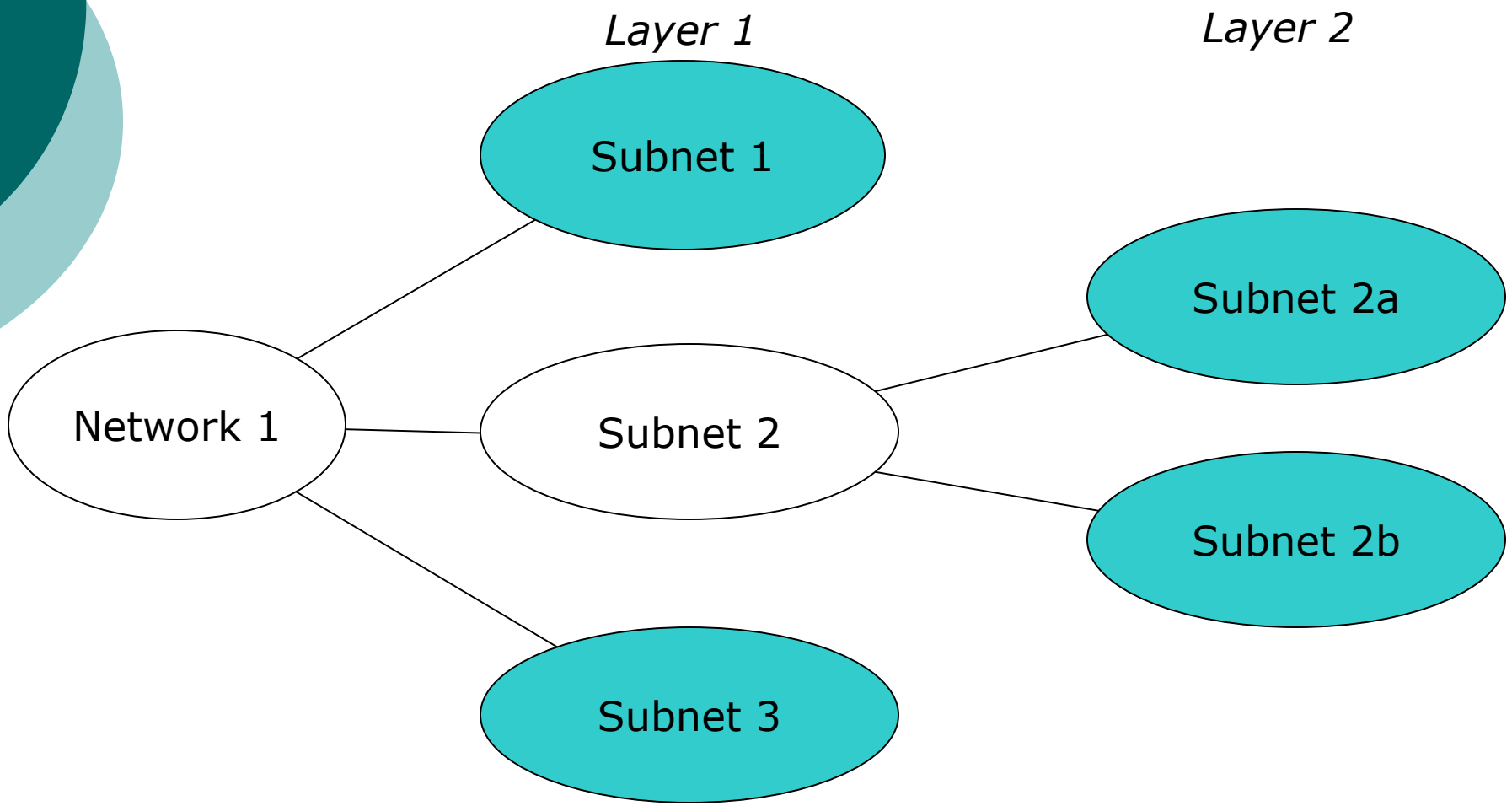
Routing with Subnets



Multi-Level Subnets

- A subnet can be divided into subnets
  - If the first layer of subnetting used 2 bits for the subnet portion, a second layer can be used to subnet within each subnet
    - Using more bits from the host portion of the address

Multi-Level Subnets



Calculating Subnet IDs

- Calculating the subnet ID is very much the same process as calculating a network ID (net ID)
  - The difference is that typically net IDs are calculated using one of the three standard subnet masks:
    - 255.0.0.0 (Class A)
    - 255.255.0.0 (Class B)
    - 255.255.255.0 (Class C)
  - A subnet ID is calculated using a non-standard subnet mask
    - e.g. 255.255.192.0 (192_{10} = 11000000_2)

Common Class B Subnet Masks

Subnet Mask	**# of Subnets**
255.255.192.0 ($192_{10} = 11000000_2$)	4 (2^2)
255.255.240.0 ($240_{10} = 11110000_2$)	16 (2^4)
255.255.252.0 ($252_{10} = 11111100_2$)	64 (2^6)

- Class A and C subnet masks would be similar

CIDR Notation

- A convenient way to specify this kind of subnet mask is CIDR addressing
  - e.g. 137.207.32.2/255.255.0.0: 137.207.32.2/16
  - e.g. 24.1.2.3/255.0.0.0: 24.1.2.3/8
- The number after the '/' is the number of bits that are 1s in the subnet mask
  - 137.207.177.81/255.255.240.0: 137.207.177.81/20 (16 bits for network ID + 4 bits for subnetting)