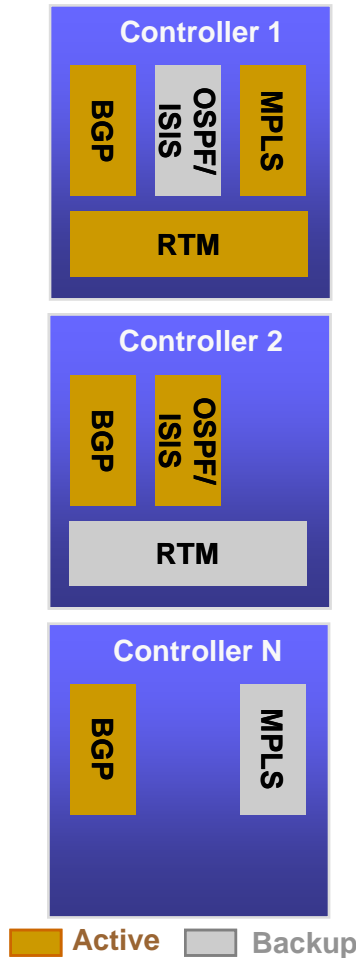


# Carrier Class Reliability



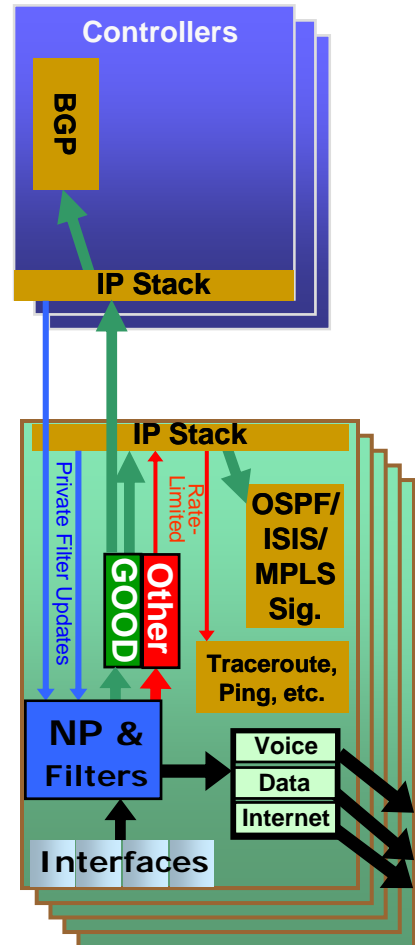
## Carrier Class Foundation

- Fully modular routing software, with task-specific resiliency
- Primary & backup modules can be assigned to any controllers
- Neighbor-specific IGP & MPLS tasks distributed to Line Cards
- Control Plane in-service scalable - add controllers in any slot at any time, and replicate tasks
- Data plane is programmable, redundant, and in-service scalable



## Carrier Class Resiliency

- Task replication and distribution eliminates single-point-of-failure
- Dual Protection Modes
  - ✓ Active/Backup
  - ✓ Standalone
- Task Monitoring
  - ✓ Operating system
  - ✓ Inter-task monitoring
- In-Service Upgrades
  - ✓ Upgrade backup tasks
  - ✓ Hitless per-task restart
  - ✓ Version-independence



