Architecting the Network

Part 3

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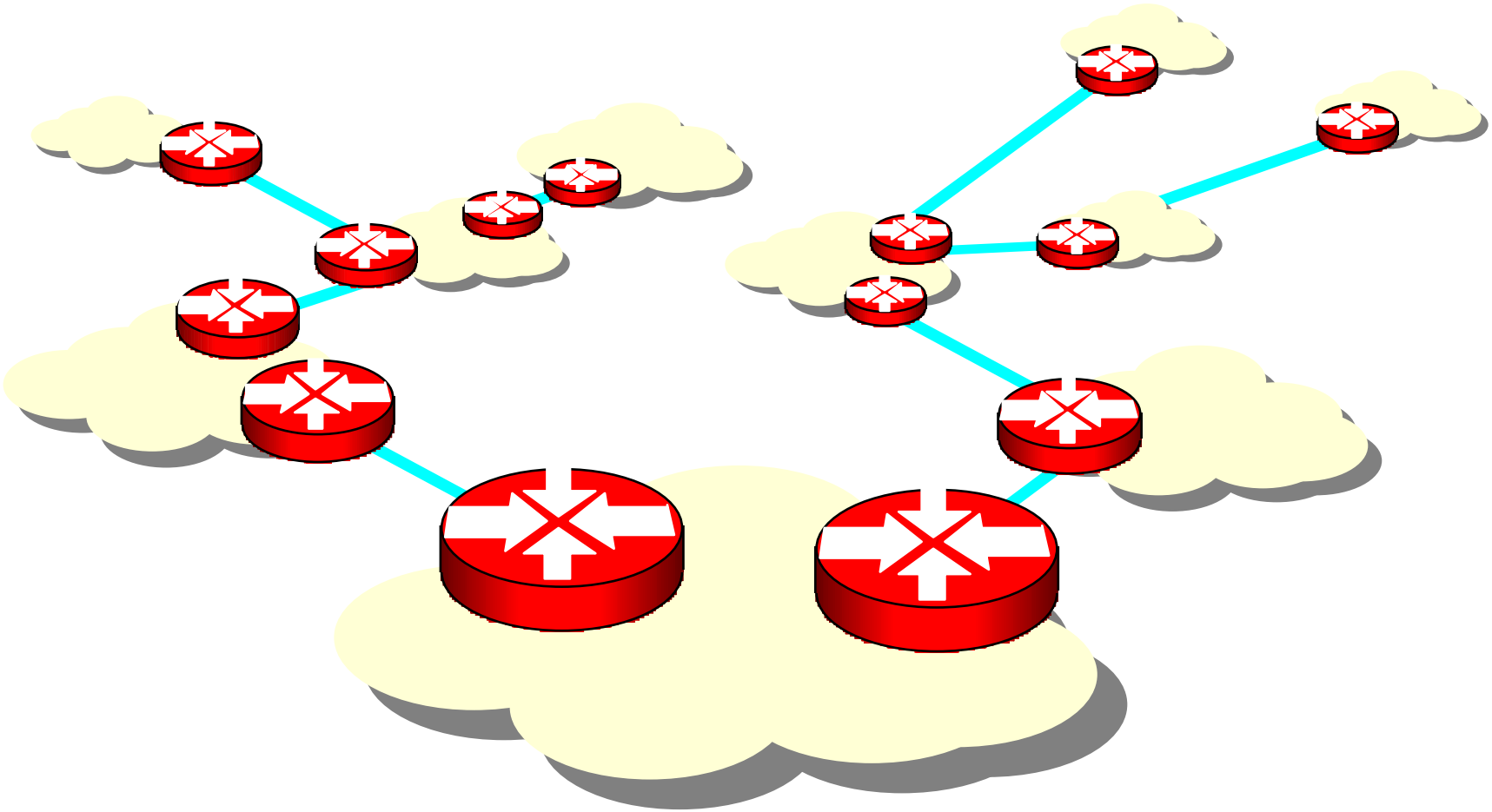
ISOC Workshop

Network Peer Interface



Network Peer Interface

- Who is my peer?
  - Differentiating between:
    - client network (they pay me!)
    - service provider network (I pay them!)
    - peer network (we pay each other!)
- There are no Internet mechanisms to objectively determine who is a peer network!

Network Peer Interface

- Where do I peer?
  - Onshore 1:1
  - Onshore at a layer 2 exchange
  - Offshore via Service Provider
  - Offshore at a layer 2 exchange

Network Peer Interface

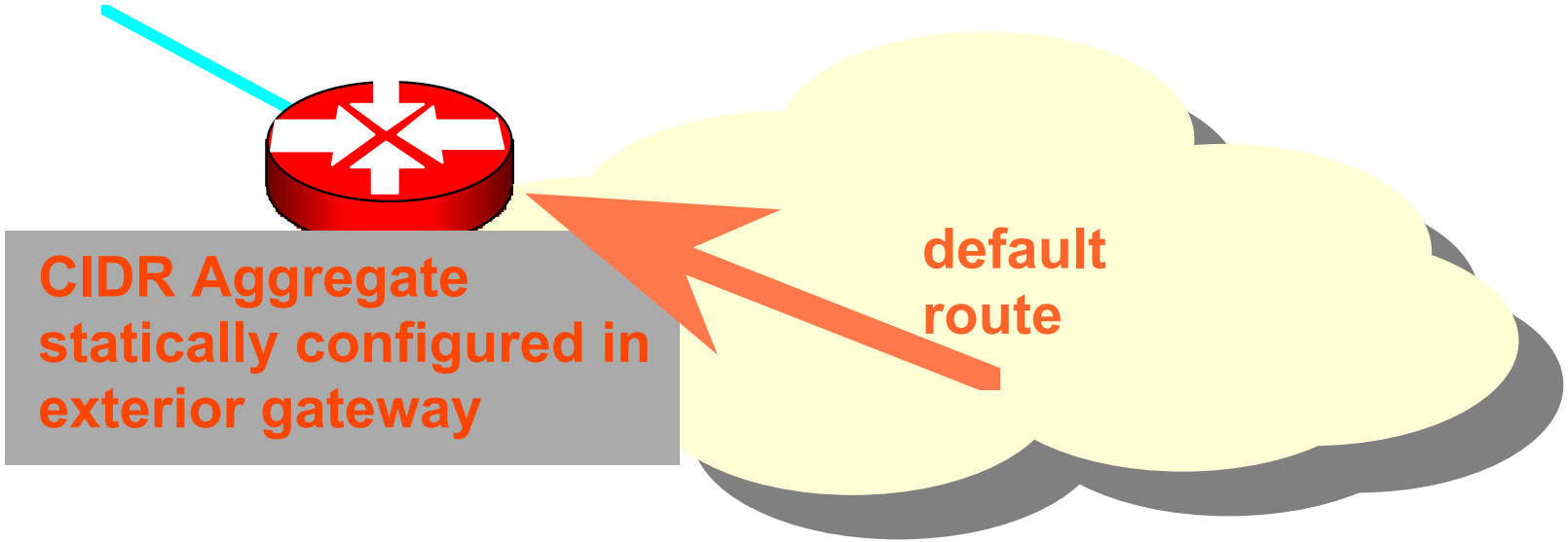
- Routing Considerations
  - Export routes via BGP4 using CIDR
  - Import routes using whatever works easily!
- Operational Considerations
  - Minimise bandwidth used by routing
  - maximise operational stability

