

An Information-centric network prototype for IoT

Miguel Gutiérrez-Gaitán

Agenda

- Research context
- Motivations
- Problem statement
- Approach proposed
- Conclusions

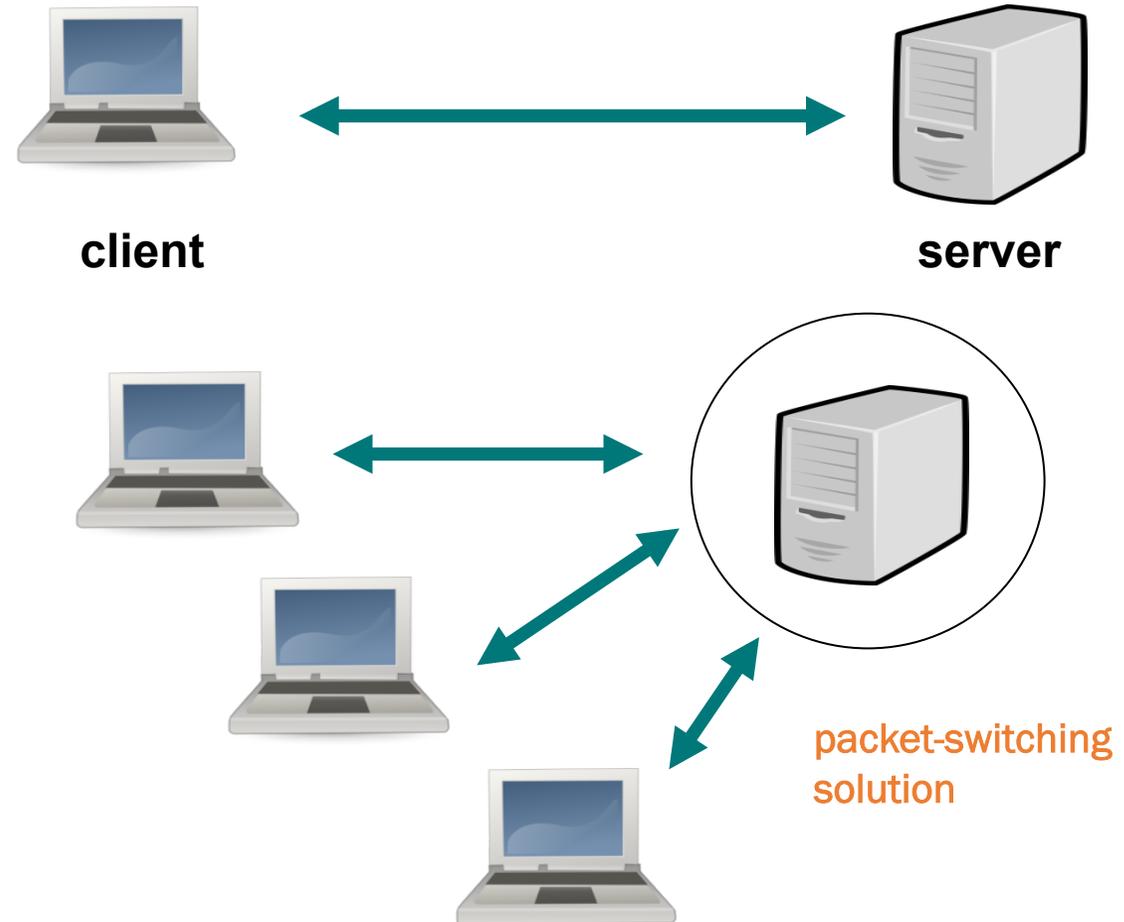
Research context

> Beginnings of Internet:

- > HTTP
- > FTP
- > Email
- > ...

> Internet Model?

- > Client-server



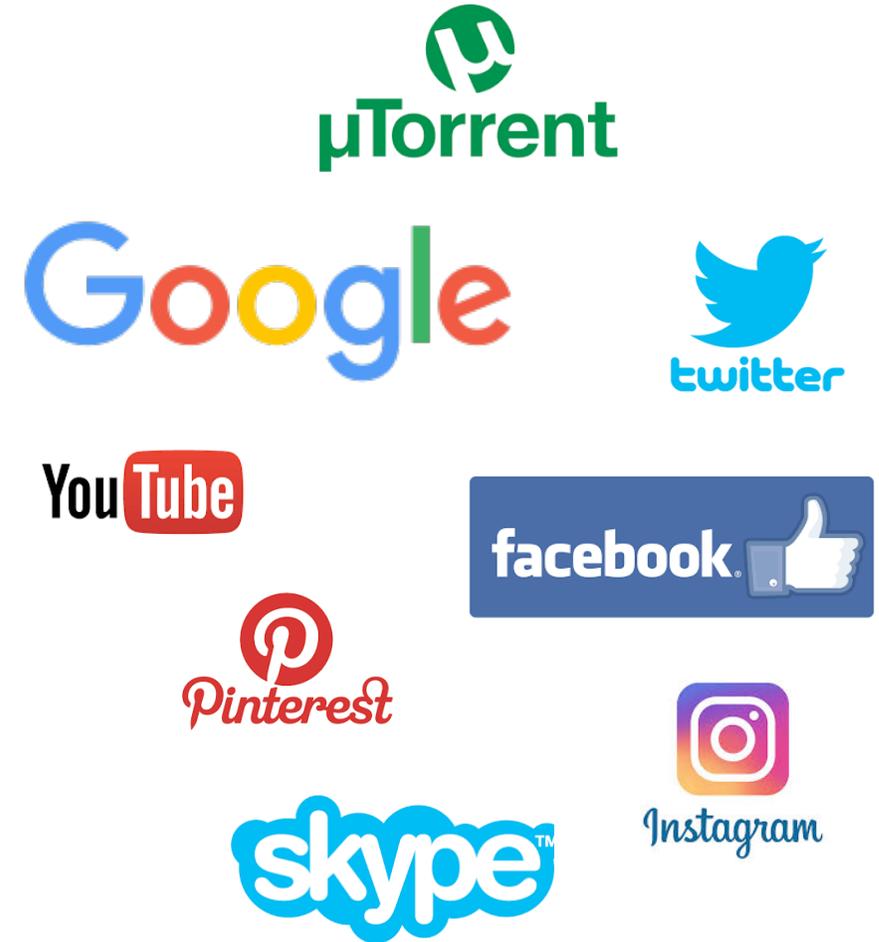
Research context

> Today's Internet

- > P2P
- > VoIP
- > CDNs
- > ...

> Internet Model?

