AN OBSERVABILITY, MONITORING AND ANALYTICS FRAMEWORK FOR THE CONTROL AND MANAGEMENT OF 6G MULTI-TENANT ENVIRONMENTS

SMART NETWORK MANAGEMENT, INCLUDING FUTURE DEVICES AND RADIO EVOLUTION

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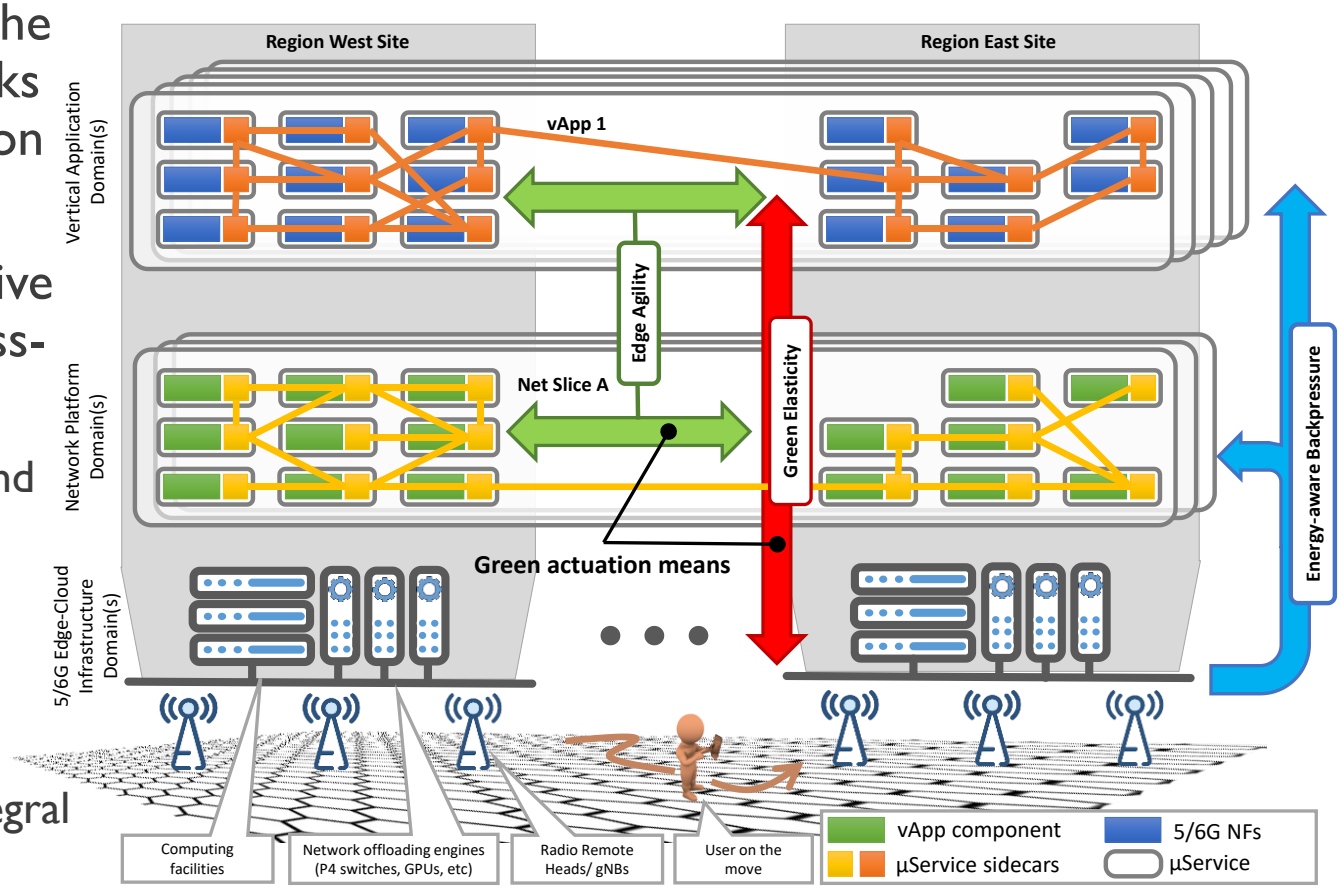
CONTEXT

- 5G came to light with the promise of digitalizing our society and transforming our means of production and everyday lives alike with innovative vertical applications with real time and low latency requirements.
- Enabling technologies, mainly NFV and Edge Computing, allow for flexible deployment and orchestration of application components and network slices tailored for even the most specific demands.
- However, the price to pay for such technological advancements is a spike on energy consumption due to the increase of the computing resources needed to instantiate and use the virtualized objects.
- Indeed, in today's cloud computing scenario, resources/services are instantiated and used in an as-a-Service fashion, inducing heterogeneous utilization (i.e., in terms of network, computing and storage) and energy consumption to the physical infrastructures.