Network Route Management

- Obtain registered Autonomous System number (AS)
  - from your Regional Registry
- Generate aggregate mask which covers all announced networks
- Announce CIDR aggregate to peer via BGP4 session

Single Exterior Peer

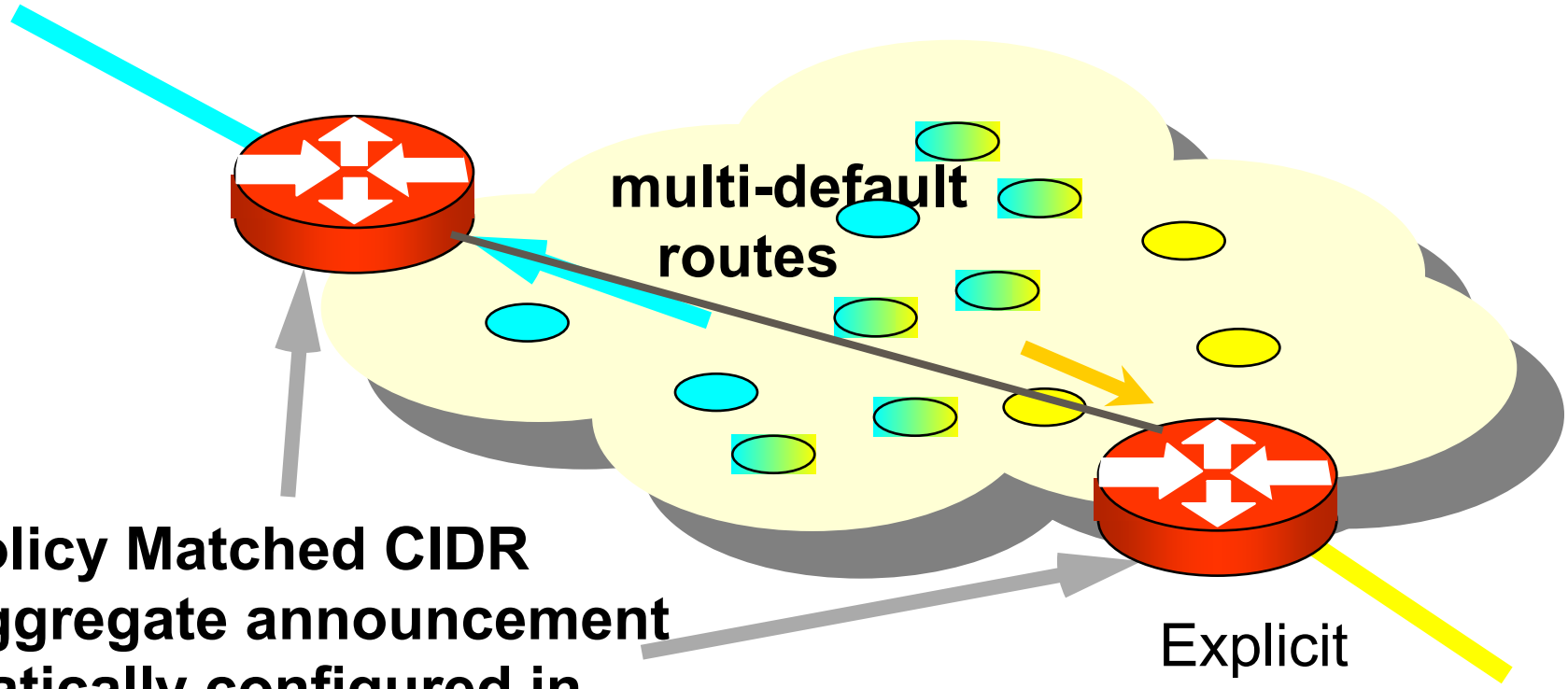
- Announce local nets via CIDR aggregate using BGP4
- Synthesise static default route directed to exterior peer gateway



Multiple Exterior Peers

- Externally Imposed Policy differentiation
  - For example:
    - Academic & Research peer external network
    - Commercial peer external network
- Routing is Destination address-based - not source address
  - Default route based on best policy match
  - Explicit routes are imported from other network peers
  - Traffic path based on destination net - not local source policy

Multiple Exterior Peers

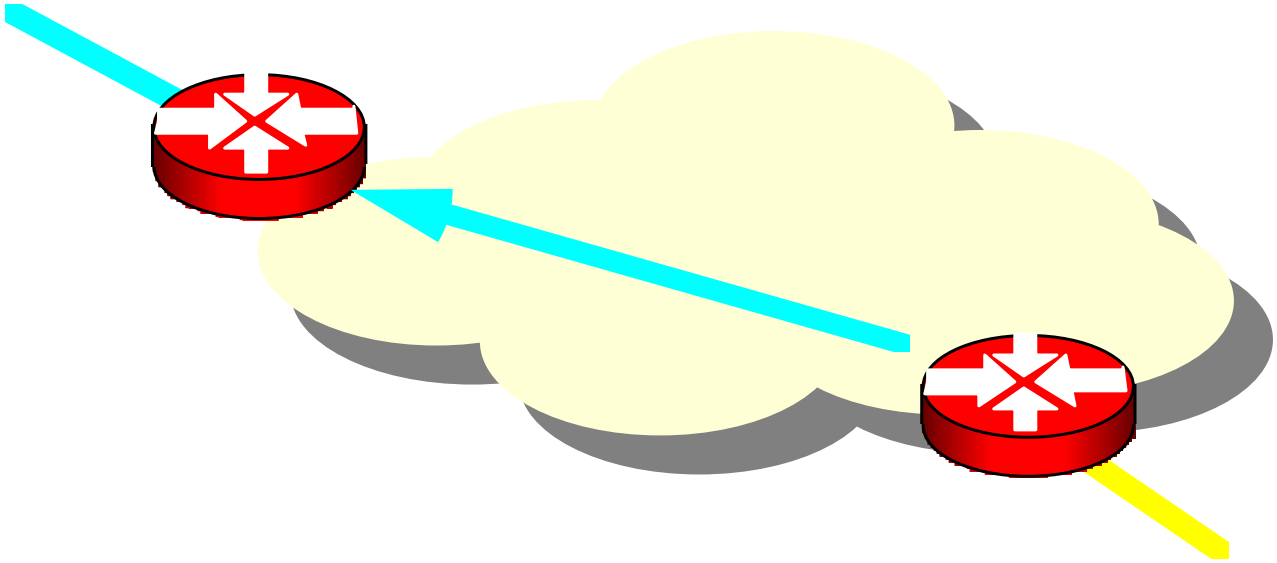


Policy Matched CIDR Aggregate announcement statically configured in exterior gateways

Explicit routes imported via BGP4

Multiple Exterior Peers

- Transit Arrangement
  - Importation of transiting AS network numbers
  - Announcement of transiting networks via AS path mechanism



