# The Dark Side of Cloud and Edge Computing: An Exploratory Study

Klervie Toczé, Maël Madon, Muriel Garcia, and Patricia Lago

LINKÖPING UNIVERSITY

IRIT Institut de Recherche en Informatique de Toulouse
CNRS - INP - UT3 - UT1 - UT2J

VU VRIJE UNIVERSITEIT AMSTERDAM

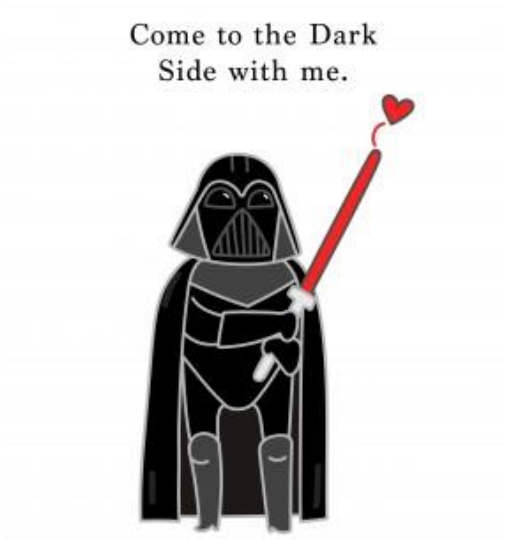
# The bright side


Picture: https://medium.com/andcloudio/get-visibility-and-control-into-your-saas-apps-usage-c34b7af8688f



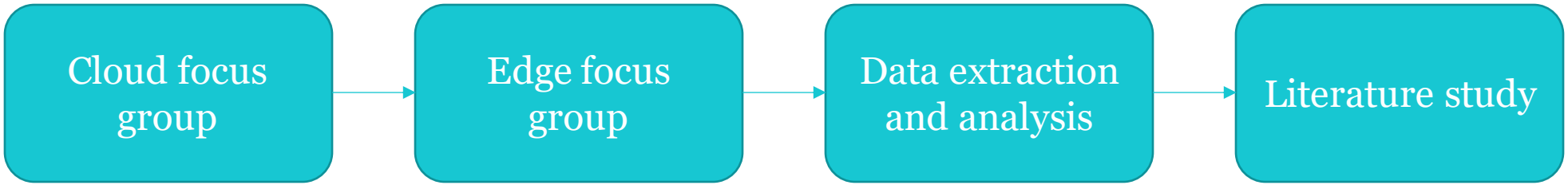
Pictures: https://europe.autonews.com/automakers/autonomous-vehicles-undergo-reality-check
https://www.ericsson.com/en/blog/2020/4/how-5g-and-edge-computing-can-enhance-virtual-reality
https://www.activeadvice.eu/news/concept-projects/what-is-smart-health-and-how-do-people-benefit/

# Is there a dark side?




Picture: https://www.mypostcard.com/sv/designs/kaerlek/join-the-dark-side-star-wars-love-postcards-send-online-9154