WHAT - 6GREEN

- Objective: promote energy efficiency across the whole 6G value-chain, and enable 6G networks and vertical applications to reduce their carbon footprint by a factor of 10 or more.
- Exploit and extend state-of-the-art cloud-native technologies and the B5G SBA with new cross-domain enablers to:
  - boost the global ecosystem flexibility, scalability and sustainability enable all the 5/6G stakeholders
    - Edge agility
    - Green elasticity
    - Energy-aware backpressure
  - reducing their carbon footprint by becoming integral parts of a win-win green-economy business.



HOW - METHODOLOGY

Edge Agility

- Smart, fast, and automated horizontal scalability across the edge-cloud continuum.
- Workload redistribution according to user or infrastructure-driven events.
- Control plane integration to assure seamless operations based on cloud-native service-mesh routing.
- Rapidly scale to zero the footprint of unused slice/vertical applications, and quickly resume them when needed.

Green Elasticity

- Enable smart vertical scalability across the 6G ecosystem.
- Rely on hardware acceleration engines to lower processing latency and reduce consumption by exploiting standby/low power modes joint with optimal configurations/deployments.
- Holistically optimizing the trade-off between the energy/carbon footprint and the performance of network and application artefacts.

Energy-aware Backpressure

- Cross-domain analytics to evaluate the energy and the carbon footprint that a vertical application, a slice, or the 6G network induce onto the edge-cloud infrastructure.
- Establish business models and decarbonized service agreements.
- Algorithms to guarantee proportionality between the resource usage footprint, energy consumption, performance and workloads.

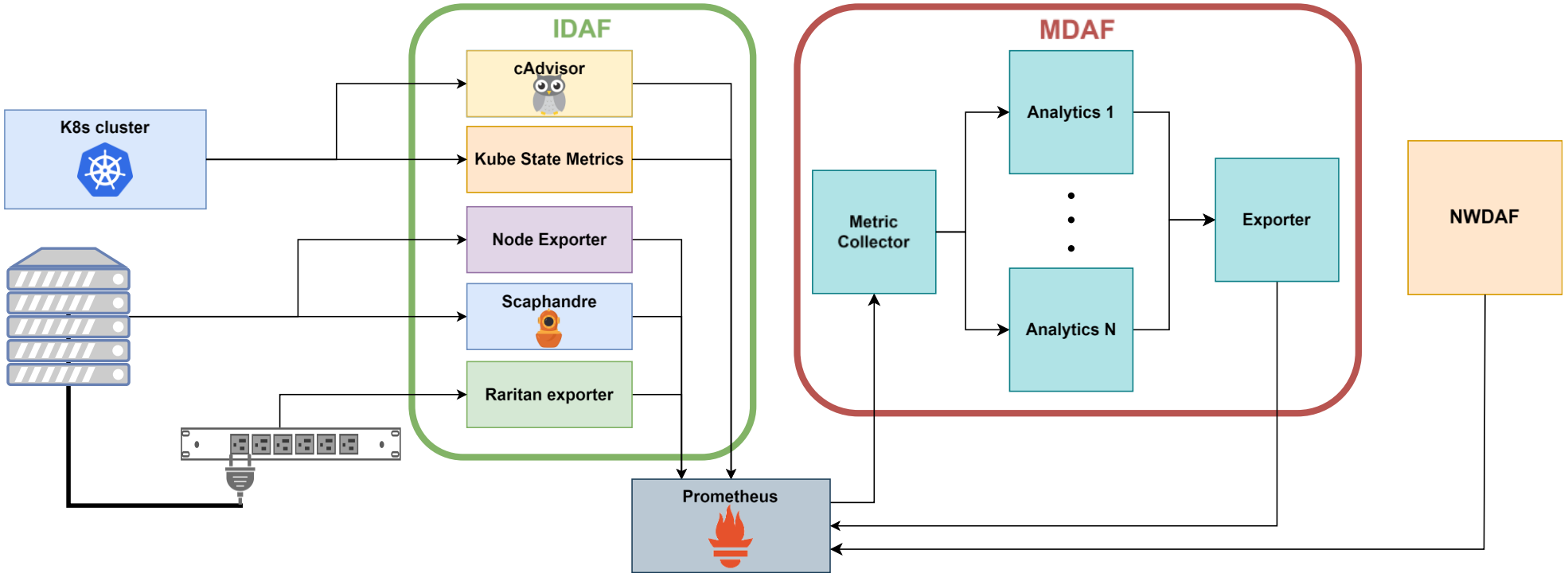
WHY - STAKEHOLDERS

- Only the (physical) infrastructure layer consumes energy.
- The way stakeholders acting on the virtual level (e.g., vertical application and network platform providers) consume and release resources has a direct impact on the carbon footprint of the stakeholders acting on the physical level (e.g., infrastructure providers).
- Sustainability must become a common business target of all the stakeholders to achieve significant carbon reductions: infrastructure, network platform and vertical application providers must be incentivized to cooperate towards joint carbon footprint and energy efficiency targets.