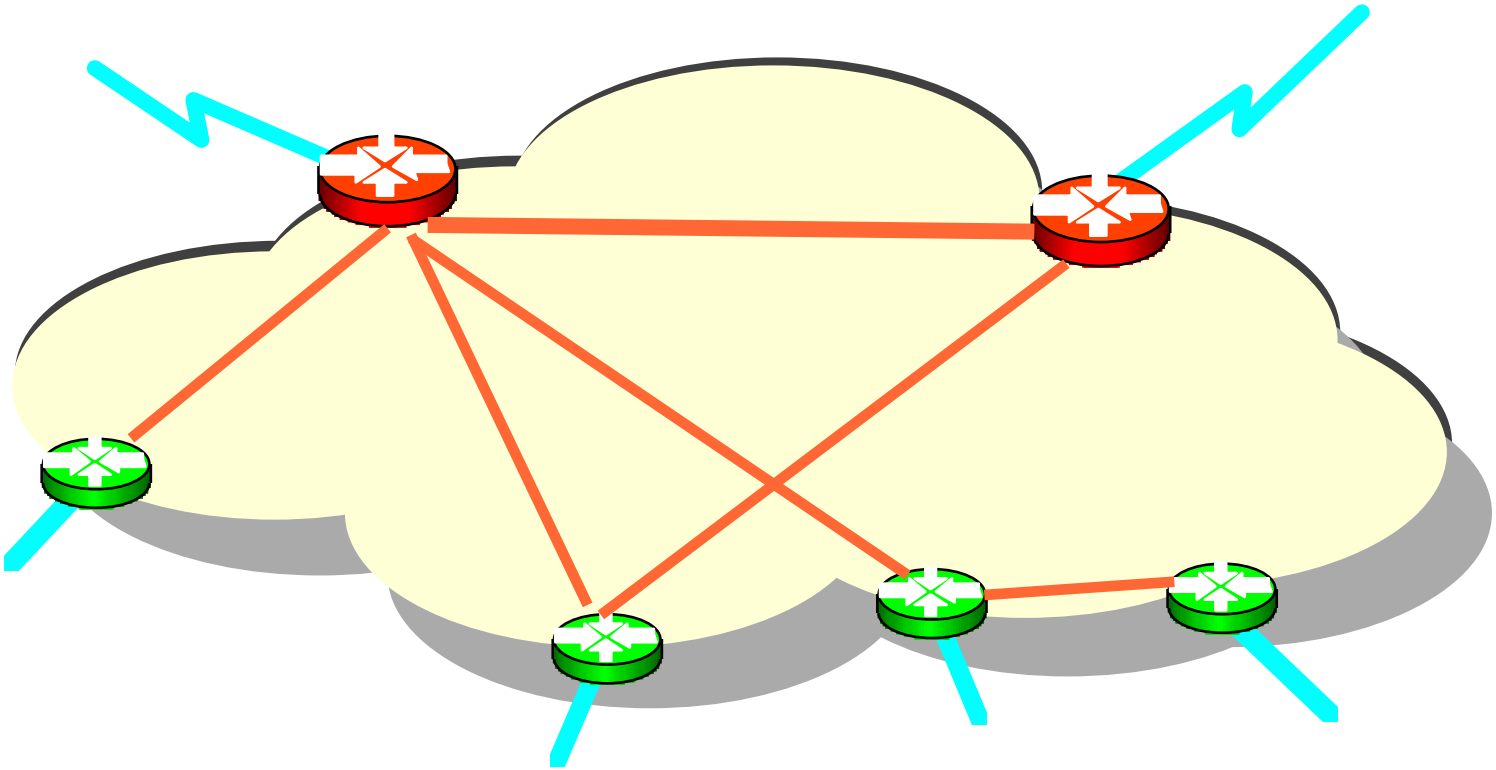
Exterior Peering

- Importing a default route is cost effective and highly efficient as long as there is a suitable policy and capability match with the peer
- Default-less routing is expensive, time-consuming, and can be unstable
- Default-less routing allows greater levels of self-determination of policy - with an operational cost

Exterior Peering

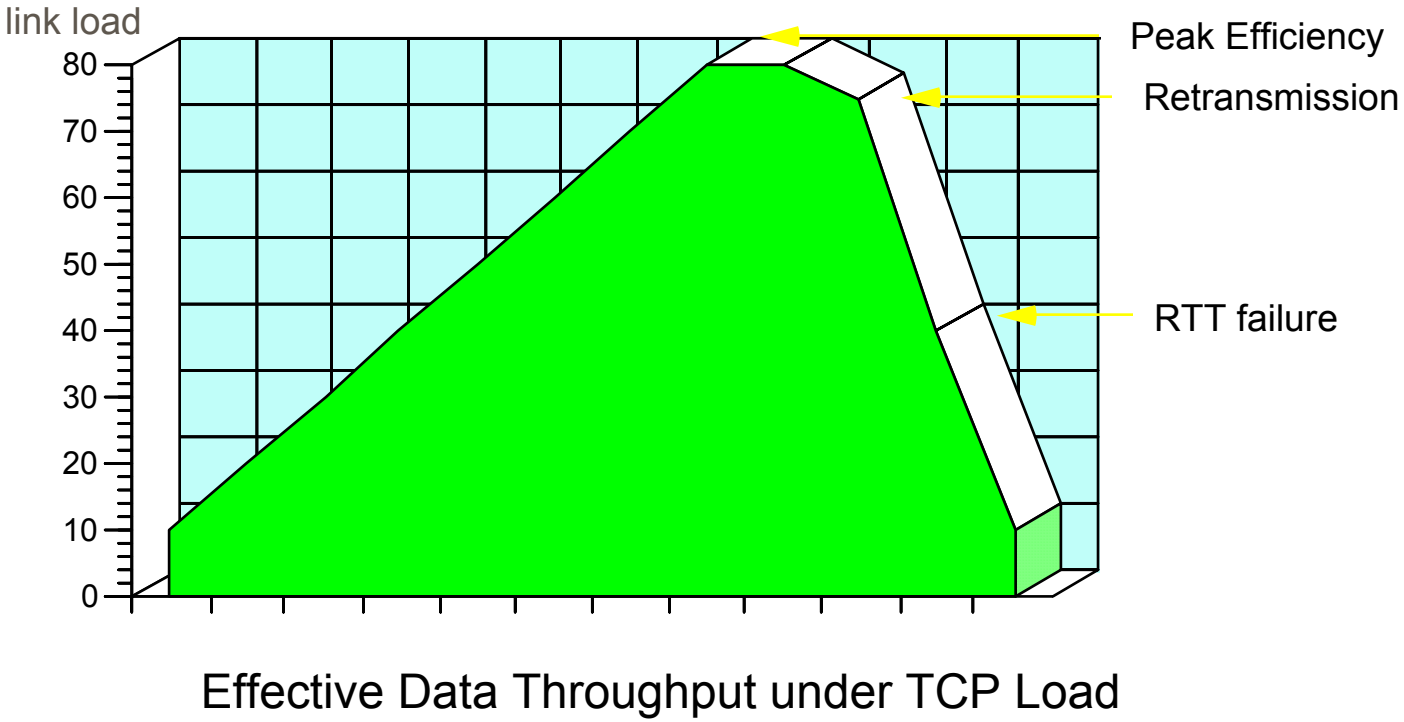
- Use a simple model initially:
  - Single exterior peer
  - Derived default route
  - Announce CIDR aggregate to peer

