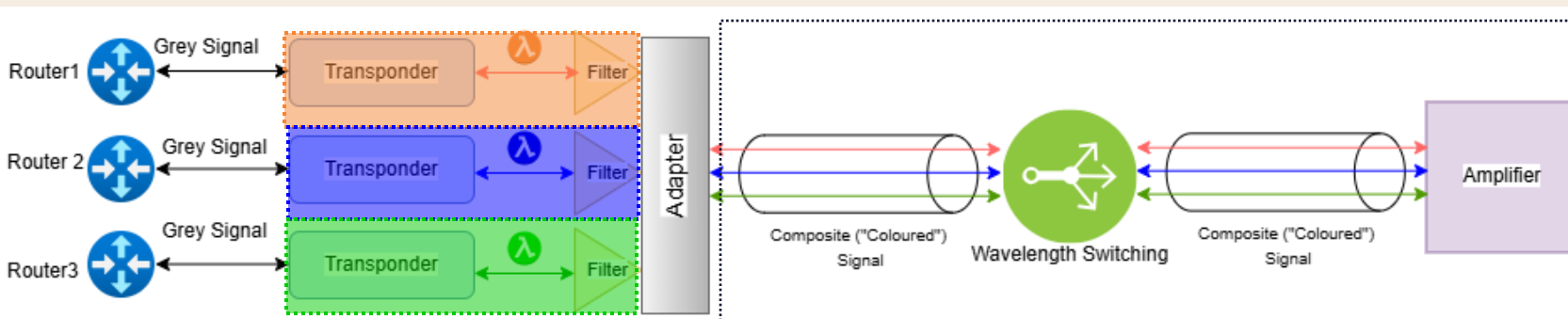
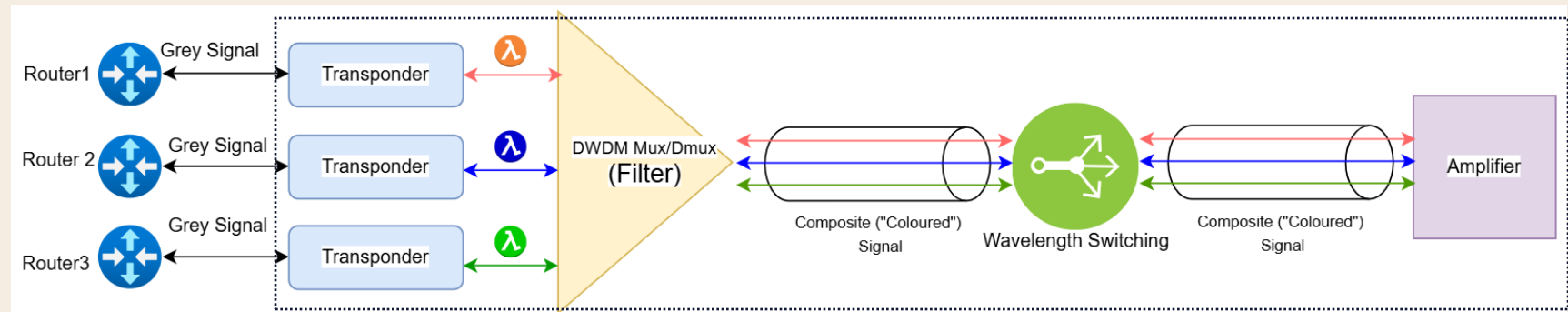


Breaking the Light Barrier: Optical Spectrum Sharing for Scalable Terrestrial Networks

1. Optical Transport and Spectrum Sharing, Overly Simplified
2. Out of the Blue - the Evolution from Sea to Land
3. Digging into Terrestrial Spectrum Sharing
4. Key Attributes of Terrestrial Spectrum Sharing
5. Spectrum Sharing vs Managed Optical Services vs Dark Fibre
6. Summary & Takeaway