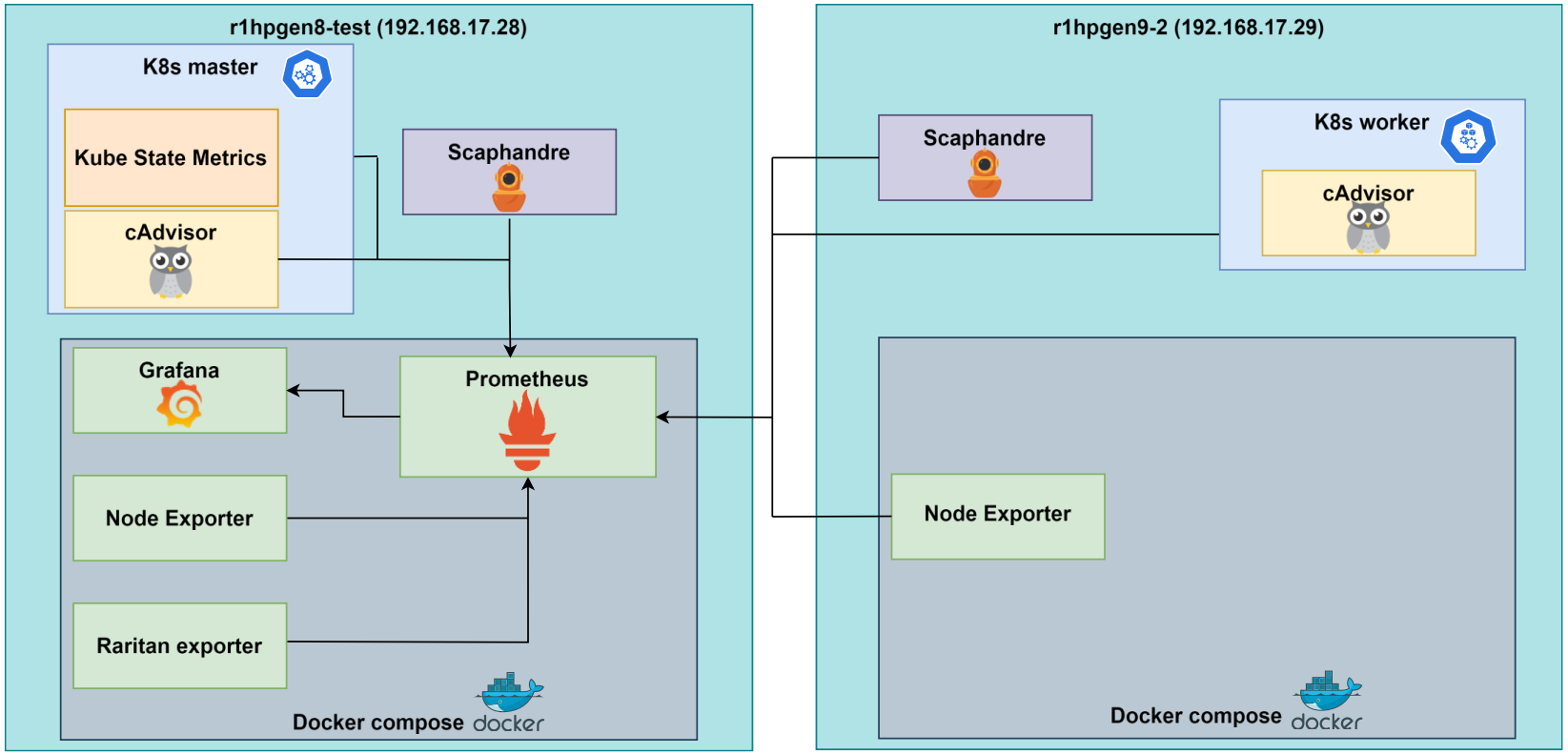
HOW - OBSERVABILITY

- In order to understand the impact of a specific tenant over an infrastructure, it is necessary to infer the (energy and resource) consumption ascribable to it.
- It is not trivial:
  - Usually, the same piece of hardware is used by multiple artefacts from more than one tenant at a time.
  - Some artefacts might be shared among multiple tenants (e.g., a single UPF hosting multiple slices).
- Potential observability framework should not be too "invasive" to avoid to consume more energy/carbon footprint than what can be saved.