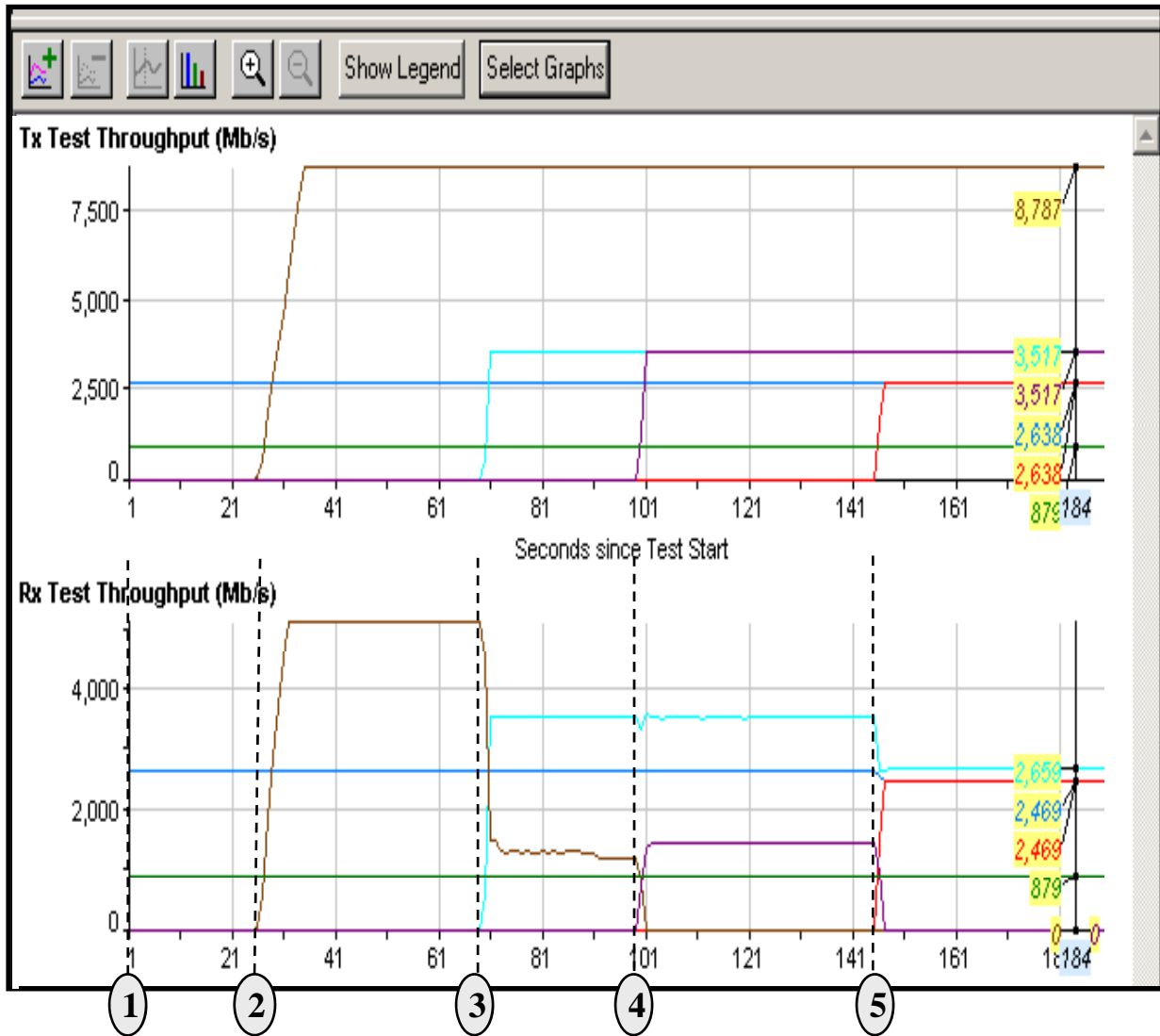
## Carrier Class Security

- Public plus Private Filters on each line card
- Control plane updates wire-speed filters to prioritize known-good control-plane traffic
- Pings, Traceroute, signaling, etc., handled by line cards.
- Unknown traffic rate-limited to prevent CPU exhaust
- Data plane protects total bandwidth for each service