- > Client-server



Research context

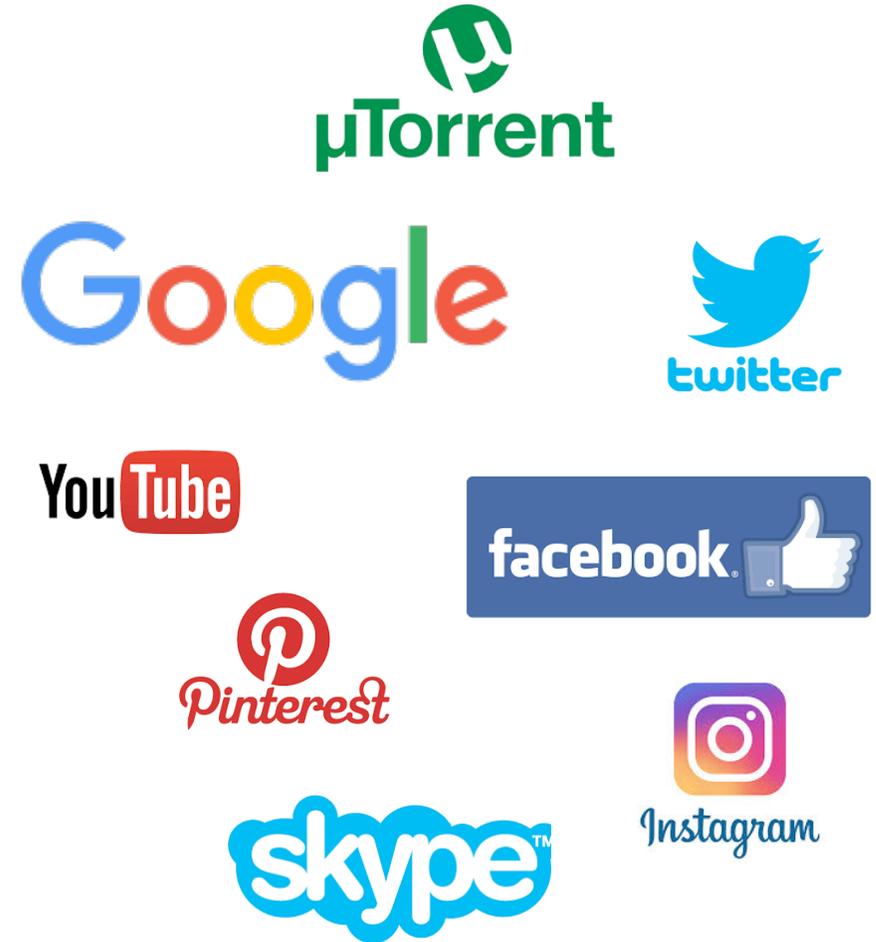
> Today's Internet

- > P2P
- > VoIP
- > CDNs
- > ...

The same model!

> Internet Model?

- > Client-server



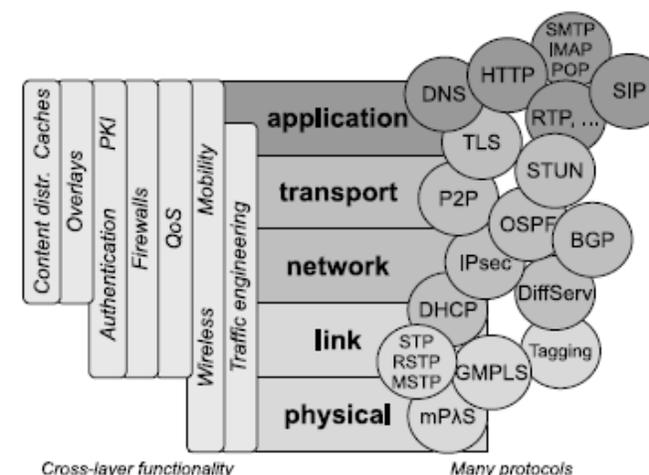
Research context

> Future Internet?



> New approach

> Clean-slate based on ICN



arquitectural patch-work

Research context

> Future Internet?



> New approach

> Clean-slate based on ICN

+ An extension
in the context of IoT

Motivations

> ICN and IoT

- > **ICN** is one of the most relevant paradigms for Future Internet.
- > ICN integrates (1) naming, (2) name-based routing, (3) in-network processing and (4) caching as part of the network architecture.
 - > But, it commonly supports its operations in more "powerful" nodes.
- > Thanks to its properties related to content retrieval, ICN has been considered as an **applicable solution in the context of IoT**.

Motivations

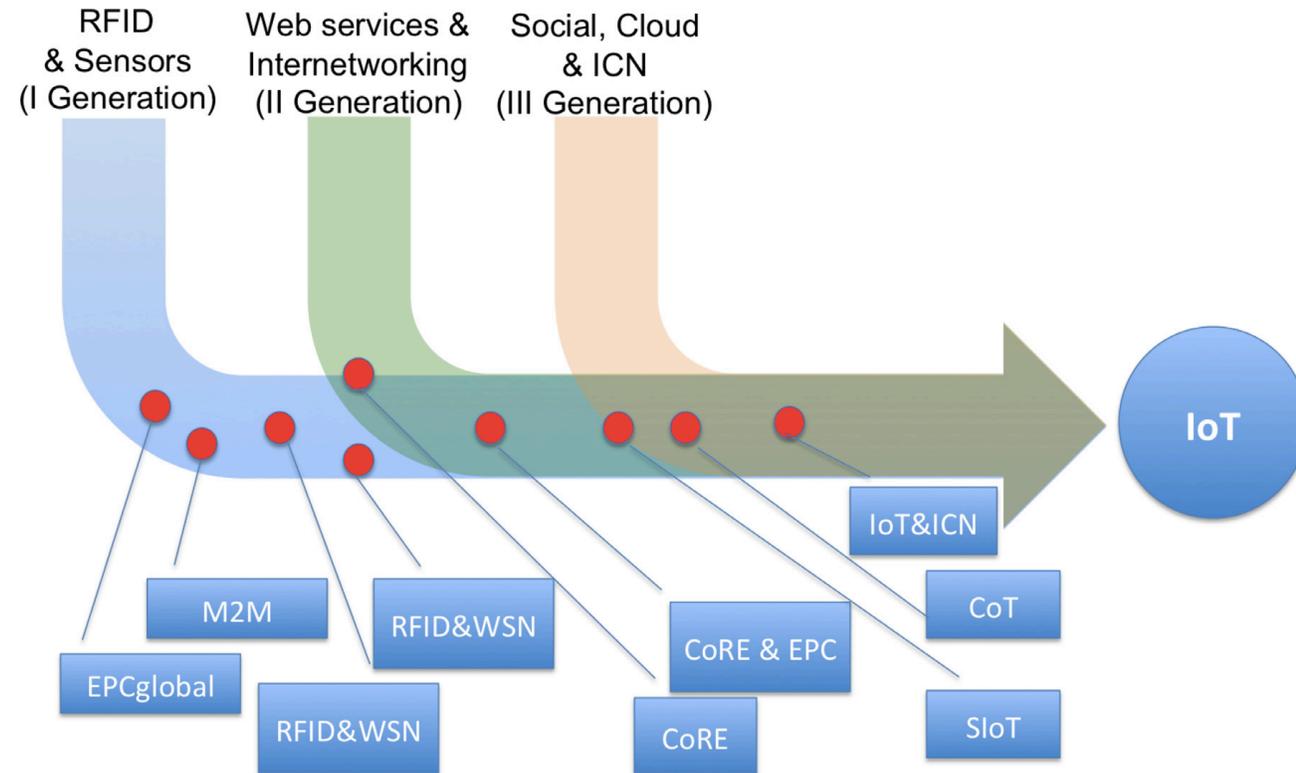
> However...

- > Research in the ICN-IoT context is still considered as **incipient**.

(Zhang, Yanyong, et al., 2015)

- > There are still **many challenges** in terms of the realization of a unified **ICN-IoT proposal**.