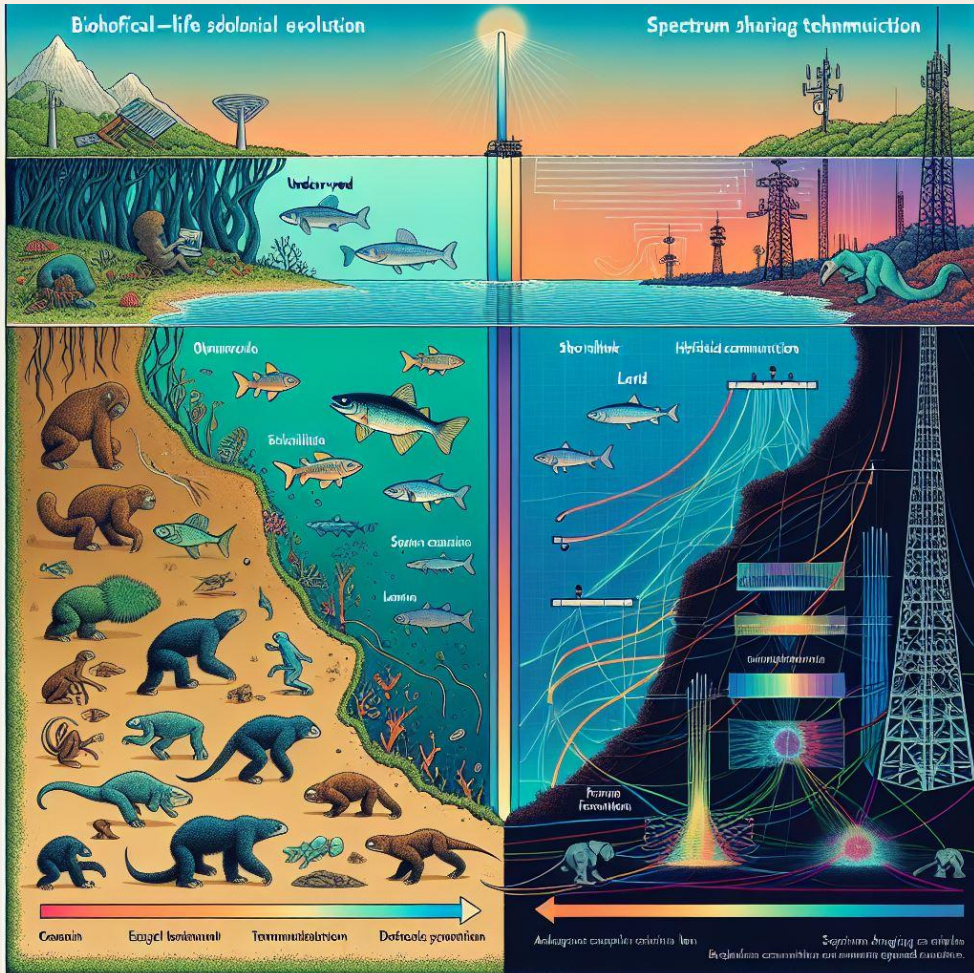
Optical Transport and Spectrum Sharing, Overly Simplified

- Optical Transport (WDM) is the most colourful black magic!
- Essentially it does three main functions:
 - Converts multiple “grey” signals to coloured ones so they can co-exist on the same fibre.
 - Boosts the lights so they can reach great distances.
 - Steers wavelengths through the network to connect different endpoints



Spectrum sharing is a construct where a portion of the “colours” is allocated to an operator, who can then utilise them at their will, without having to operate the underlying line system

