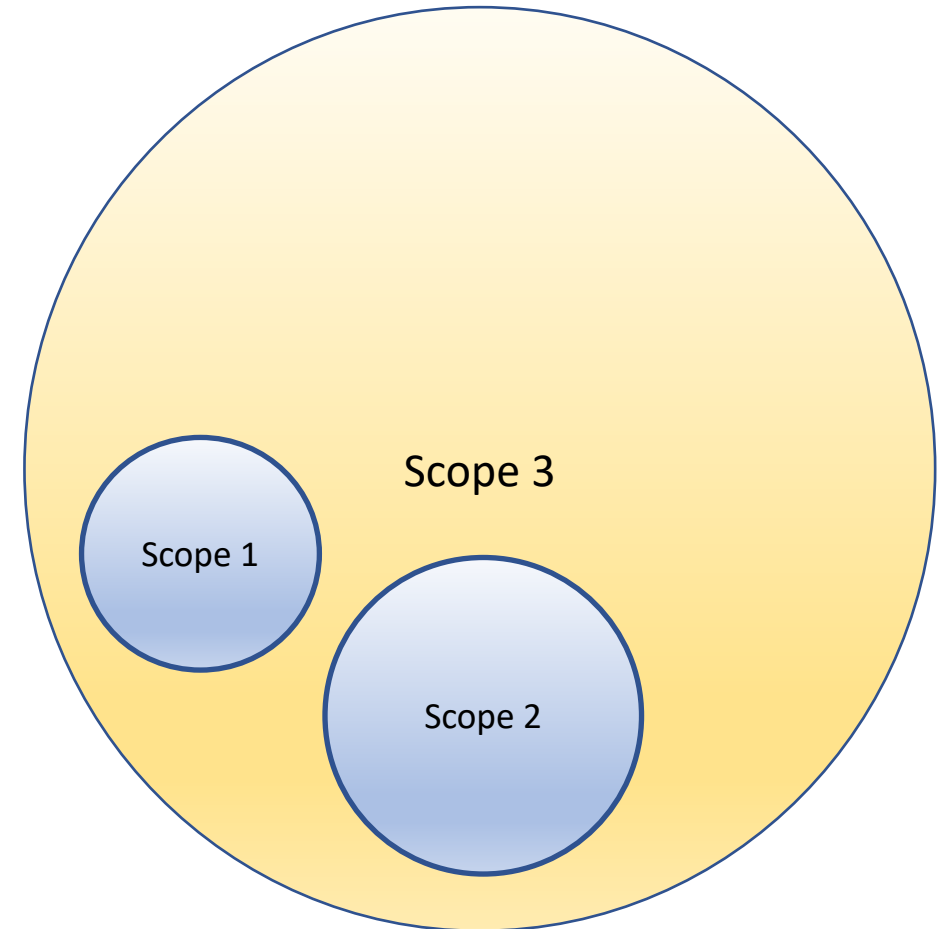
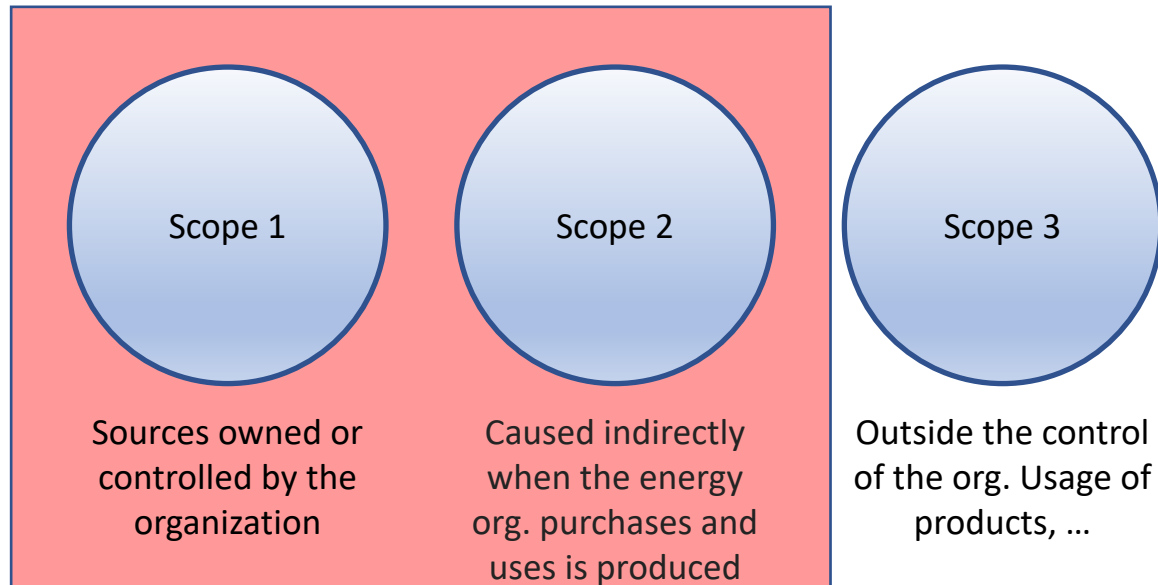