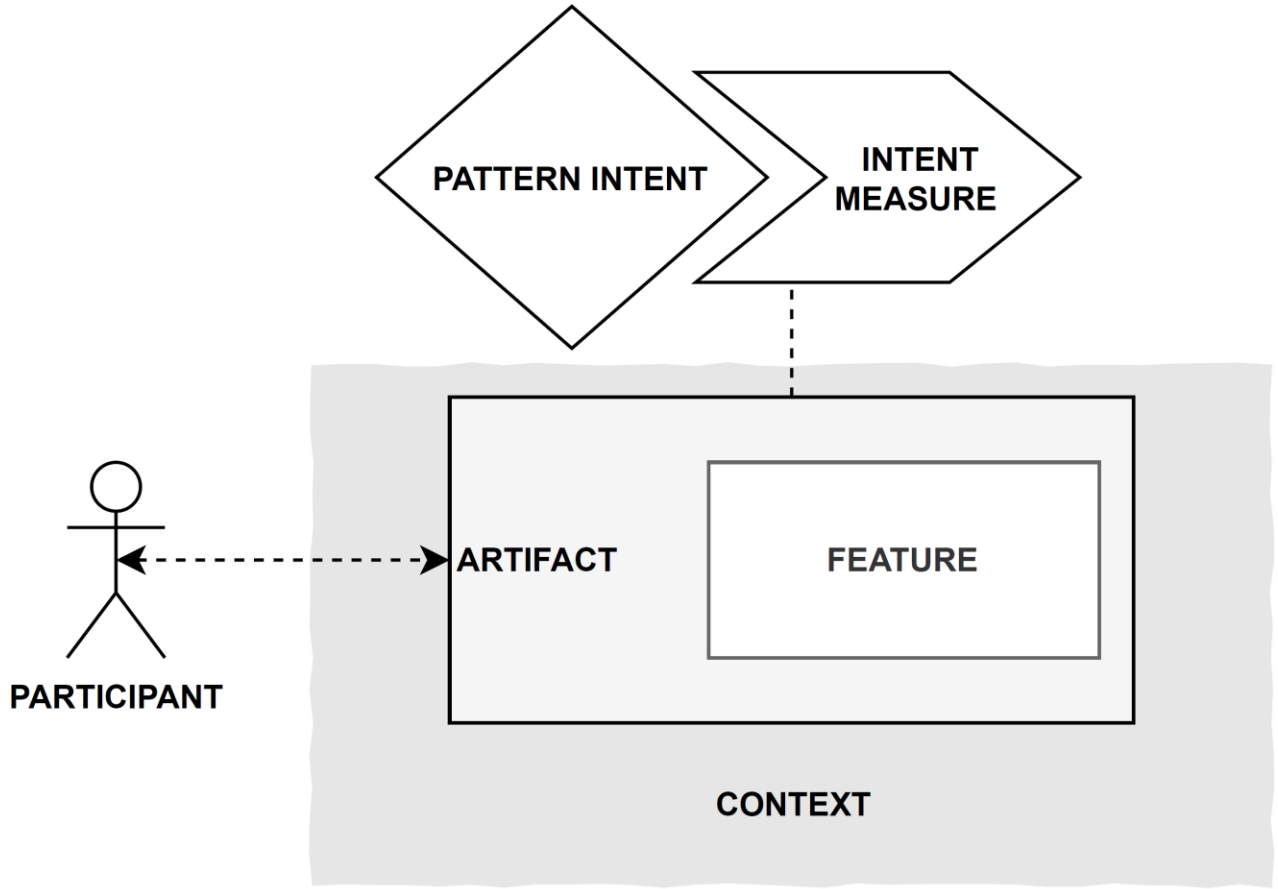
# Study overview




Pattern model

Pattern catalog

# Pattern model



# Pattern catalog – Edge computing

| ID | Name | Pattern Intent | Intent Measure | Participant | Artifact | Feature | Context |
|---|---|---|---|---|---|---|---|
| E2 | Hardware multiplication | Spreading hardware devices that need to be produced | Amount of hardware needed, Life cycle assessment of the hardware considered | hardware-producer, edge-provider | Infrastructure | Distributed nature of edge | Deployment and normal operation |
| E7 | Concealed impact | Hindering the awareness of the end user's negative impact | Level of awareness of the end user | end-user, edge-user, edge-provider, government | Application /service | Visibility of usage and cost of resource consumption | Normal operation |
| E17 | Green-washing | Using a small fraction of "green" applications as an excuse to develop the technology which will mainly be used for other purposes | Share of the applications being directly aimed at sustainability | edge-provider, edge-user, innovation-driver | Technology | Motivation behind the development of the technology | Innovation |

# Countermeasures

| ID | Name | Countermeasures |
|---|---|---|
| E2 | Hardware multiplication | • Use already existing devices as edge devices (for example embedded systems) instead of building dedicated edge devices. |
| E7 | Concealed impact | • Create awareness by e.g. indicators-as-a-service and green labels<br>• Promote energy-aware edge computing |
| E17 | Green-washing | • Raise awareness<br>• Increase regulation<br>• Improve transparency of environmental reporting |

# Some takeaways

01

Research on systemic effects of cloud/edge needs interdisciplinarity

02

Issues and countermeasures should always be tailored for cloud/edge

03

Need to explore the pattern intentionality

# What next?

- Key actors reflect upon sustainability questions

- Further studies on the identified patterns
- Identification of additional patterns
- Ways to transform unsustainable patterns into sustainable ones

- Digital version of the pattern catalog

Thanks for listening!

klervie.tocze@liu.se

LINKÖPING UNIVERSITY

IRIT Institut de Recherche en Informatique de Toulouse
CNRS - INP - UT3 - UT1 - UT2J

VU VRIJE UNIVERSITEIT AMSTERDAM