“Out of the Blue” - the Evolution from Sea to Land



Spectrum Sharing: Proven First in Subsea

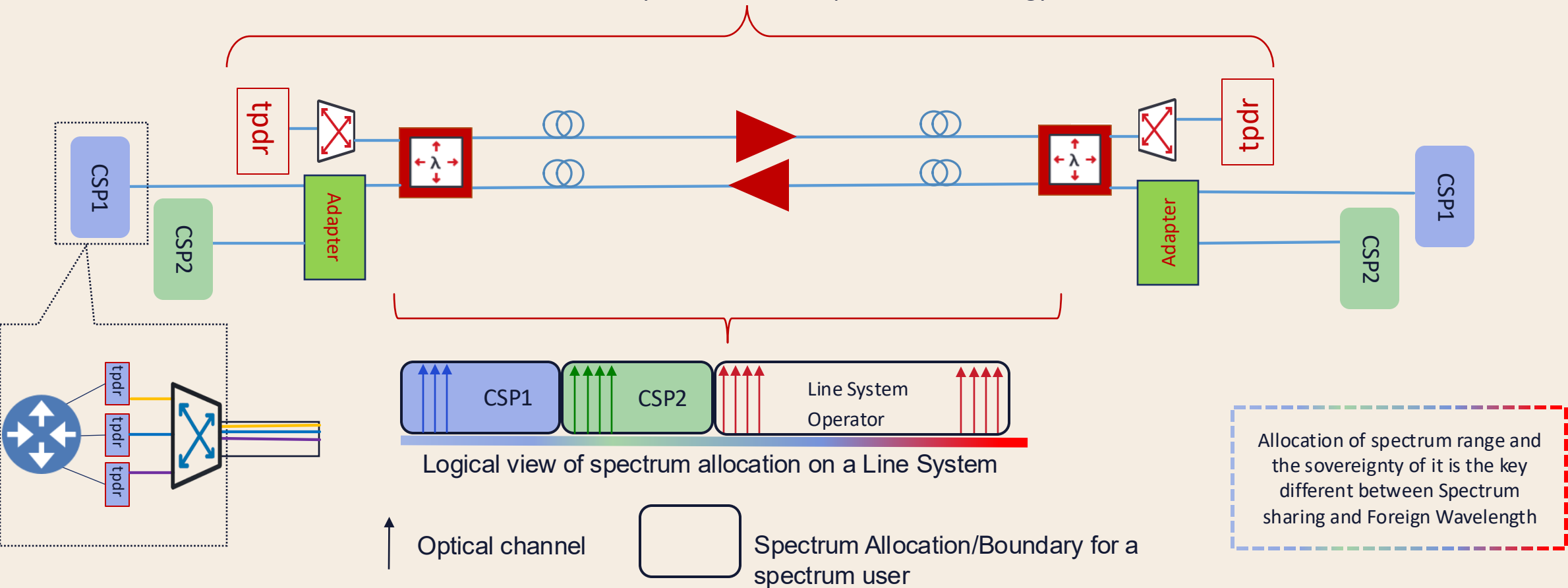
- High cost of cable deployment + operation led to consortium **joint ownership**.
- The most efficient ownership approach is to partition the optical spectrum between users, enabling independent operation.
- Each user is responsible for generating ASE (friendly noise) to balance the optical power across their own spectrum.

Technologies in Submarine have made a landing

- Largely driven by the void between managed services and running full-on optical systems
- **Single ownership**: Spectrum users just need to manage their own transponders, the optical line system owner fills and policies spectrum
- Spectrum users can focus on IP networks while still enjoy flexible and dynamic bandwidth options, without having to manage complex optical line systems

Diving Digging into Terrestrial Spectrum Sharing

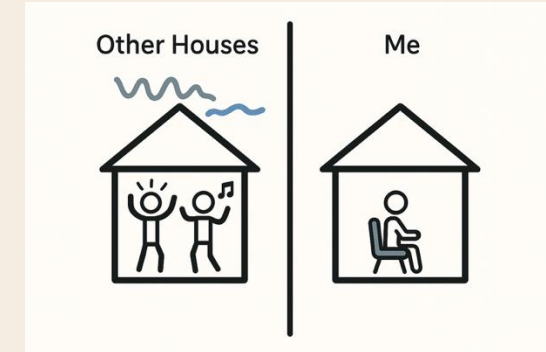
All line equipment is under physical control/management of the line system operator; other CSPs lease chunks of spectrum and have the flexibility to dictate transponder technology