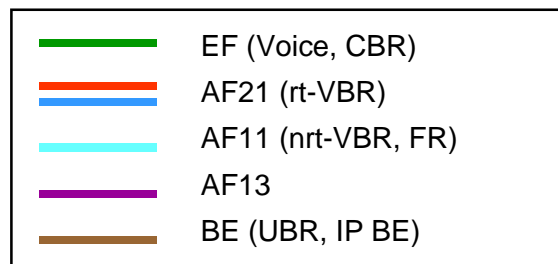
HYPERCHIP  
CORE IP SYSTEMS

# Carrier Class QoS



## ATM-Grade Results over IP

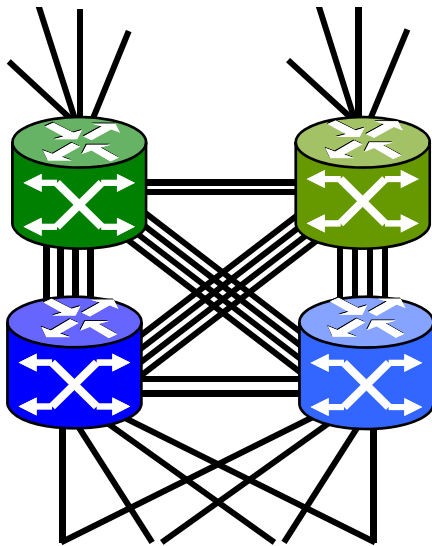
1. Inject EF and AF21 traffic
2. Inject BE (brown) traffic
3. Inject AF11 (light blue) traffic
4. Inject AF13 (purple) traffic
5. Inject AF21 (red) traffic





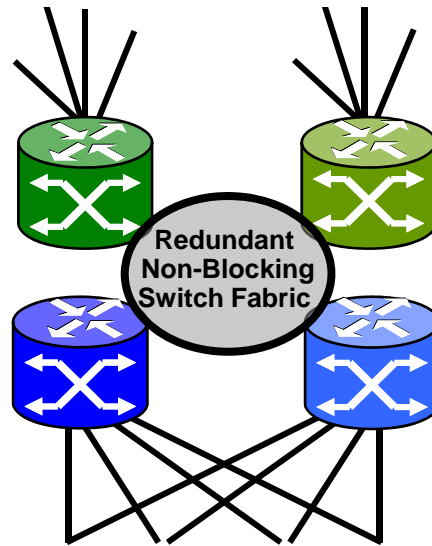
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# Carrier Class Logical Routers



## Incumbent PoP Core

30%-35% line cards outward facing






## Hyperchip

100% line cards outward facing  
(WITHOUT PoP architecture change)

## 70% Less Infrastructure



-  Controllers
-  Cold Backups
-  Line cards



|                          |                 |
|--------------------------|-----------------|
| Control-plane processors | 4 Active        |
| Backup processors        | 4 <b>Cold</b>   |
| Productive Line cards    | 8 (14%)         |
| Redundant Line cards     | 8 (14%)         |
| Interconnect Line cards  | <b>40 (71%)</b> |

|                          |               |
|--------------------------|---------------|
| Control-plane processors | 4 Active      |
| Backup processors        | 4 <b>Hot</b>  |
| Productive Line cards    | 8 (50%)       |
| Redundant Line cards     | 8 (50%)       |
| Interconnect Line cards  | <b>0 (0%)</b> |