Network Infrastructure



Network Infrastructure

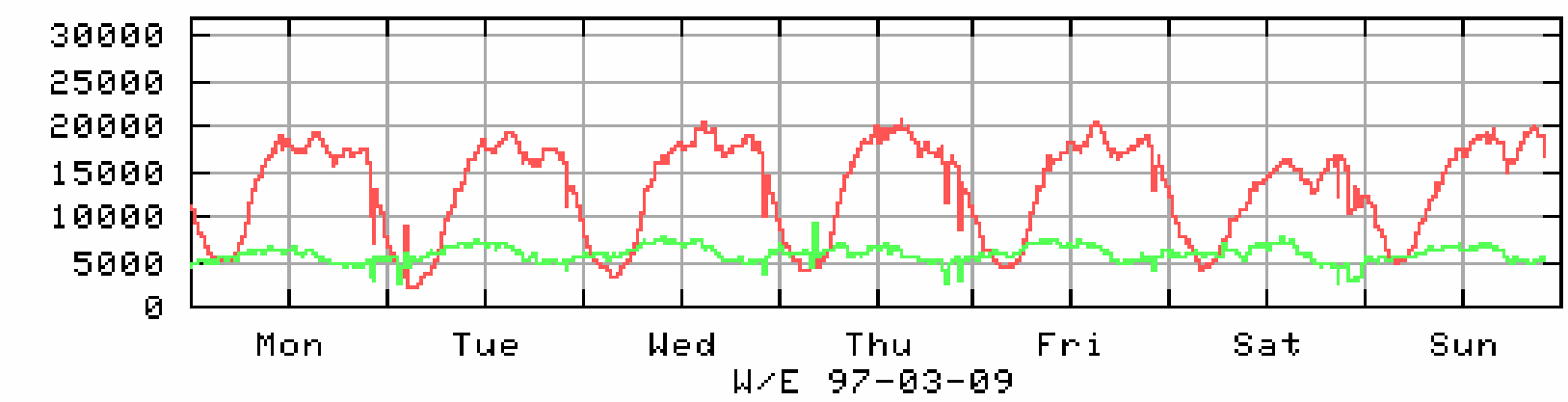
- Bandwidth is a coarse control tool

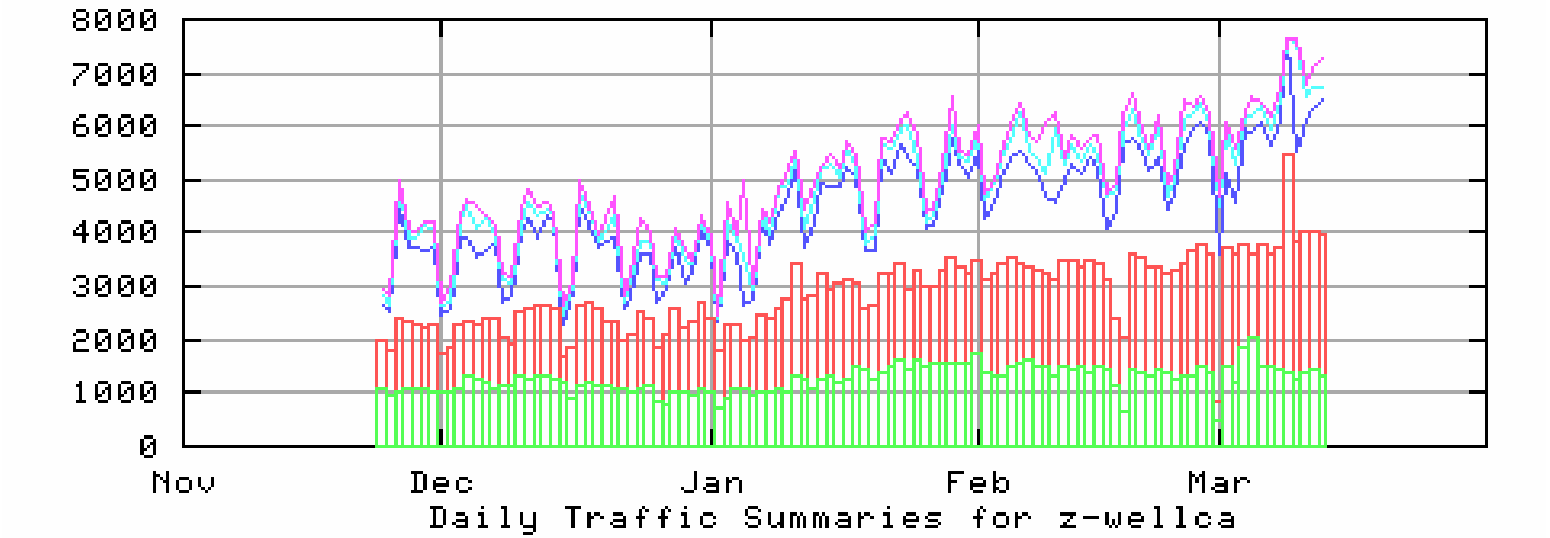


Network Infrastructure

- Engineer capacity for peak demand periods
- Understand end-to-end flow patterns
- Attempt to avoid sustained (> 15 minutes) acute congestion on any link
- Constantly monitor bandwidth utilisation and flow patterns
- Generate trend patterns and plan accordingly