(Amadeo, Marica, et al., 2016)



(Atzori Iera & Morabito, 2016)

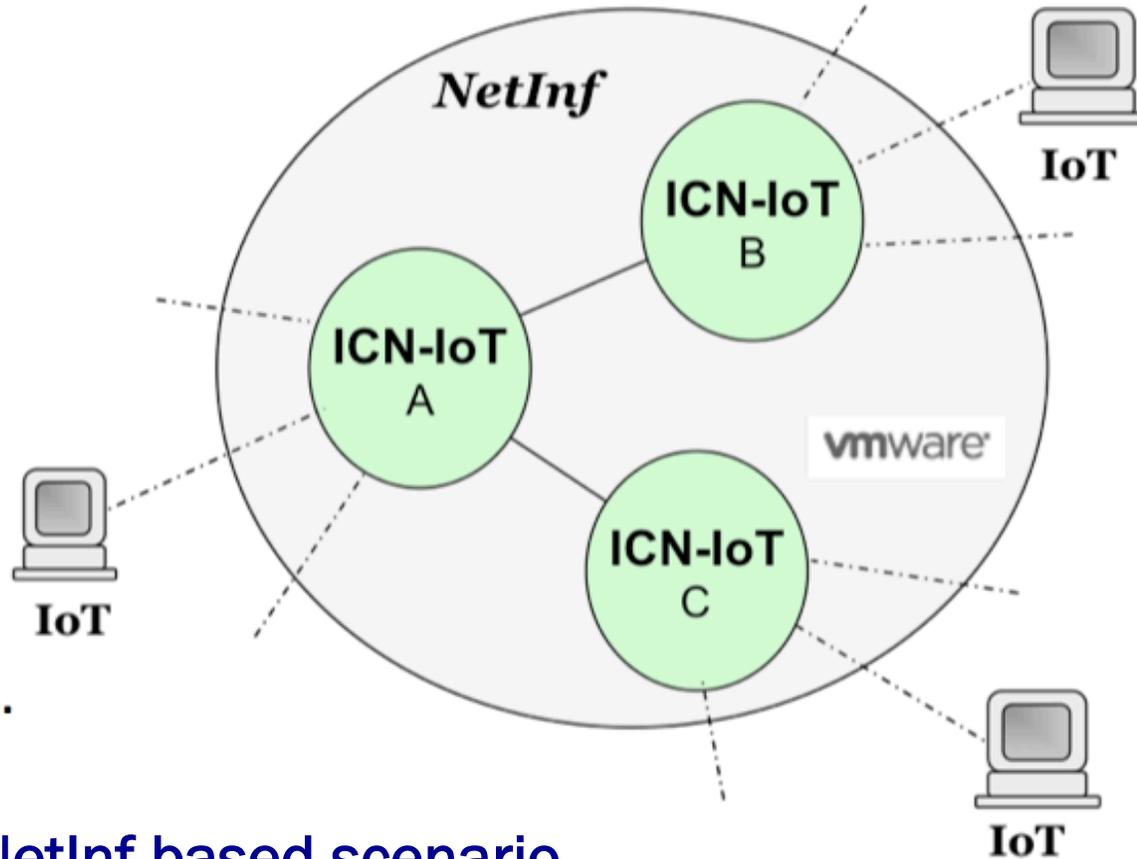
Problem statement

This presentation focuses on the definition of an **ICN-IoT unified solution valid** for both constrained nodes (as typical in IoT) and nodes with greater capacities (as common in ICN).

In particular, this approach prototypes an **ICN-IoT generic node** that serve as a basis for operation with **heterogeneous IoT devices** under an **information-centric** communication model.

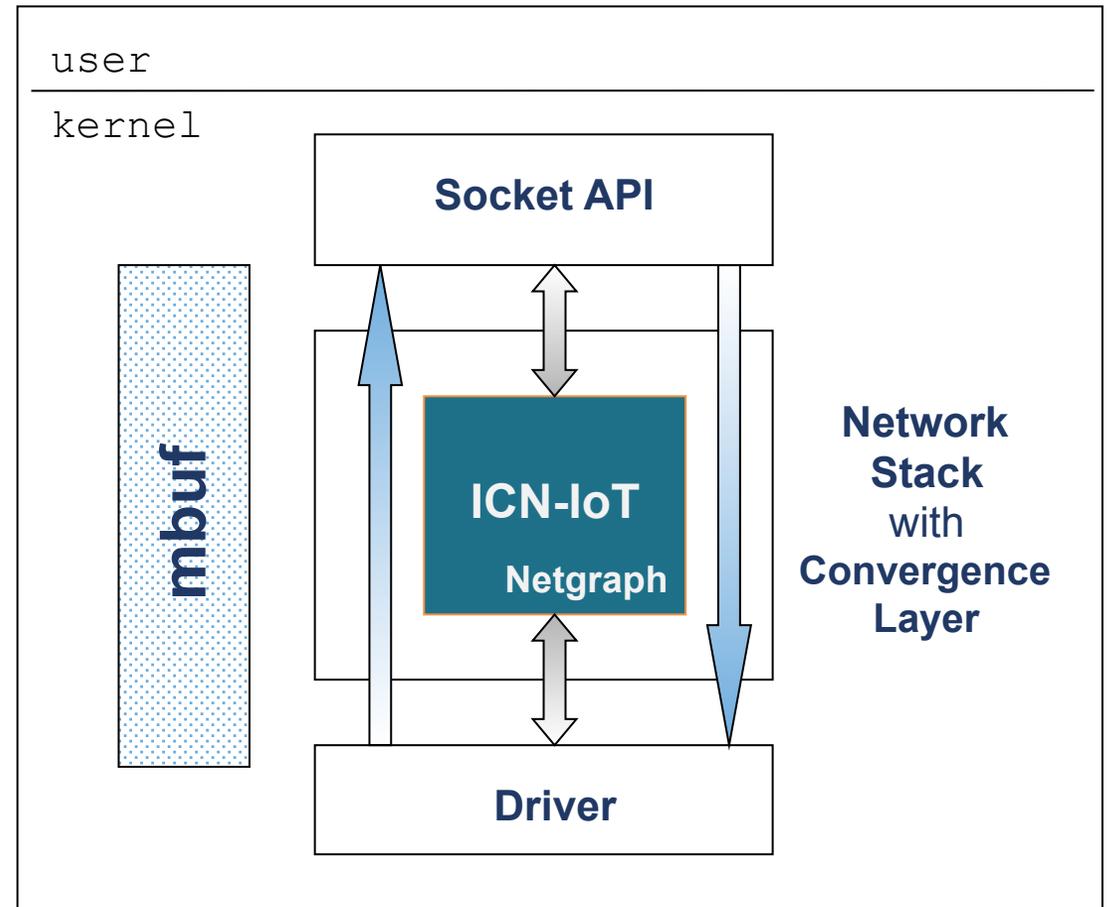
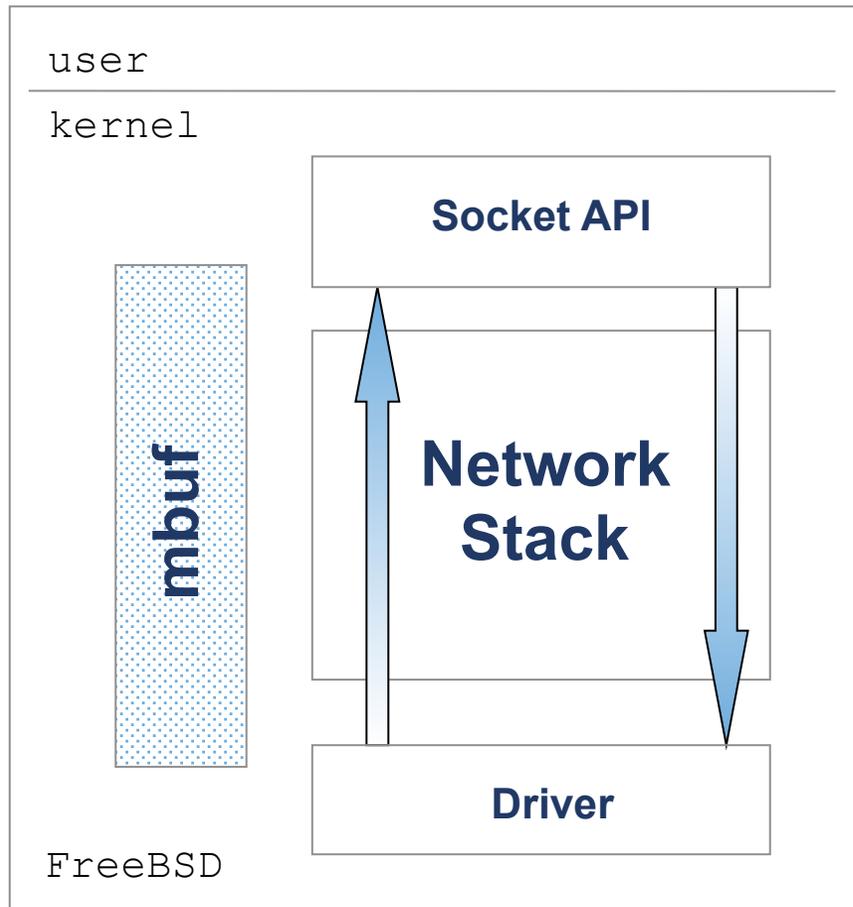
Approach: NetInf-based scenario