Sustainability Considerations for Networking Equipment

Suresh Krishnan & Carlos Pignataro

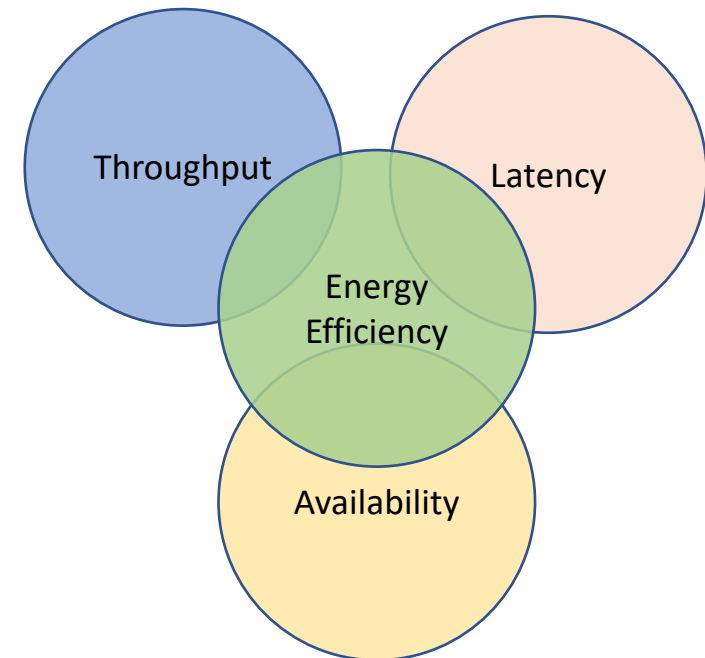
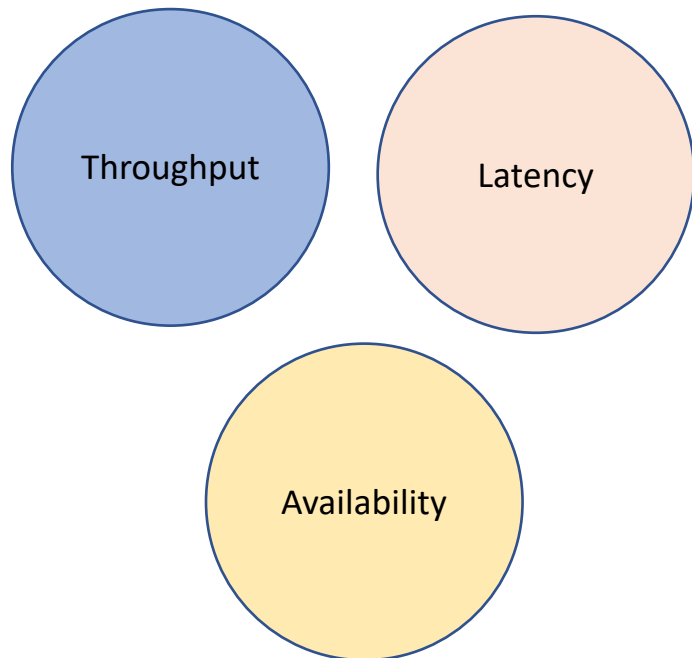
Where is the forest?



Networking Industry

Scope 3 for someone is Scope 2/1 for someone else

What are we optimizing for?



Step by Step



Visibility

You cannot improve what you don't measure

- The IETF, IRTF and the IAB have a long history of work in this field
 - Successful in standardizing and collecting metrics for network management, performance, and troubleshooting
- Need to work on similar efforts on measuring environmental impact
 - Delays will risk **ill-defined, potentially redundant, proprietary, or even contradicting** metrics.

Insights and Recommendations

Show the impact and drive improvements

- Provide open-source reference implementations for users to visualize their environmental impact
 - Build on the common metrics to build Lowest Common Denominator
 - Allow vendors to build plugins to integrate
 - Facilitate multi-domain optimization
- Provide advice and recommendations to reduce environmental impact
 - Operational changes
 - Creation of best-practices
 - Changes towards a greener, more environmentally friendly equipment, software, platforms, applications, and protocols

Self-Optimization and Automation

Enable smaller time scales

- Phase 2 helps decision makers over longer time scales but does not help in the short run
 - 24x7 monitoring and manual changes are neither feasible nor desirable
- Need to provision some amount of self-awareness into the network
 - Recognize opportunities for improvement and make those changes
 - Measure the effects of the changes (closing the feedback loop) and repeat
- Make it possible to specify the goals of the consumers in a declarative fashion
 - Networks can continually use mechanisms such as ML/DL/AI with an additional goal to optimize for improvements in the environmental impact.
- Identify opportunities & solutions for Scope 4 (avoided emissions)

Concrete & Immediate Steps

- We need to help consumers of our technologies measure and understand their emissions impact (Scope 3)
 - Provide vendor-agnostic standard ways of measuring and reporting energy impact
 - Preempt greenwashing
- Build robustness and recoverability into protocols
 - Consider avoiding over-engineering and unnecessary redundancy
 - Meet the SLAs in the most energy efficient way
- Eschew micro-optimizations and consider product lifecycle
 - Currently protocols and network equipment are designed in a tightly optimized manner for a very specific use case and context.
 - This does not take into account that the same equipment and protocols could be reused in a different context in the near future.
 - It is very likely that extending the life of such equipment with higher flexibility could provide a better environmental benefit than micro-optimizing for today.