"LightKone Project: Lightweight Computation for Networks at the Edge"

Van Roy, Peter

Abstract
LightKone combines two recent advances in distributed computing to enable general-purpose computing on edge networks: * Synchronization-free programming: Large-scale applications can run efficiently on edge networks by using convergent data structures (based on Lasp and Antidote from previous project SyncFree) → tolerates dynamicity and loose coupling of edge networks * Hybrid gossip: Communication can be made highly resilient on edge networks by combining gossip with classical distributed algorithms (based on Plumtree epidemic broadcast trees used in industry) → combines naturally with synchronization-free programming

Document type: Communication à un colloque (Conference Paper)

Référence bibliographique
Van Roy, Peter. LightKone Project: Lightweight Computation for Networks at the Edge. TEKK Tour Digital Wallonia (Mons, Belgium, 03/11/2017).
LIGHTKONE Project

Lightweight computation for networks at the edge

November 6, 2017

Peter Van Roy
LightKone coordinator
Université catholique de Louvain

TEKK Tour Digital Wallonia 2017
Mons International Congress Xperience (MICX)

See Web site: lightkone.eu
Edge computing (Internet of Things)

- Edge computing is the next big frontier for the Internet
  - In 2020 there will be 50 billion Internet of Things devices
  - In 2027 there will be >1000 IoT devices per human on earth

- Killer apps are rapidly appearing for edge computing
  - A good example is personal health monitoring: each human being will have a personal sensor array and a personal data center
  - Data streams from the sensor array are continuously analyzed using deep learning algorithms to detect early signs of health problems
  - This will reduce costs and increase quality of healthcare for all
LightKone project in a nutshell

- **LightKone: Lightweight computation for networks at the edge**
  - 9 partners (4 industrial, 5 academic), 3.57M€ budget

- **The goal of LightKone is to develop a scientifically sound and industrially validated model for general-purpose computing on edge networks**
  - This is a challenge because edge networks are heterogeneous, loosely coupled, highly dynamic, and unreliable (frequent partitions, frequent offline or failed nodes)
  - This is why today’s computations are mostly done on data centers!

- **We take up the challenge because edge networks have great potential:**
  - Greatly increased scalability (edge devices far outnumber data center nodes)
  - Much lower latency (edge computing makes real-time control possible)
  - Increased resilience (the connection to the data center is a weak point)
  - Increased security (edge computing avoids data center security and privacy issues)
  - Local decision making ability (edge computing enables quick action in crisis situations)
## Project partners

**Academic / industrial partners**

<table>
<thead>
<tr>
<th>No.</th>
<th>Partner 1</th>
<th>Partner 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>UCL (Belgium)</td>
<td>Université catholique de Louvain (coordinator)</td>
</tr>
<tr>
<td>2.</td>
<td>UPMC + INRIA (France)</td>
<td>Université Pierre et Marie Curie + INRIA</td>
</tr>
<tr>
<td>3.</td>
<td>INESC TEC + UMinho (Portugal)</td>
<td>Instituto de Engenharia de Sistemas e Computadores – Tecnologia e Ciência + Universidade de Minho</td>
</tr>
<tr>
<td>4.</td>
<td>TUKL (Germany)</td>
<td>Technische Universität Kaiserslautern</td>
</tr>
<tr>
<td>5.</td>
<td>NOVA ID + UNL (Portugal)</td>
<td>Associação para a Inovação e Desenvolvimento da FCT + Universidade Nova de Lisboa</td>
</tr>
<tr>
<td>6.</td>
<td>Scality (France)</td>
<td>Scality</td>
</tr>
<tr>
<td>7.</td>
<td>Gluk (Netherlands)</td>
<td>Gluk Advice BV</td>
</tr>
<tr>
<td>8.</td>
<td>UPC + Guifi (Spain)</td>
<td>Universitat Politècnica de Catalunya (Guifi Community Network)</td>
</tr>
<tr>
<td>9.</td>
<td>Stritzinger (Germany)</td>
<td>Peer Stritzinger GmbH</td>
</tr>
</tbody>
</table>
LightKone technology

LightKone combines two recent advances in distributed computing to enable general-purpose computing on edge networks:

- **Synchronization-free programming**: Large-scale applications can run efficiently on edge networks by using convergent data structures (based on **Lasp** and **Antidote** from previous project SyncFree) → tolerates dynamicity and loose coupling of edge networks

- **Hybrid gossip**: Communication can be made highly resilient on edge networks by combining gossip with classical distributed algorithms (based on **Plumtree** epidemic broadcast trees used in industry) → combines naturally with synchronization-free programming
Sensor-based management (Gluk)

- By adding edge computing, sensor and actuator arrays can manage systems directly on the edge
- We target precision agriculture, healthcare, and smart homes

LightKone H2020 project
Advanced content search (Scality)

- Advanced search with indexed metadata (e.g., on image content) is done in data centers today
- Doing indexing directly at the edge gives much faster response and enables custom search based on machine learning
Services for a community network
(Guifi / UPC)

- Guifi.net is a common resource developed bottom-up by users
- It has more than 32,600 nodes (Jan. 2017), mostly in Catalonia
- We implement Guifi.net services by *edge microclouds*
Transport for manufacturing (Stritzinger)

- Automatic transport of partial products between processing stations in a factory
- Partial products have RFID tags and their paths through the factory are managed directly by the networked nodes
LightKone technology at your service

- We are developing open-source software both for light edge (edge by itself) and heavy edge (edge plus data center)
  - Lasp edge computing platform for light edge: https://lasp-lang.org
  - Antidote database for heavy edge: http://antidotedb.org

- Please contact us if you are interested in learning about our technology or collaborating
  - https://lightkone.eu