Summary of work in H2020 CloudButton - IMT

Abstract

IMT has contributed to several aspects of the CloudButton serverless computing stack. First, IMT developed (jointly with URV) a framework for stateful serverless programming named Crucial. Crucial allows writing Java applications for serverless much like one would write them for a regular computer. The framework was used to port successfully part of Smile, a state-of-the-art machine learning library. It was also employed to create the serverless shell which allows to execute massively parallel scripts in a serverless environment.

Crucial is built atop a distributed storage layer (DSO). Internally, DSO uses state-machine replication (SMR) to maintain availability, and passivation for data durability. During the project, IMT contributed to both the theory and practice of SMR and data persistence. IMT invented new protocols to boost SMR latency and fault-tolerance. It has also authored J-NVM, an efficient framework to leverage non-volatile memory (NVM) in the Java language.

Staff members that participated in the project

Pierre Sutra (Prof.)
Aurèle Maheo (PostDoc)
Mohammad Zakerzadeh (PostDoc)
Boubacar Kane (PhD)
Anatole Lefort (PhD)
Tuanir F. Rezende (PhD)

List of publications (with links, everything must be open access). Staff participating in each publication. Total number of publications by partner.

total: 9

Daniel Barcelona-Pons, Marc Sánchez-Artigas, Gerard París, Pierre Sutra, Pedro García-López
On the FaaS Track: Building Stateful Distributed Applications with Serverless Architectures
Middleware'19: 20th International Middleware Conference
link, open access

Tuanir França Rezende, Pierre Sutra
Leaderless State-Machine Replication: Specification, Properties, Limits
DISC'20: 34th International Symposium on Distributed Computing
link, open access

Vitor Enes, Carlos Baquero, Tuanir França Rezende, Alexey Gotsman, Matthieu Perrin, Pierre Sutra
State-machine replication for planet-scale systems

EuroSys'20 : Fifteenth European Conference on Computer System
link, open access

Pierre Sutra
On the correctness of Egalitarian Paxos
Information Processing Letters
link, open access

Aurèle Mahéo, Pierre Sutra, Tristan Tarrant
The Serverless Shell
Middleware'21: 22nd International Middleware Conference (industry track)
link, open access

Anatole Lefort, Yohan Pipereau, Kwabena Amponsem Boateng, Pierre Sutra, Gaël Thomas
J-NVM: Off-heap Persistent Objects in Java
SOSP'21: 28th ACM Symposium on Operating Systems Principles
link, open access

Vitor Enes, Carlos Baquero, Alexey Gotsman, Pierre Sutra
Efficient Replication via Timestamp Stability
EuroSys'21 : Sixteen European Conference on Computer System
link, open access

Daniel Barcelona-Pons, Pierre Sutra, Marc Sánchez-Artigas, Gerard París, Pedro García-López
Stateful Serverless Computing with Crucial
ACM Transactions on Software Engineering and Methodology
open access

Pedro García-López, Marc Sánchez-Artigas, Simon Shillaker, Peter Pietzuch, David Breitgand, Gil Vernik, Pierre Sutra, Tristan Tarrant, Ana Juan-Ferrer, Gerard París
Trade-Offs and Challenges of Serverless Data Analytics
Technologies and Applications for Big Data Value
open access

List of github repositories (with links). Staff contributing to each repository. Total number of repositories.

total: 6

Crucial: a fully-fledged framework for stateful serverless programming
Pierre Sutra, Aurèle Maheo, (Daniel Barcelona-Pons,Gerard París Aixalà)
link

The serverless shell

Pierre Sutra, Aurèle Maheo
link

J-NVM: Off-heap Persistent Objects in Java
Anatole Lefort, Pierre Sutra, (Yohan Pipereau, Kwabena Amponsem)
link

On the correctness of Egalitarian Paxos
Pierre Sutra
link

Degradability: A principled approach to data consistency
Boubacar Kane, Pierre Sutra
link

List of dissemination activities. Staff contributing to each dissemination activity. Total number of dissemination activities.

total: 10

P. Sutra was invited to the VDS Workshop (w. NETYS'19), June 2019
P. Sutra was invited to I'MTech (online blog), Oct. 2019
T. Rezende gave a talk at DISC, Sept. 2020
P. Sutra participated to Sciences Num. (online podcast), May 2021
A. Lefort gave a talk at SOSP, Oct. 2021
A. Mahéo gave a talk at WoSC (w. Middleware), Dec. 2021
A. Mahéo gave a talk at Middleware, Dec. 2021
A. Lefort gave an invited talk at HMEM, June 2022
A. Lefort participated to NVMW, May 2022
P. Sutra gave an invited talk at PER3S, June 2022

List of exploitation activities. Staff contributing to each exploitation activity. Total number of exploitation activities.

All of the software production made at IMT is being advertised and pushed toward the open source community.
(For instance, the serverless shell already has ~140 stars on github.)
However, we do not plan so far to commercially exploit these software.

List of collaborations or integrations with other partners. Staff contributing to each collaboration activity. Total number of collaboration activities.

IMT worked jointly with URV on the Crucial framework. IMT also contributed to new modules for the Infinispan datastore maintained by Red Hat. In particular, IMT wrote the DSO storage layer as well as an NVM-ready persistent backend atop J-NVM.