Network Infrastructure





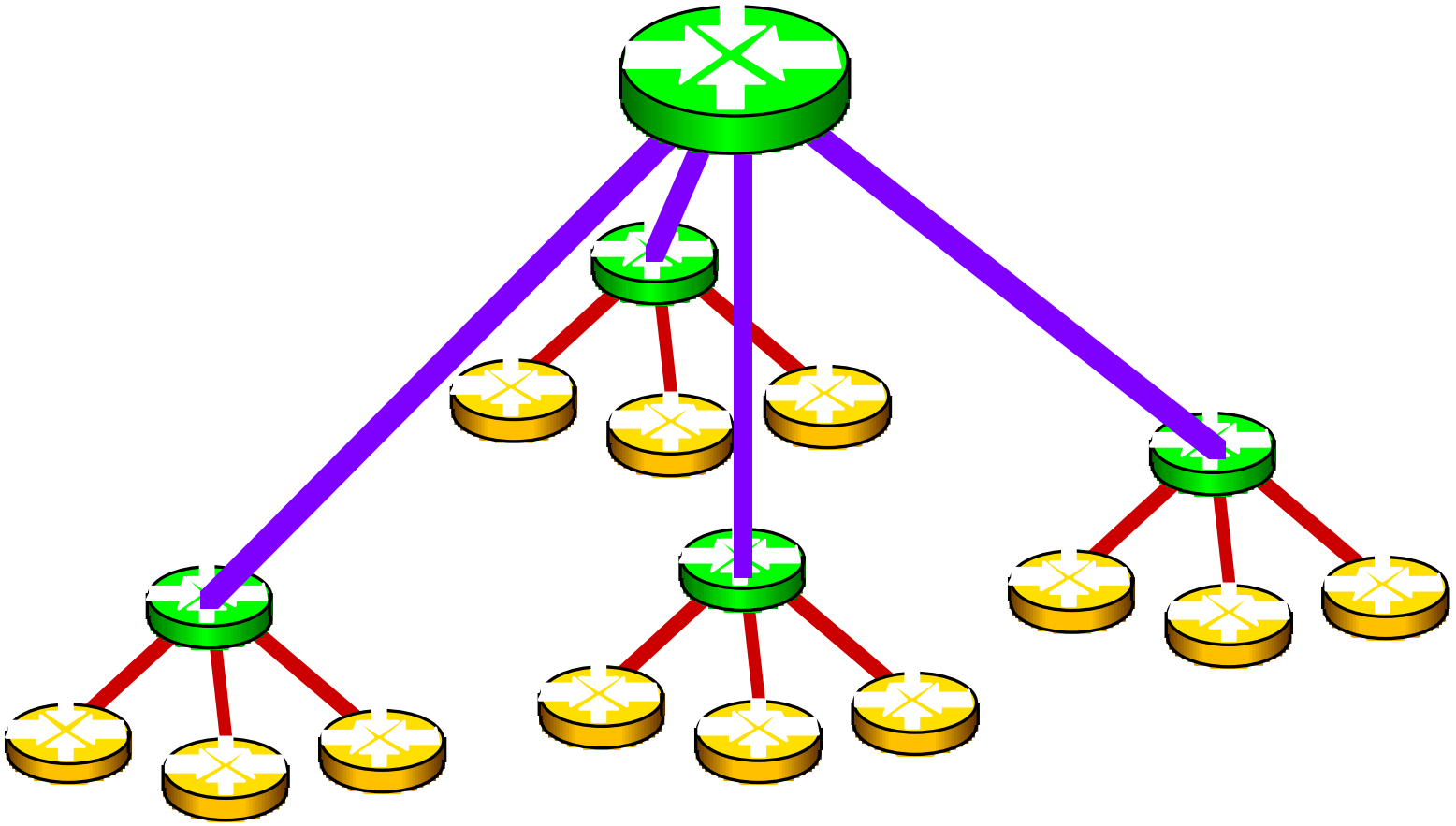
Network Infrastructure

- Communications technology choices:
  - Dedicated Facilities
    - point to point leased circuit
    - point to point radio
  - Common Switched Facilities
    - X.25
    - Frame Relay
    - SMDS access
    - ATM

Network Infrastructure

- Leased circuit design
  - Performance
  - Reliability
  - (In)Flexibility
  - Cost

