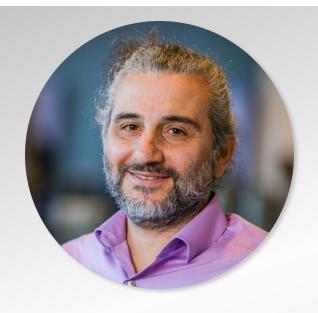
### NaaS Al Use Cases:

## Al Ops and Al Empowered Provisioning



Ahmad Khalil

AVP - Head of Programmable Networking & Technologies, Tata Communications



Jakub Niezgoda

Technical Leader, Amartus



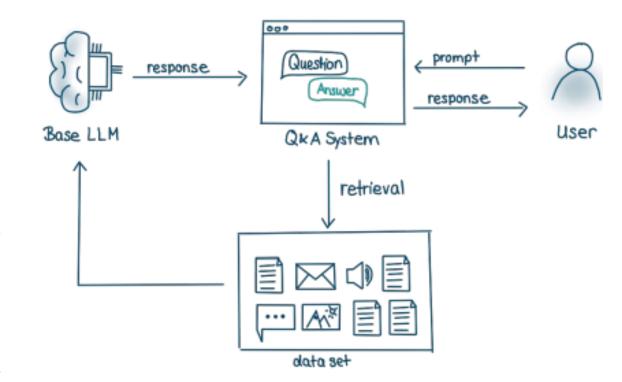
Yuta Yamagishi

Solutions Architect, NTT Communications



# High-Level Concept

- Enhancing the output of LLMs with external knowledge by RAG (Retrieval-Augmented Generation)
- This approach can fetch the domain specific data to augment the LLM's prompt and provides a quick and costeffective way to integrate domain specific knowledge to LLM through retrieval mechanism without needing to customize LLM.
- **Step 1:** Collect domain data, perform data preprocessing & transformation to vector and store in vector database for fast retrieval.
- **Step 2:** Augment model with domain specific context coming directly from vectorized information stores.
- Think of it as enhancing the prompt with an extra layer of context, instead of a skilled engineer fine tuning the questions. However, the added context isn't just a few details - it's an entire dataset of knowledge, and domainspecific





# Realizing the Next Generation NaaS by Adopting GenAl

A full Al powered NaaS ecosystem, is to have fully on-demand, everything automated from day 0, 1 and Day 2. This can be achieved by enabling users to manage their network operations in a self-managed manner and have the flexibility to handle everything, not only provisioning their service through a NaaS portal, but also troubleshooting and speeding up RCA in case network issues and eventually making network configuration changes to fix the problem.

### Design (DAY 0)



#### E.g.,

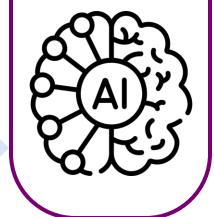
- Input Network requirements with traffic volume, scale and etc ...
- Output the network diagram and configuration steps.

### **Optimization (DAY 2)**



E.g., Propose configuration changes for better performance and security.





### **Operation (DAY 1)**

#### E.g.,

- Service orders such as ordering new VPNs via interactive chat
- Modify Security Appliance Settings



NaaS API





### **Troubleshooting (DAY 2)**

E.g., Intelligent and enhanced troubleshooting to speed-up RCA resolution without the need of network expertise





# 2024 Use Cases



# Day 1 - NaaS Enabling Self-managed NW Ordering

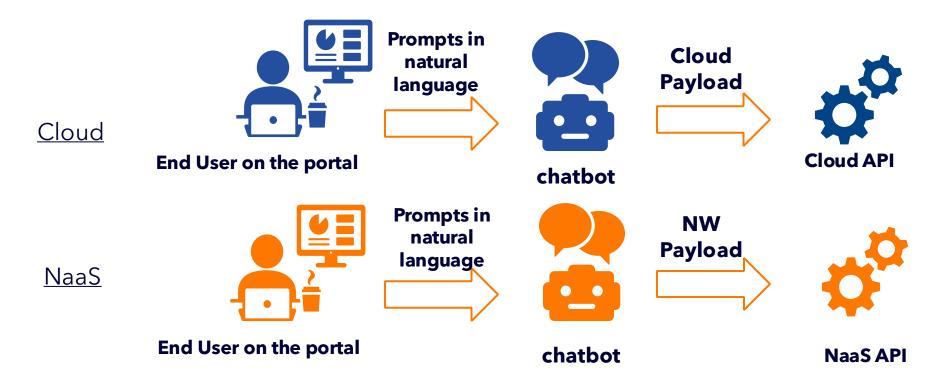
NaaS has enabled NW ordering with using API and made the NW operation self-managed.

#### Before Now End users used to fill up an Excel form and send End users can order a new NW and change a it to operators when they order a new NW and configuration on a self-management portal immediately. change a NW configuration Take a few minutes to Take a few days to **Portal** complete an order. complete an order. Manual Operator OSS / BSS OSS / BSS **End User** input monitoring Real time monitoring of entire network



# Day 1 - Blueprint of GenAl Based NW Provisioning

- In the field of cloud, automated provisioning is already achievable, and the network domain needs to follow suit in the same way.
- By utilizing a chatbot to enable interactive automated provisioning for networks, we can make operations on NaaS simpler as the cloud world.