- ICN-IoT nodes on FreeBSD virtual machines.
- Convergence layer implemented with Netgraph
- IoT clients simulated with packet generators.



NetInf-based scenario

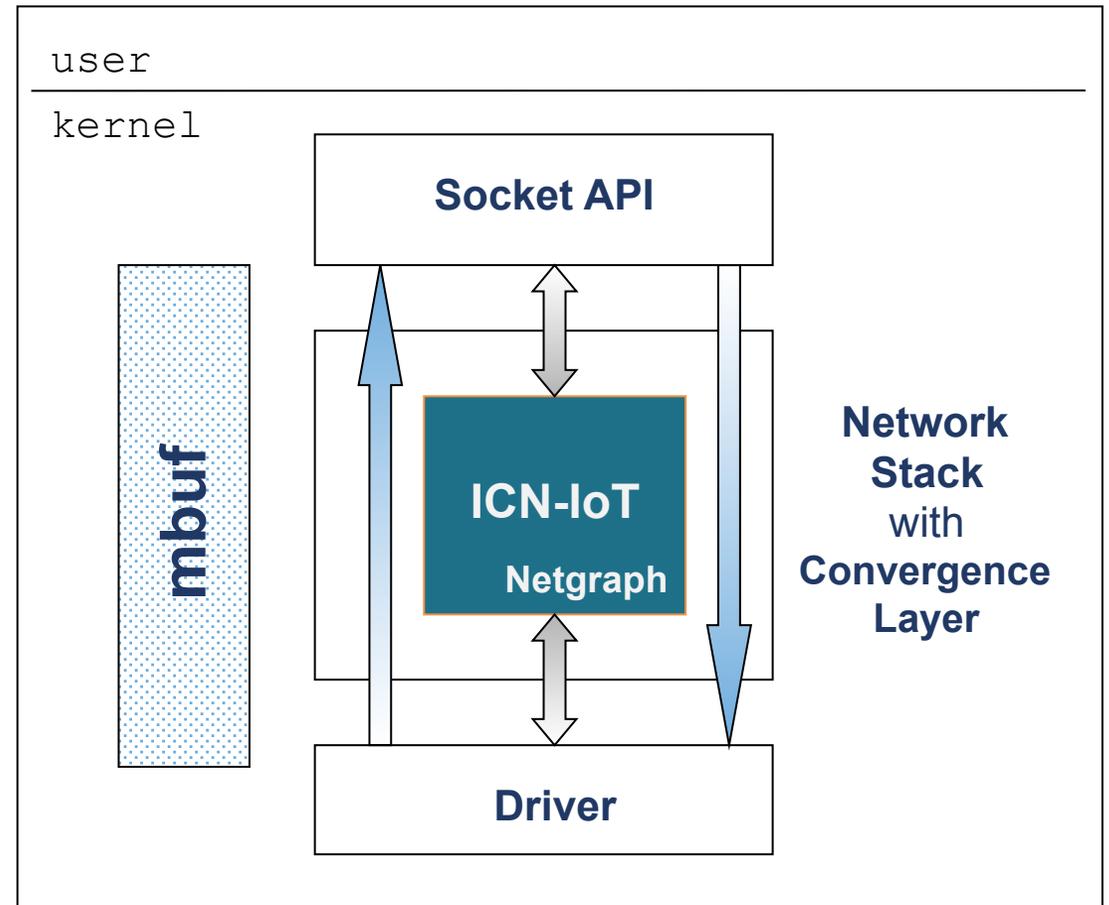
Approach: kernel-based prototype



Approach: kernel-based prototype

> Netgraph

- > It provides a wide range of 'ng_nodes' of arbitrary complexity

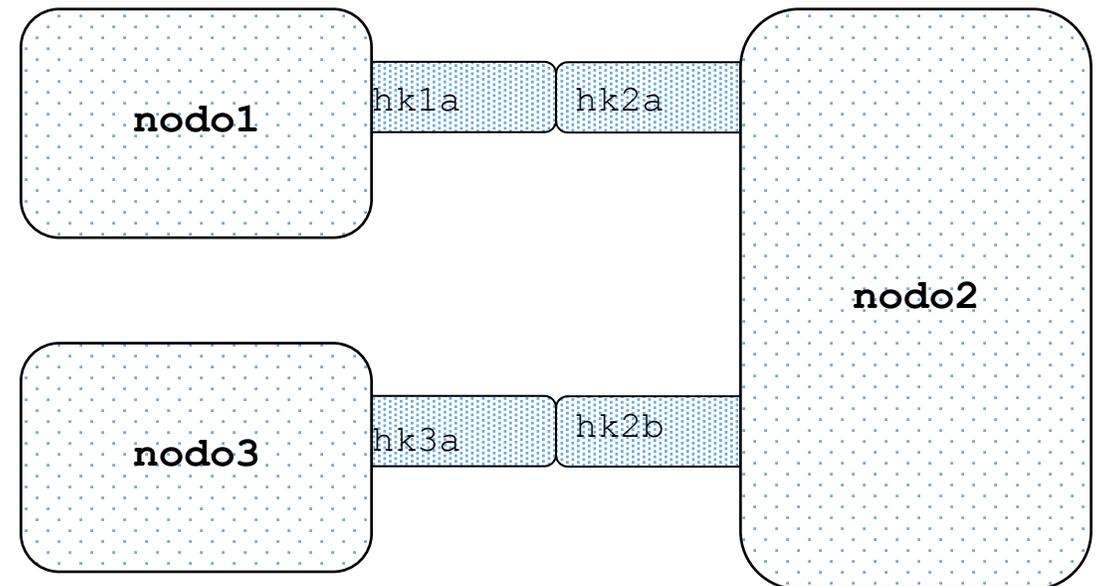
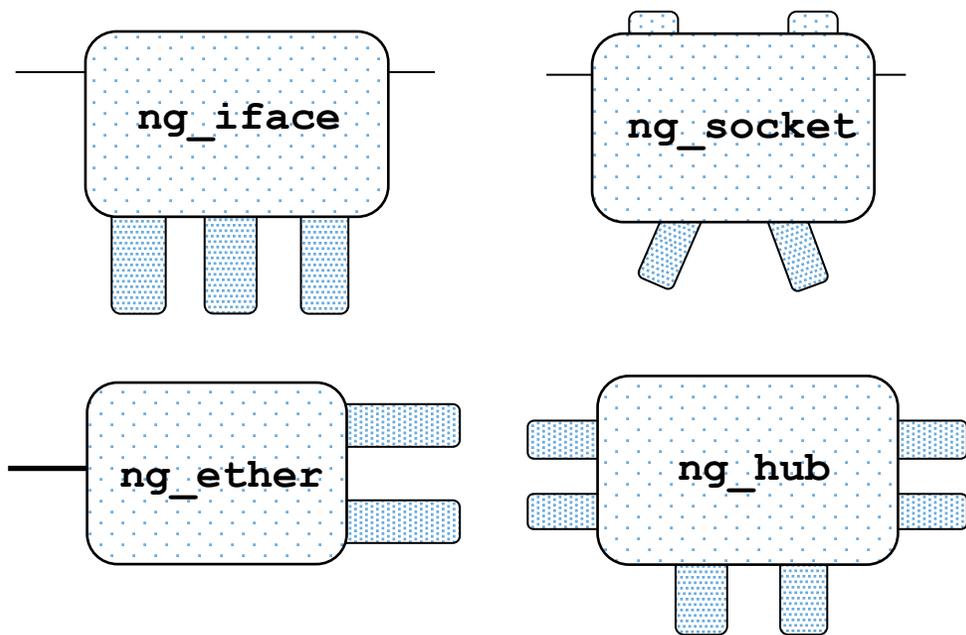


