

## ❖ General context

The recent merger between telecommunication operators and IT providers through virtualization has triggered the advent of software defined networking and virtualized functions (SDN and NFV) opening new horizons to network operators. This evolution introduces novel and tailored service offers while reducing the overall deployment and maintenance costs.

To meet these requirements and face the related challenges, we introduce the concept of « Global Operating System or **Global OS** »: a distributed and software-defined platform that handles the entire IT and network resources deployed by the operator for its services. Global OS also allows the user to control and tune its services. The reliability, high availability, and coherence of a shared context in a distributed environment are strong requirements.

In such a system, the data is a central element that focuses the attention of deployed services over GlobalOS. Databases went through several revolutions of their own to meet the IT needs in each era since the 60s: relational model, distributed transactions, NoSQL, graph databases, in-RAM (volatile memory) databases and even NewSQL. Several challenges related to this context should be considered in GlobalOS where one ambition is to unify networking and IT resources within the same orchestration and management system. To this end, this thesis should study and implement a prototype database that includes knowledge representing the GlobalOS system state dynamically evolving in a coherent manner. This database system should be reliable, considers fail-over mechanisms, and presents a coherent view of the geo-distributed system data.

This thesis will be supervised jointly by Orange and Inria in the common </O> Laboratory. Inria will provide its expertise in distributed systems architecture well suited to networking challenges. This collaboration will highlight the fundamentals of data coherence in a geo-distributed scalable system. In particular, the PhD candidate will consider GlobalOS[1], WebCom system by Orange [2], and “antidote” by team Regal from Inria[3][4] as entries of the state of the art bibliography.

## ❖ Keypoints and position towards Orange’s research strategy.

Configuration management is a necessary component of the GlobalOS framework. It should consider the targeted GlobalOS properties of geo-distribution, accessibility to third parties, and high dynamicity of data updates. Not only does the thesis consider the configuration management aspects but should also study the applications’ data in a virtualization context that is moving towards containerization. In particular, the following keypoints points should addressed:

- Database coherence in a geo-distributed context.
- Use transitory states of the data (during a commit, for example) to create « shadow » versions or « avatars » for disconnection-tolerant applications (adhoc, 5G, IoT)
- Heterogeneous data sources (datastore, RDBMS, other)
- Failure tolerant system.

## ❖ Position towards other Orange Labs research

This PhD thesis contributes to the ongoing GlobalOS framework design. Configuration management aspects are essential to the telco operator. This thesis will address the distributed database system problem in a context of heterogeneous data coming from virtualized networking elements and other applications in the Global OS system. The multi-tenant aspect where a third party could have a limited view of our deployed infrastructure should be considered. The concurrent access to these data stores should also be addressed. This thesis proposal will involve the OLN and OLPS entities from Orange. Inria should contribute with its academic background in the field of geo-distribution of data and the coherence of it. Orange will ensure the adaptation of these principles in an operational context. The Webcom system (Flexible datasync) will be a base for the prototype.

## ❖ Thesis description

This thesis should aim at proposing models and mechanisms for coherent management of configuration information linked to GlobalOS system. In this geo-distributed context, open to concurrent access and frequent failures, key challenges can be summarized as follow:

- Design of a database system with coherence in a geo-distributed context.
- Use transitory states of the data (during a commit, for example) to create « shadow » versions or « avatars » for disconnection-tolerant applications (adhoc, 5G, IoT)

- Use heterogeneous data sources (datastore, RDBMS, other)
- Support failures in the system.

The PhD candidate will :

- Identify use cases where coherent and concurrent access to dynamically changing configuration parameters would be better supported through special database management systems
- Define and implement said systems
- Use transitory states to create snapshot images usable by disconnection-tolerant applications (IoT)
- Define configurable dynamic models taking into account changes in topology (network, IT)

#### ❖ Initial schedule

1 –State of the art:

- Define use case covering important usage scenarios of GlobaOS regarding configuration and application data
- Identify database systems requirements in the context of a convergent IT and Networks scenario: hierarchical SDN controllers, infrastructure orchestrators...
- State of the art of new database systems respecting ACID properties

2 – Propose database systems and management mechanisms for the data in GlobalOS

- Instanciation mechanisms
- Versioning of data (stateful/stateless) in a coherent manner
- Enhance identified metrics with relevant proposals

3 – Validation of the proposals developed during the thesis

- Prototyping and validating the proposals as they are defined
- Publish and write the final manuscript

#### ❖ The ideal candidate profile

The candidate must have a 2<sup>nd</sup> year MSc degree or equivalent in the field computer science and engineering. The candidate should also have a previous work or internship experience in the field of computer systems, architecture or software, or distributed systems and databases management. Skills should include:

- Knowledge of networking, Telco and IT
- Confirmed mathematical skills
- Knowledge of Operating Systems, distributed software architectures, and networking systems is an advantage
- Fluent English
- Curious, independent, and organized
- A genuine interest and motivation in doing a PhD

#### ❖ Additional information and application (try one of the links):

<https://orange.jobs/jobs/offer.do?ref=0014817>

<https://orange.jobs/jobs/offer.do?joid=57777&lang=EN>

<https://orange.jobs/jobs/search.do?lang=EN&keyword=0014817>

PS: In case of bad formatting in your navigator, try one of the following:

- Go to: <https://orange.jobs/jobs/search.do?lang=EN>, and search for “0014817” in the search bar (keywords...)
- Unzoom on the web page (press: “CTRL” and “-“)
- Try a smaller size for the web navigator

#### References

- [1] <https://recherche.orange.com/vers-une-plateforme-ouverte-et-programmable-globalos/>  
 [2] <https://webcom.orange.com/doc/tutorial-welcome.html>  
 [3] <https://pages.lip6.fr/Marc.Shapiro/papers/Cure-final-ICDCS16.pdf>  
 [4] <https://github.com/SyncFree/antidote>