Key Attributes of Terrestrial Spectrum Sharing

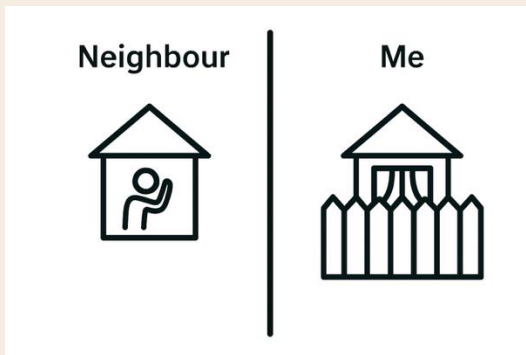
Channel Independence

My channels are shielded from all the other changes outside my allocated spectrum range. Whatever happens next door is their business, there is no impact on me (or think about shower temp change)



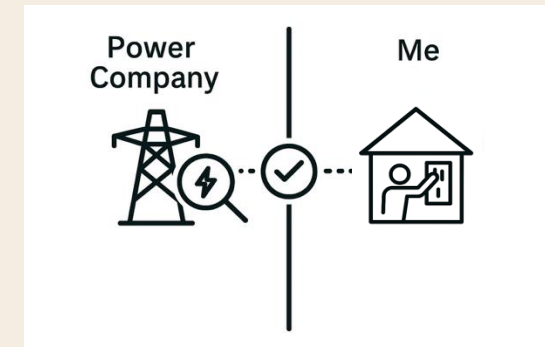
Resiliency & Privacy

Physical separation crucial to ensure no impact or privacy breach is possible due to misconfiguration. I have tall fences and all my windows have curtains so my neighbours can't just peak into my house.



Enhanced Monitoring

Monitoring points exist to ensure power for my channels are as expected always. While I am responsible for the electrical system in my house. The power company monitors and detects power issues on the grid impacting to my property and they proactively work with me to fix these issues



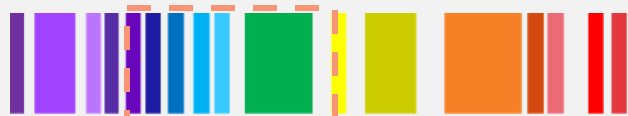
Spectrum Sharing vs Managed Optical Services vs Dark Fibre



Wavelength Services

10G/100G/ 400G

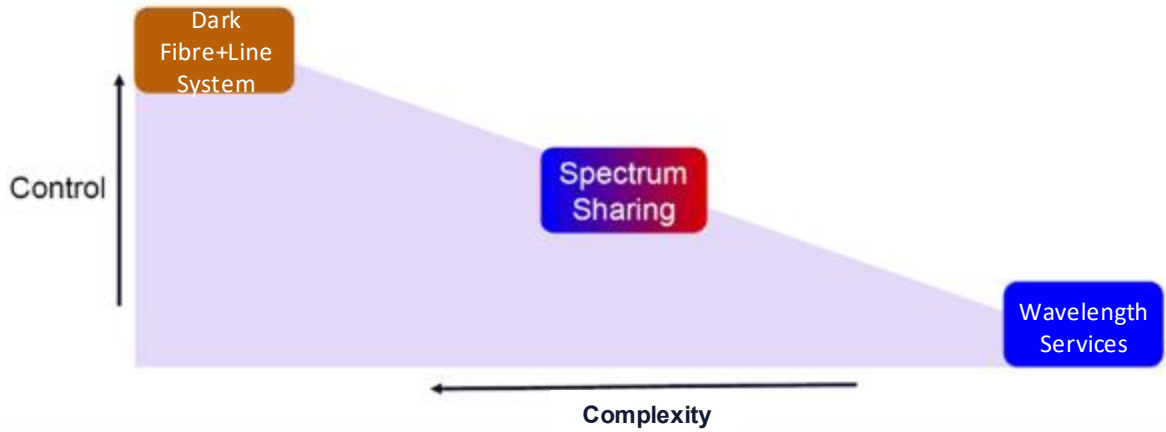
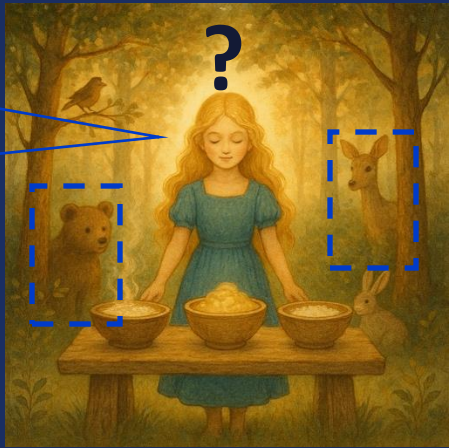
Spectrum Sharing Services