Approach: kernel-based prototype

> Netgraph

> It provides a wide range of 'ng_nodes' of arbitrary complexity

> With them is possible to **build a graph** based on existing nodes (or new ones)

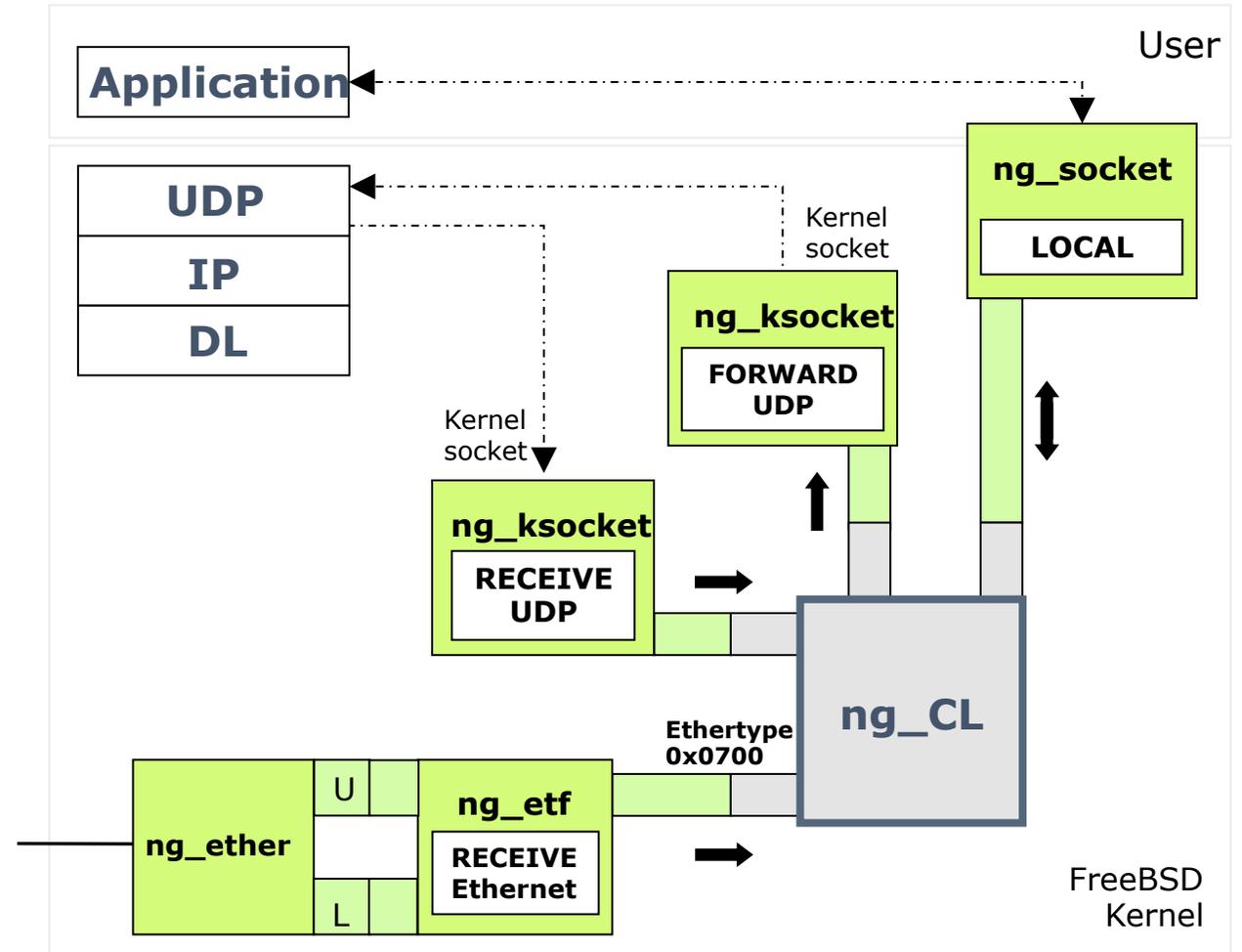


Approach: ICN-IoT generic node

> Internal structure

> Existing ng_nodes:

- ✓ ng_ether
- ✓ ng_etf
- ✓ ng_socket
- ✓ ng_ksocket



Approach: ICN-IoT generic node

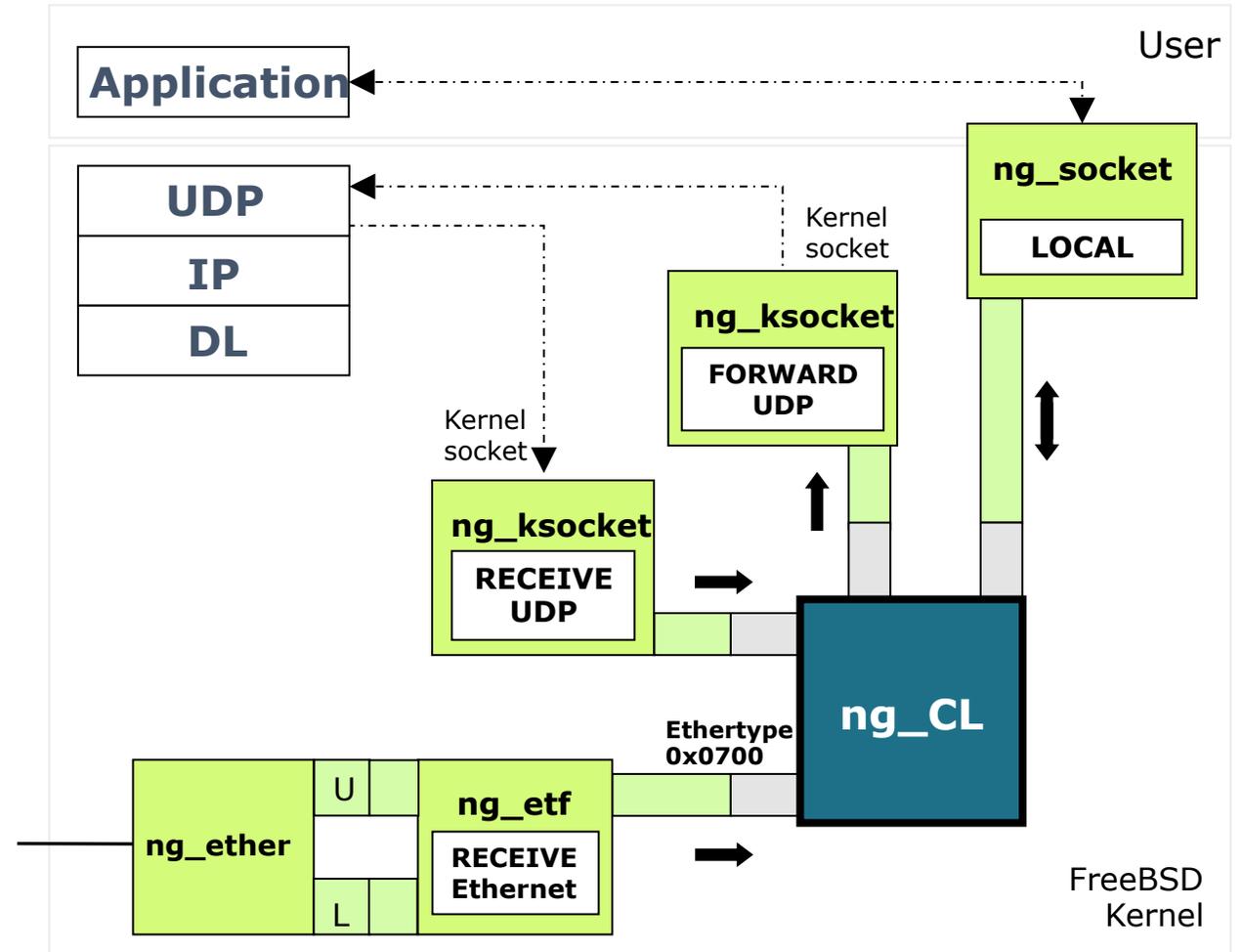
> Internal structure

> Existing ng_nodes:

- ✓ ng_ether
- ✓ ng_etf
- ✓ ng_socket
- ✓ ng_ksocket

> New ng_node:

- ✓ ng_CL

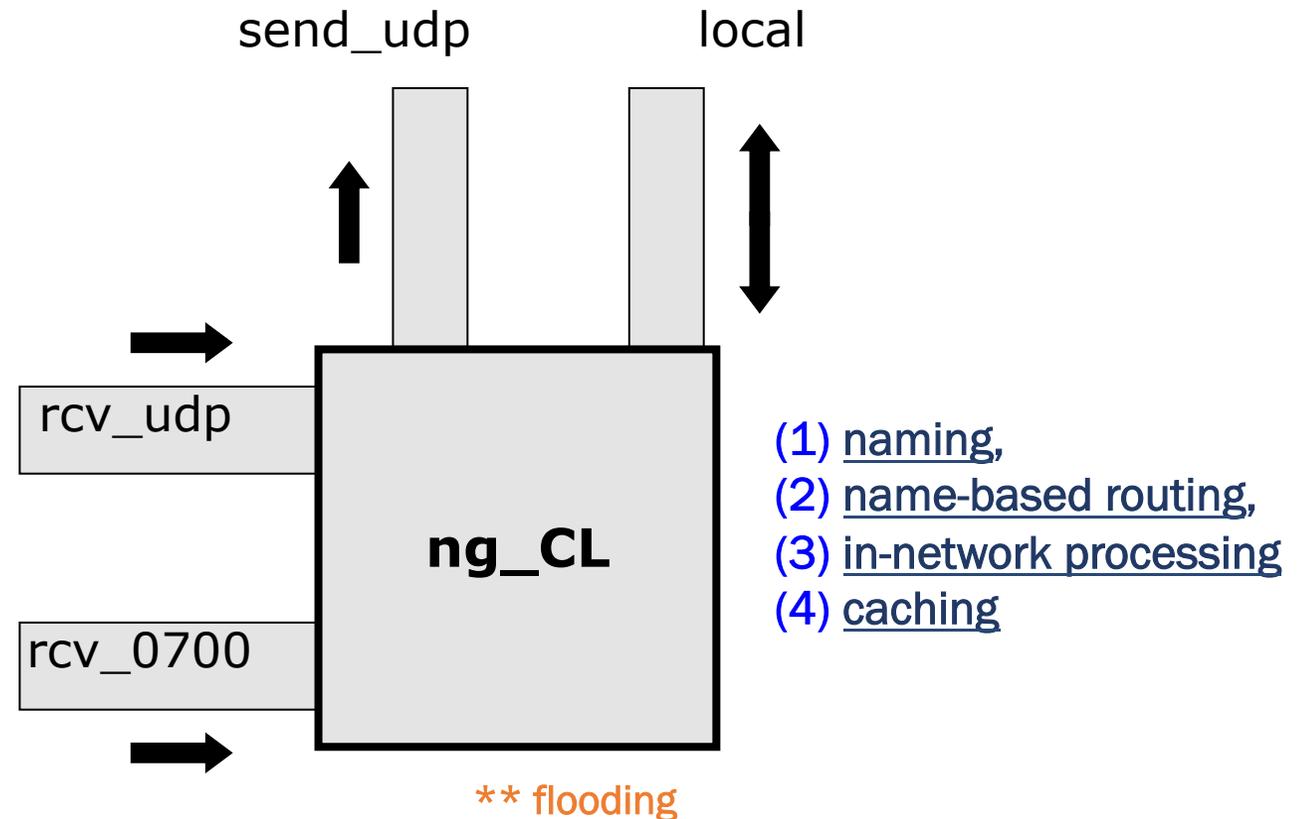


Approach: ICN-IoT generic node

> ng_CL hooks:

- > rcv_udp
- > rcv_0700
- > send_udp
- > local

```
.../netgraph/ng_CL.h  
.../netgraph/ng_CL.c  
.../net/CL.h
```