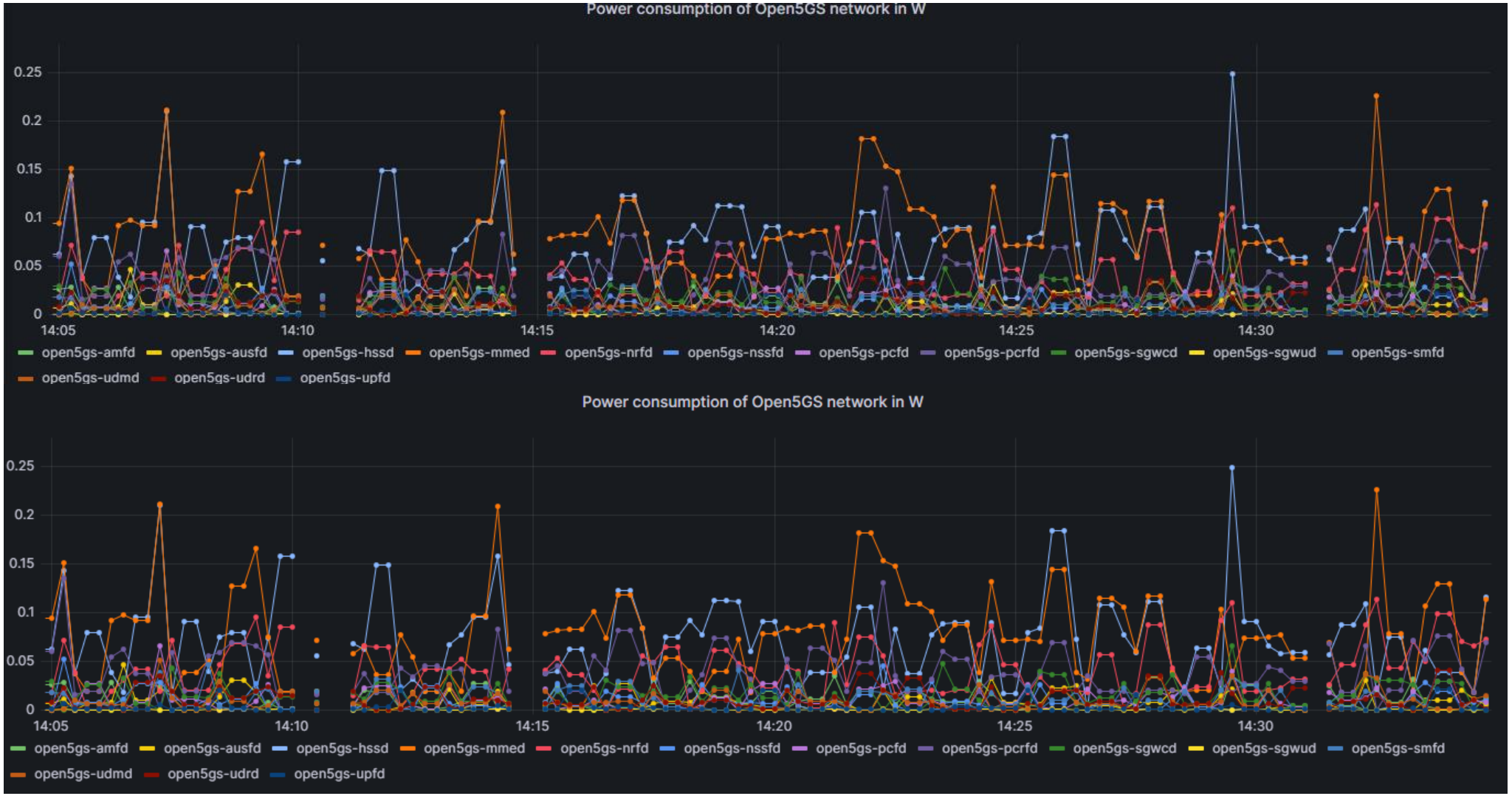
THE 6GREEN OBSERVABILITY, MONITORING AND ANALYTICS FRAMEWORK



EXPERIMENTAL SETUP



PRELIMINARY EXPERIMENTAL RESULTS



CONCLUSIONS & WIP

- Infer the colelcted data against the nature of the energy
- Modulate data collection and analytics according to potential savings
- Compare different implementations of the 5G core
- Extend to hardware rather than CPU (e.g. GPU)

- 6Green will provide SBA 5G function prototypes implementing the fullstack observability ecosystem.

THANKS FOR YOUR KIND ATTENTION!

ANY QUESTION?