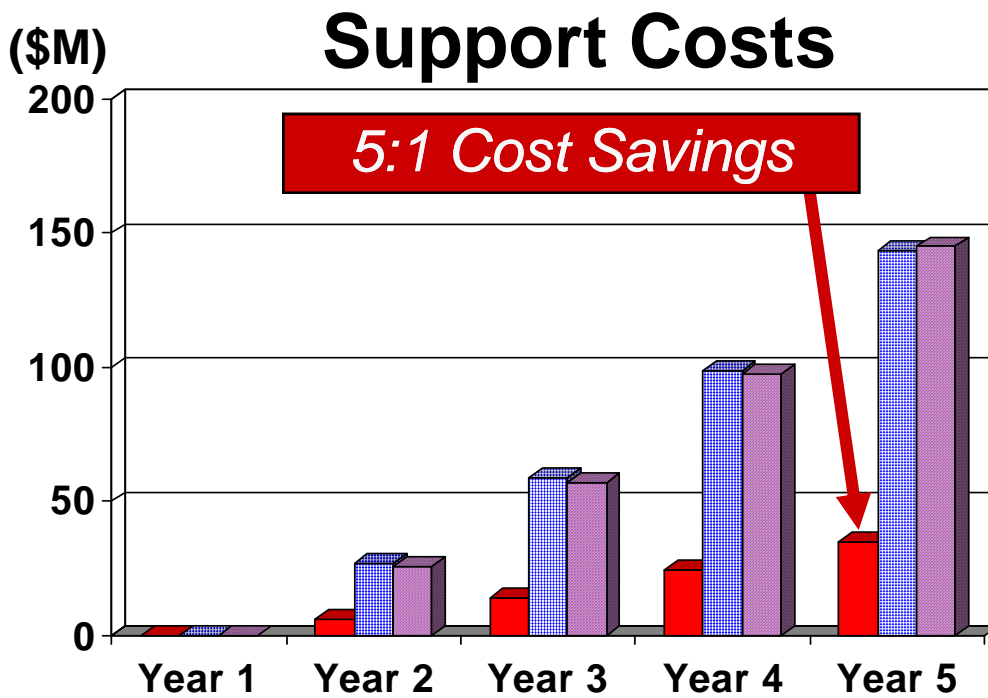
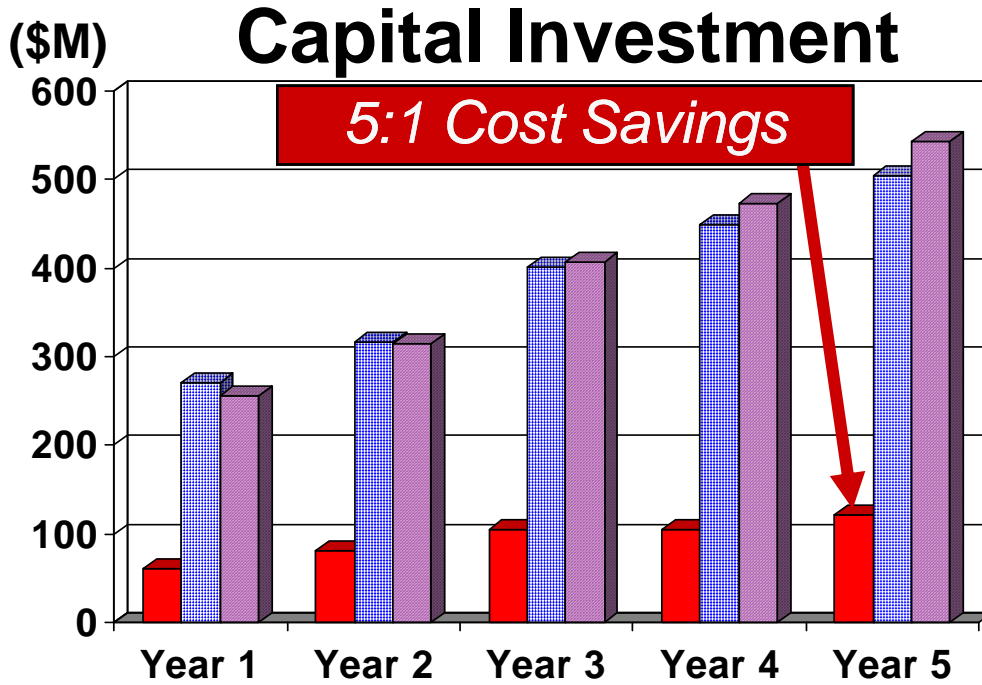
**Highest redundancy, Highest efficiency.**

**Maintains administrative, operations  
and routing domains**



HYPERCHIP  
CORE IP SYSTEMS

# Carrier ROI



Hyperchip



Incumbent #1



Incumbent #2