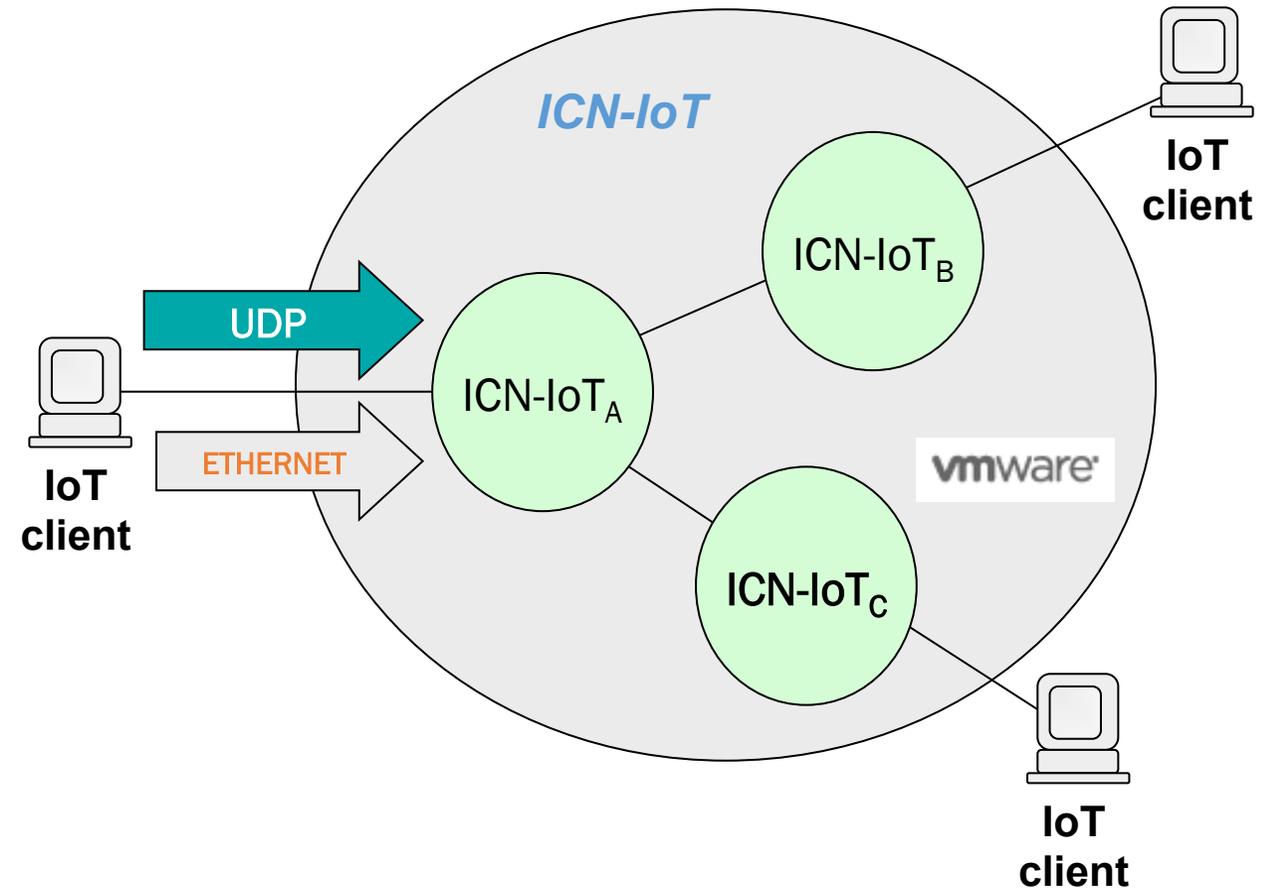


Approach: experimental scenario (1/2)

> Experiments: GET request

> Receiving:

- > UDP datagrams
- > Ethernet frames with different Ethertype (Ex.: 0x0700)



Approach: experimental scenario (2/2)

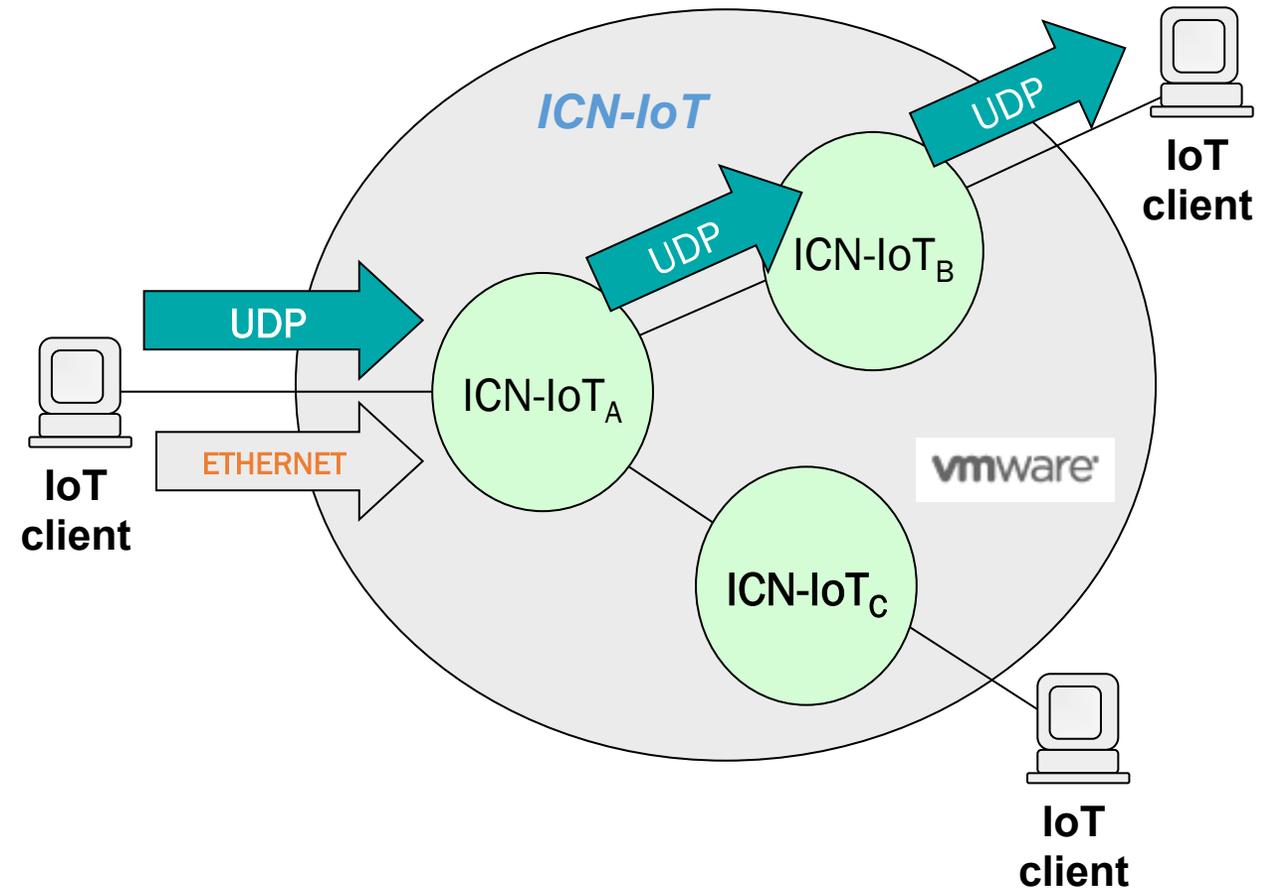
> Experiments: GET request

> Receiving:

- > UDP datagrams
- > Ethernet frames with different Ethertype (Ex.: 0x0700)