Dark Fibre + Line System



Oh deer, I can barely decide!



Summary & Takeaway

- Optical spectrum sharing evolution from sea to land
- The construct and key components of terrestrial spectrum sharing
- Key attributes: channel independence, resiliency/privacy, enhanced monitoring
- Benefits of Spectrum Sharing: a sweet spot between simplicity, flexibility, security, and cost-effectiveness

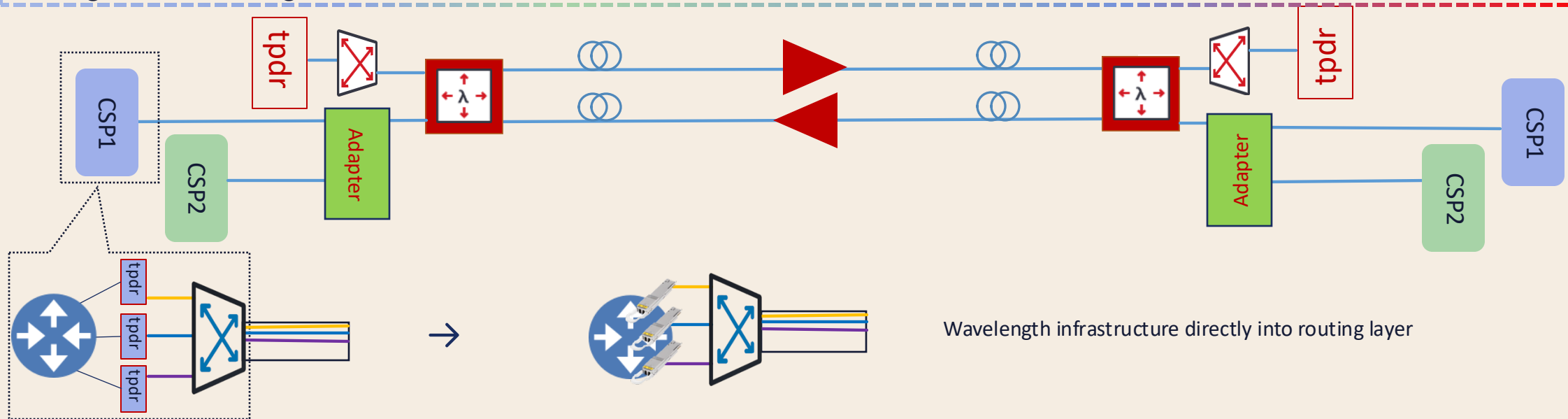
How do I know if it's for me without tasting the cold and hot porridge? Questions to ask yourself:

- Do/Will I need a lot of capacity, particularly between capital cities?
- Do I have a problem waiting for my optical service provider to turn up new capacity each time I need some?
- Am I happy to run an Intercapital optical line system (OK maybe happy is asking too much)?

... and am I using or thinking of using coherent plugs in my routers?

“Bonus” Case Study: Supporting IP-Optical Convergence

- Coherent plugs can replace transponders and facilitate IP-Optical convergence. However a line system is still required when distance is above ~100KM
- The choices are then either grey optics and connect to managed wavelength services, or run a line system of your own.
- Spectrum sharing opens up a new option: connects coherent plugs into leased spectrum and let the black magic do its thing!



Q&A^{*}

* Well you can ask your Qs but I may or may not provide the As