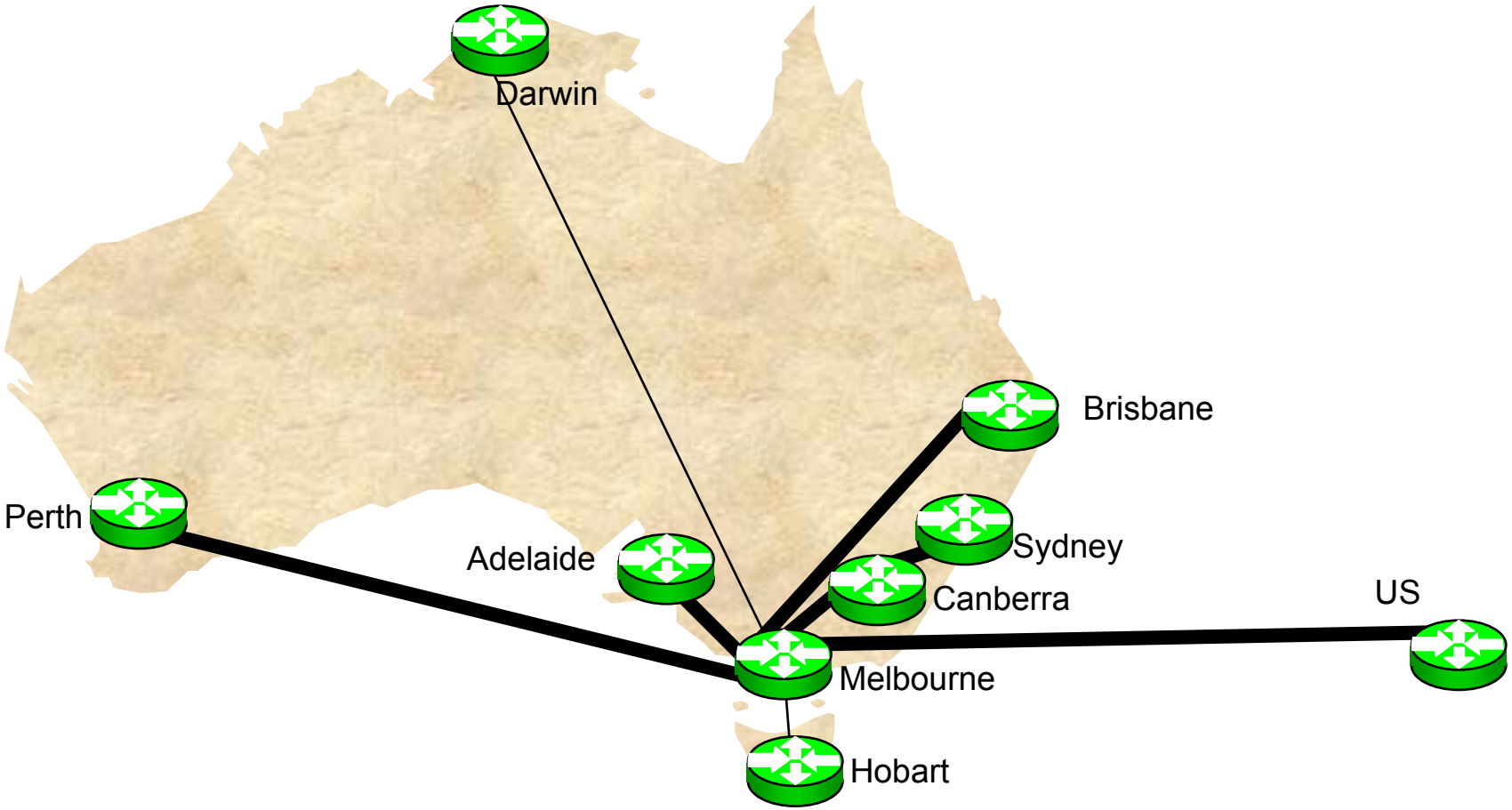
Network Design



Network Infrastructure

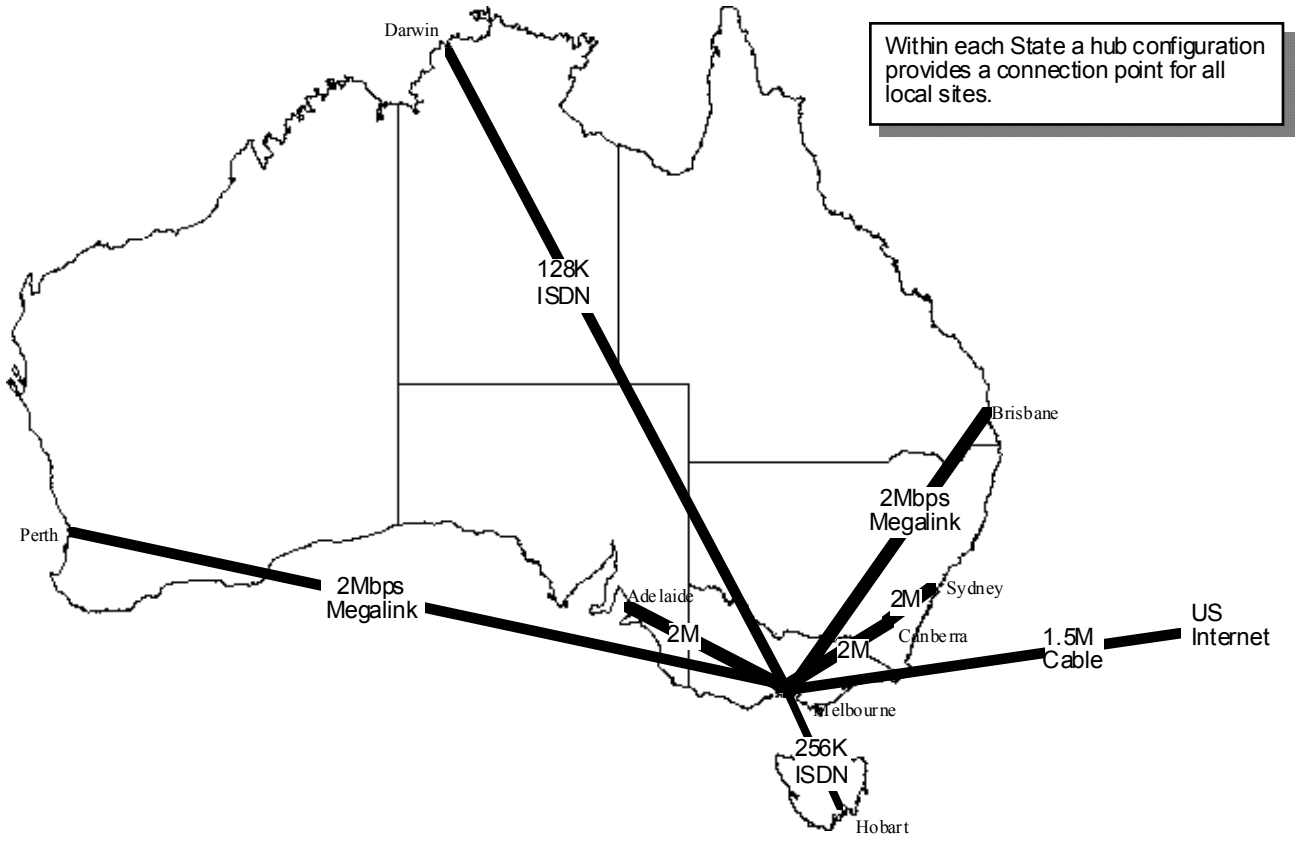
- Hierarchy (Star) Topology
  + Minimal Cost
  + Simple Topology
  + Maximal efficiency
  - Critical points of failure