> Forwarding

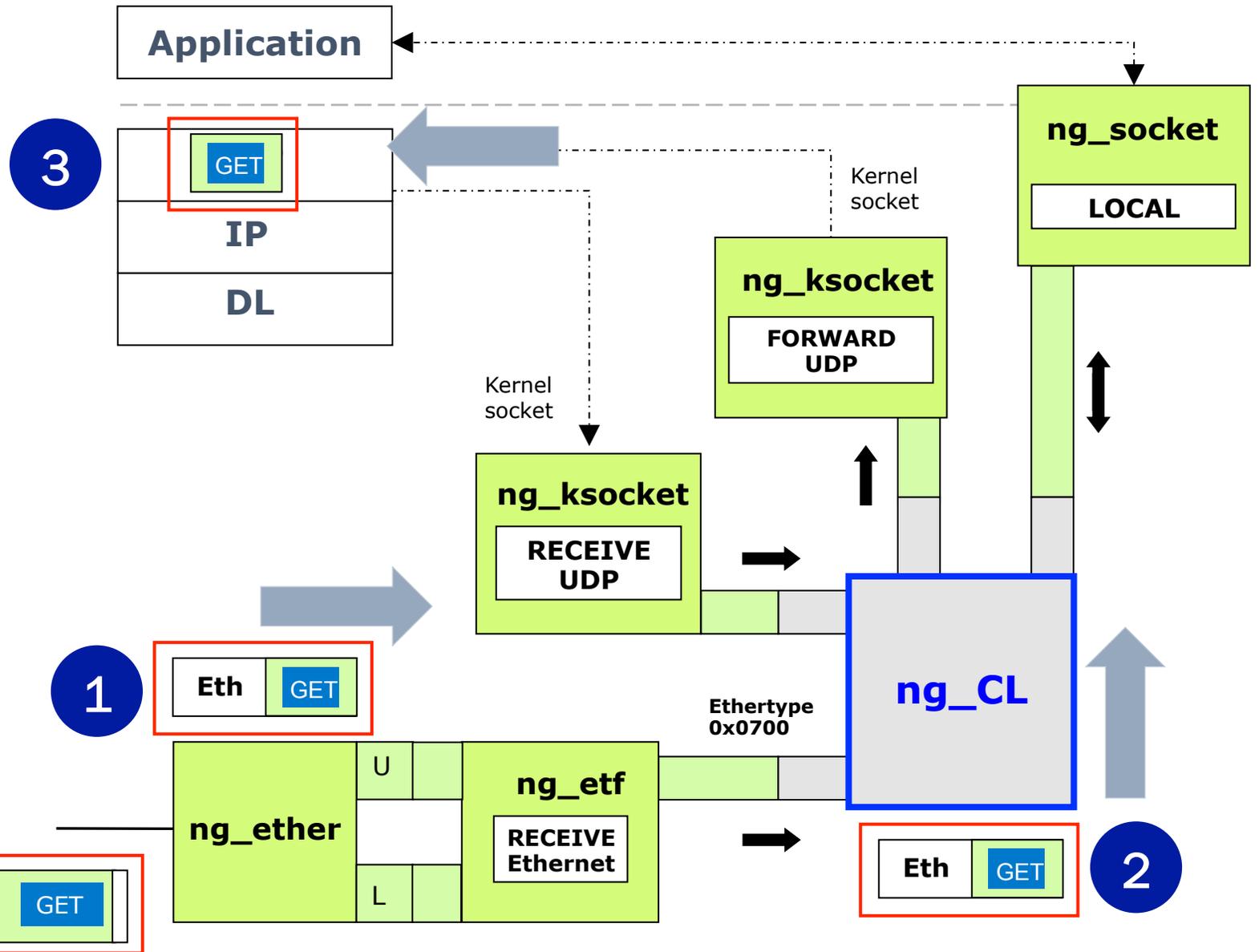
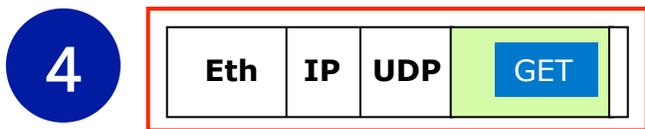
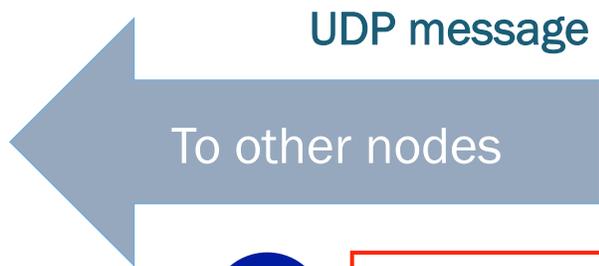
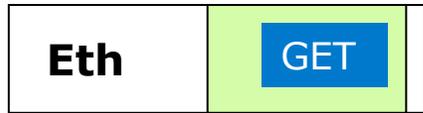
- > UDP datagrams
 - > to other ICN-IoT nodes
 - > external devices (Ex.: IoT clients)



**There is no interference with traditional network packets.

> ICN-IoT node: Internal structure

> Ethernet messages



Conclusions

ICN-IoT generic node that serve as a basis for operation with **heterogeneous IoT devices** under an **information-centric** model.

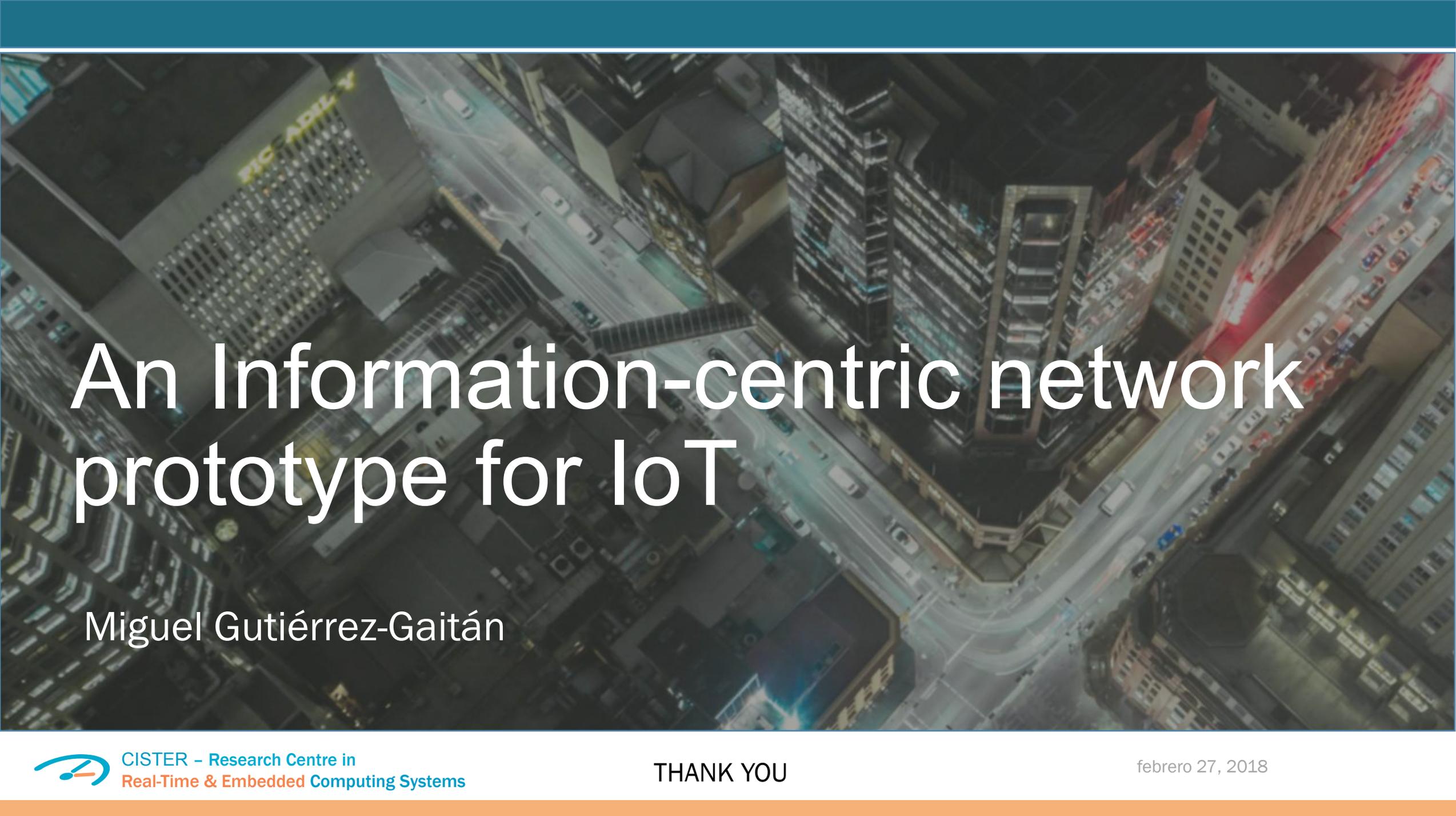
Contributions:

- Design of an **ICN-IoT generic node** as an extension of an ICN generic node based on NetInf architecture
- **Kernel-based proposal** that "conveniently" separates/combines ICN and IoT functionalities in the same node/network
- Basic **forwarding** implementation between protocols of different layers (Ethernet / UDP) in an ICN environment

Conclusions

Future Works:

- **Updates** the ICN-IoT generic node design based on more recent ICN architectures (such as NDN or CCN)
- **Evaluates** other kernel-based approaches to implement an ICN-IoT convergence layer (Ex. OpenFlow)
- **Implements** more features of ICN-IoT convergence such as in-network caching
- **Experiments** with real IoT case studies using common wireless communication protocols and IoT platforms



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