# Day 2 - Al Ops



I cannot access linux2 from Corporate network. Help troubleshoot.



- Get details about device identified by 'linux2'.
- Ping 172.20.20.107.
- Calculate delay towards 172.20.20.107.
- Get path in network (Corporate network -> linux2).









- Hostname: linux2
- o IP Address: 172.20.20.107
- Device Type: Server
- Family: Generic
- 2. Connectivity Status:
  - o Ping Result: Reachable (True)
  - Delay to Node: 0.051 ms to 172.20.20.107
- 3. Path from Corporate Network to linux2:
  - Corporate
  - CISCO\_XR1
  - JUNIPER\_QFX
  - CISCO\_XR2
- linux2



#### **Analysis and Conclusion:**

- The device linux2 is reachable from the corporate network, as confirmed by a successful ping response.
- The network delay to linux2 is minimal (0.047 ms), indicating that the network path is
  efficient



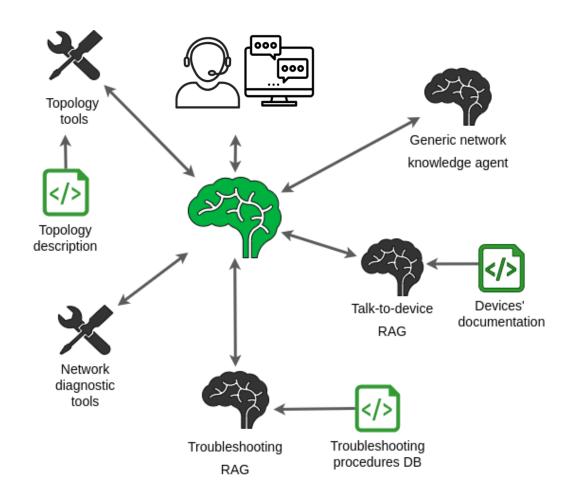
#### Recommendations

- 1. Check Device Configuration:
  - Review the device configuration directly (if accessible) to ensure it is correctly set up for communication with the corporate network.
- 2. Verify Firewall and Security Settings:
  - Ensure that there are no firewall rules or security settings blocking access to linux2 from the Corporate network.
- 3. Consider Device Compatibility:
  - If further diagnostics are needed, consider using other tools or interfaces that are compatible with the device's family type to gather more detailed information.

| Tata                    | Amartus                |
|-------------------------|------------------------|
| LLaMa 3.1               | GPT-4o                 |
| Neo4j database          | NetworkX library       |
| Real network<br>devices | Virtualized<br>network |
| Multi-agentic           | Single agent           |
| LangChain + LangGraph   |                        |



# Day 1 and 2 - Integration Complexity



### **Multiple Data Sources**

Sophisticated engine training required to correlate information and draw insights across multiple data sources

### **Domain-Specific Knowledge**

LLMs often lack deep understanding of networking concepts, requiring specialized augmentation

### **Data Privacy Concerns**

Handling sensitive network configuration data raises security and compliance issues

### **System Evaluation**

Al response probabilistic nature requires comprehensive testing and deep domain understanding



# **Outcomes & Next Steps**



### **Outcomes**



#### **LLM Capabilities and Limitations**

- Networking operational knowledge varies significantly across LLMs, vendors, and domains => conditioning required: prompting, RAG.
- Reasoning capabilities depend on the complexity of retrieved network information and the prompting.
- Programming techniques and custom tools must be tailored to specific LLM



#### **Efficient Knowledge Integration**

- Mastering prompt engineering is crucial
- **Data preparation** is critical for Al consumption
- Small changes can yield significant outcome differences



#### **System Evaluation and Human Expertise**

- Response probabilistic nature requires comprehensive testing and deep domain understanding
- Establishing base and continuous work on *improving test sets* is necessary
- Throughout development the **network domain expertise is essential**



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# **Ecosystem Evolution and Next Steps**

#### **Additional Participants**

- We know the issue of the availability of data and how difficult is to share such sensitive information. So, we need as a community to define how we can address this issue. Is there a guideline we can follow or a standard we can use to govern this process?
- By targeting various domains, whether
  utilizing the same or different technology
  stacks for comparison, we can work
  together as a community to establish best
  practices for building RAG-based
  solutions, including the evaluation of data
  sources' usefulness for specific domains,
  methods for measuring solution quality,
  and strategies for evolving the knowledge
  base without compromising solution
  quality.

#### **Full Closed Loop**

- Silent Comet is an incubation project toward the first step of close-loop troubleshooting and provisioning and it will be essential for a fully automated NaaS.
- Further, we need to enable users to manage their network operations in a self-managed manner and to have the flexibility to handle everything, not only provisioning their service through a NaaS portal, but also troubleshooting and speeding up RCA in case network issues and eventually making network configuration changes to fix the problem.

# Potential Monetization and Business Value (new services and features)

- Enhancing the user experience of customers who can request new services, without the knowledge and expertise of the provider platform and service types.
- Customers can specify their intent and objectives in writing/text and RAG powered NaaS platform will provision the network to provide the desired outcome.
- Enterprise users can now, not only provision their own services, but potentially troubleshoot issues, without the need to know the details of service provider domains using the RAG approach