Star Topology



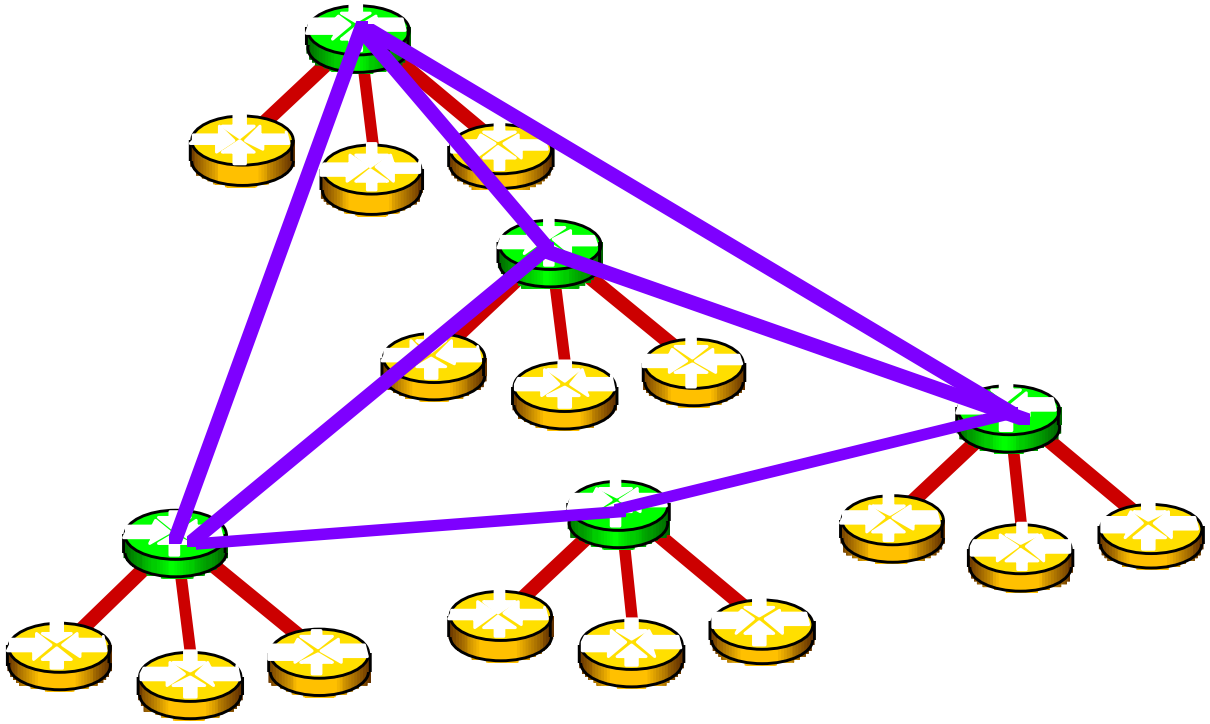
Network Design

The Australian Academic and Research Network

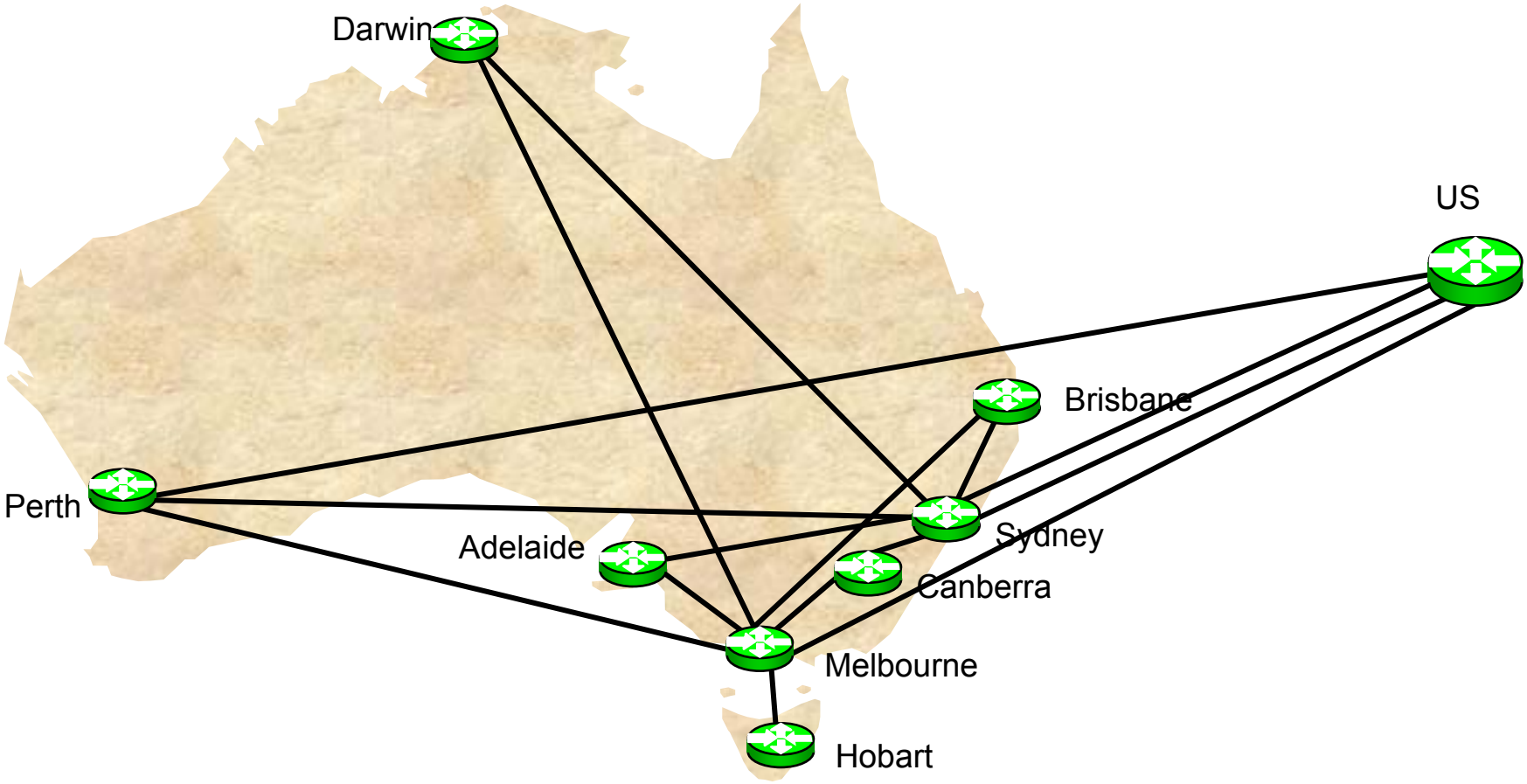


Network Infrastructure

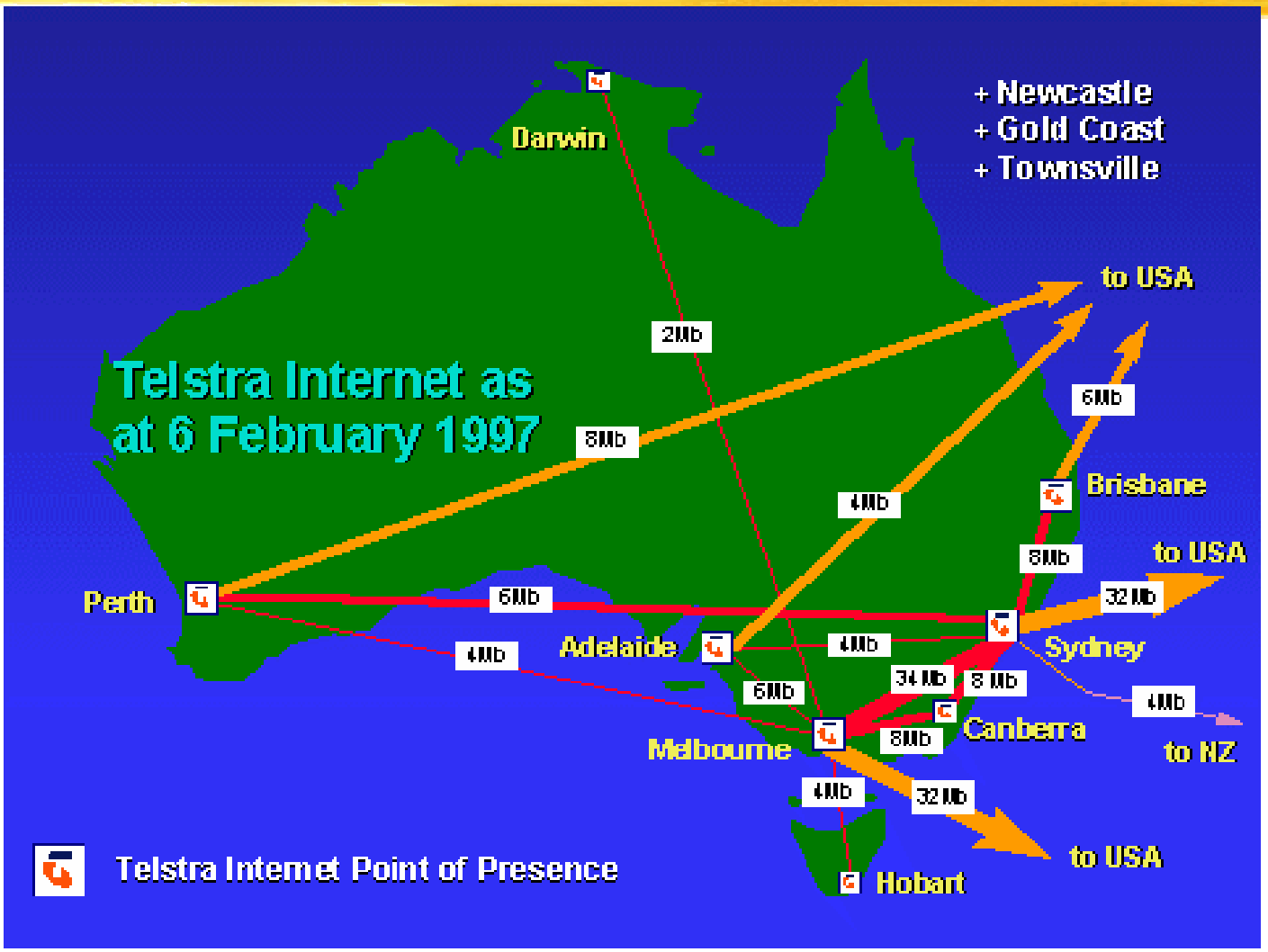
- Mesh Topology
  - + Resiliency against link or site failure
  - - Higher communications lease cost

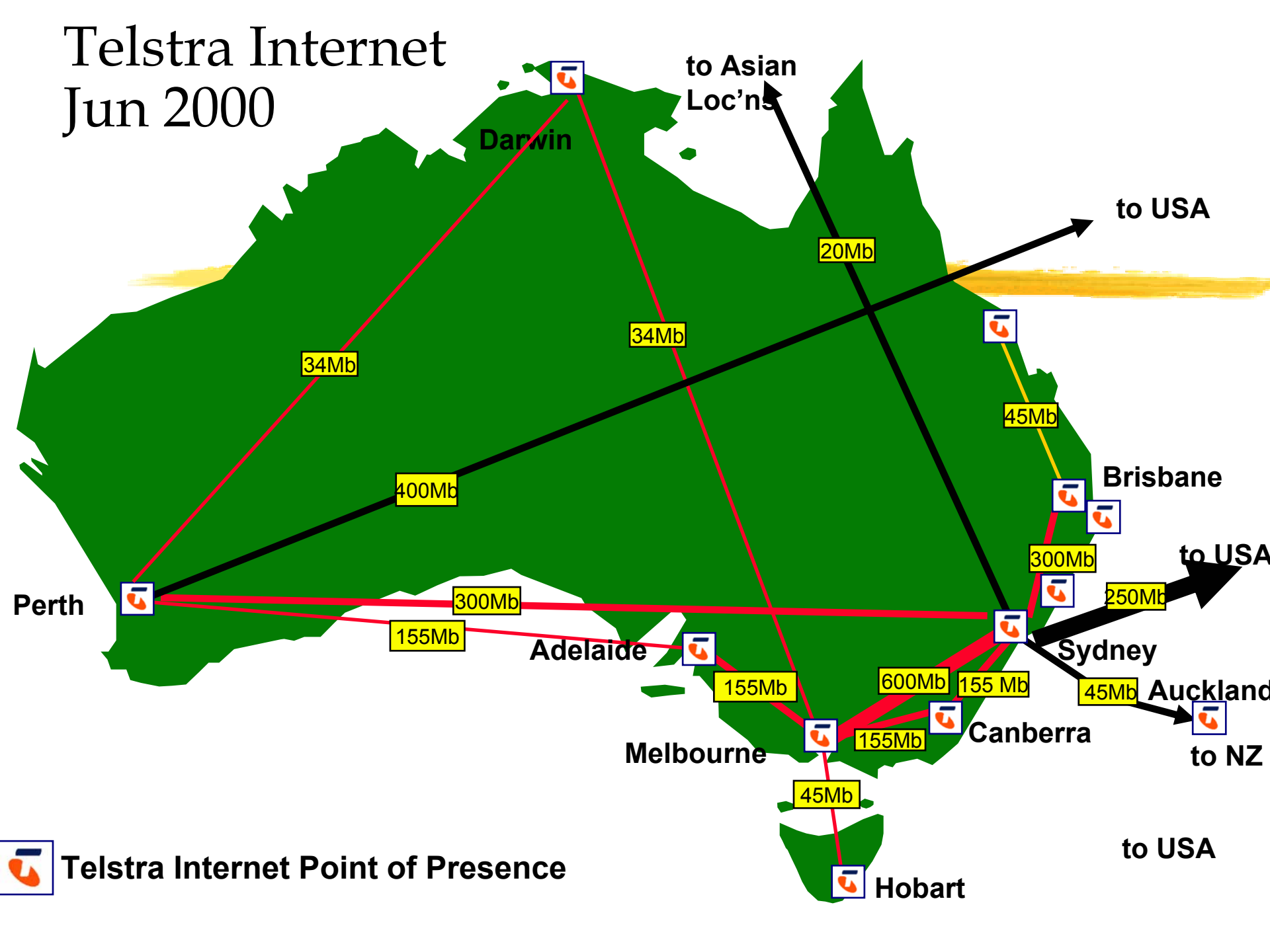


Mesh Topology



Network Design




Telstra Internet
Jun 2000
Darwin
to Asian
Loc'ns
to USA
20Mb
34Mb
34Mb
45Mb
400Mb
Brisbane
300Mb
to USA
Perth
300Mb
250Mb
155Mb
Adelaide
Sydney
155Mb
600Mb
155 Mb
45Mb
Auckland
Canberra
155Mb
Melbourne
to NZ
45Mb
to USA
Hobart
Telstra Internet Point of Presence

Network Infrastructure

- Hybrid - Resiliency via Dial-on-Demand
  - Establish backup circuits using ISDN, X.25 or modems
  - Issue of matching backup capacity against primary capacity

Network Infrastructure

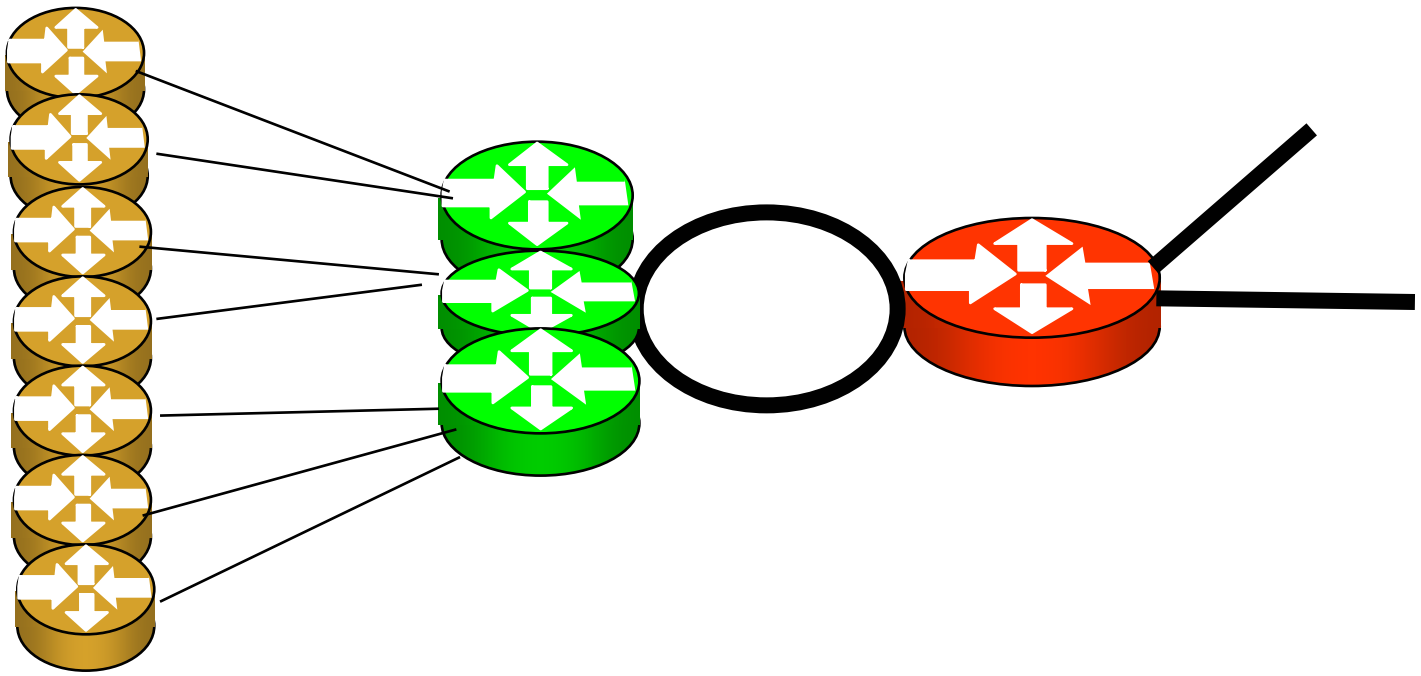
- Access to common switched services
  - X.25
  - Frame Relay
  - SMDS
  - ATM

Network Infrastructure

- Frame and ATM issues
  - Delivered Service contract (and enforceability)
  - Tariff issues
  - Dynamic vs static virtual channels
  - Efficiency
  - Congestion behaviour

Network Infrastructure Design

- Core routers driving major internal trunk lines
- Edge Routers providing client connection point
- Access Routers used on client site



Routing within the Network

- Choosing an Interior Routing Protocol
  - RIP (V2)
  - OSPF
  - (E)IGRP
  - IS-IS
- Classless routing protocols are now essential for this domain

Routing within the Network

- Integrity and stability of the routing domain is essential
- The routing protocol is not used to learn new routes
  - authenticity of the route
  - security and integrity of the routing domain
- The routing protocol is only used to promulgate the route within the network

Routing within the Network

- Use of static routes to dampen down route flaps
  - A transition of a route (up / down) causes all routers to undertake a cache dump and rebuild the route table from received routing information
  - Route Flapping can destroy network performance

Routing within the Network

- One approach – used for scaleability
  - Use OSPF as a link state maintenance protocol for the internal network infrastructure
  - Use static routes at the edge for retail customer access
  - Use eBGP for wholesale, peer and upstream accesss
  - Use BGP route attributes to associate policy with the route
  - Use I-BGP + default to carry customer routes in the Access net
  - Use I-BGP to carry full routes in the Core net