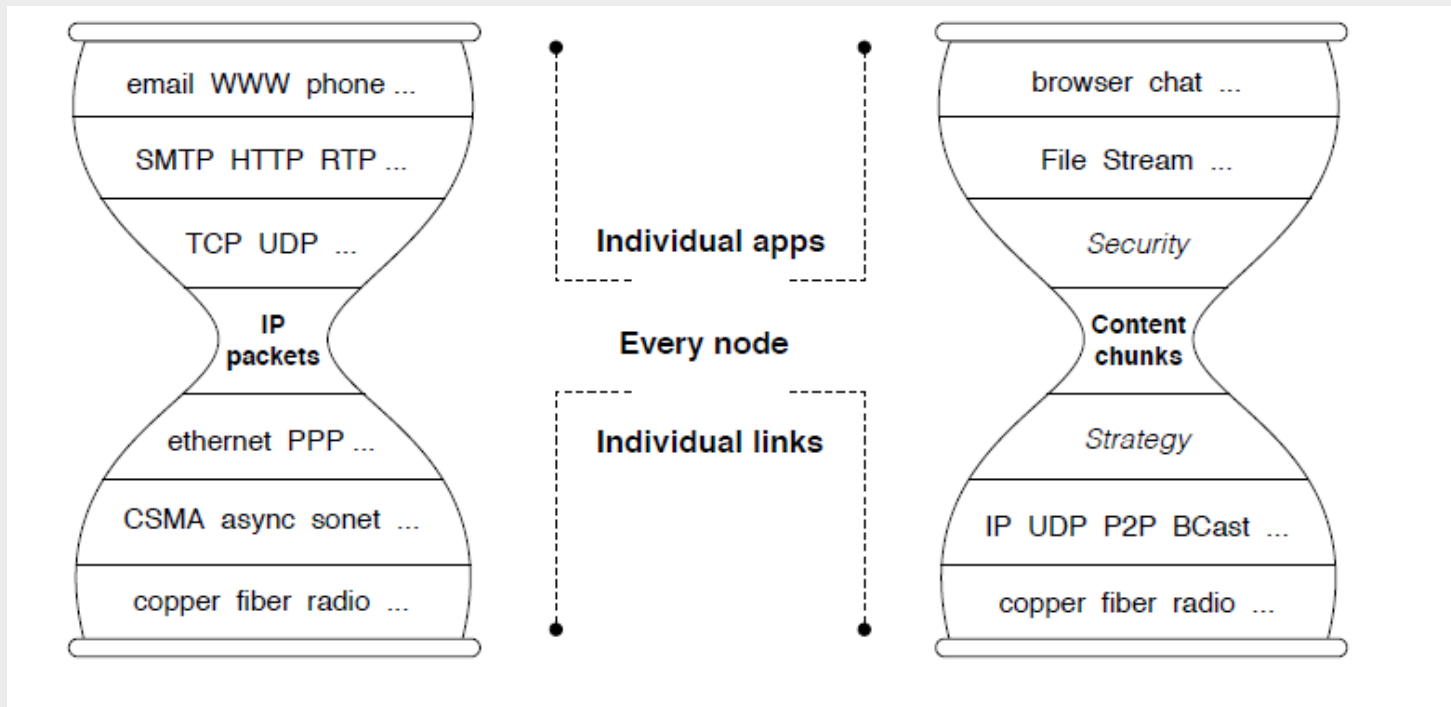




Supporting Internet of Things applications in Information-centric networking

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What is ICN?



ICN projects

- content centric networking (CCN)
 - 2007 Palo Alto Research Center (PARC)
 - 2009 first software implementation
- named data networking (NDN)
 - 2010 based of CCN
 - Funded by National Science Foundation
 - Forked in 2013

Research question

- How does content centric networking (CCN) compare to named data networking (NDN) with regards to IoT applications?

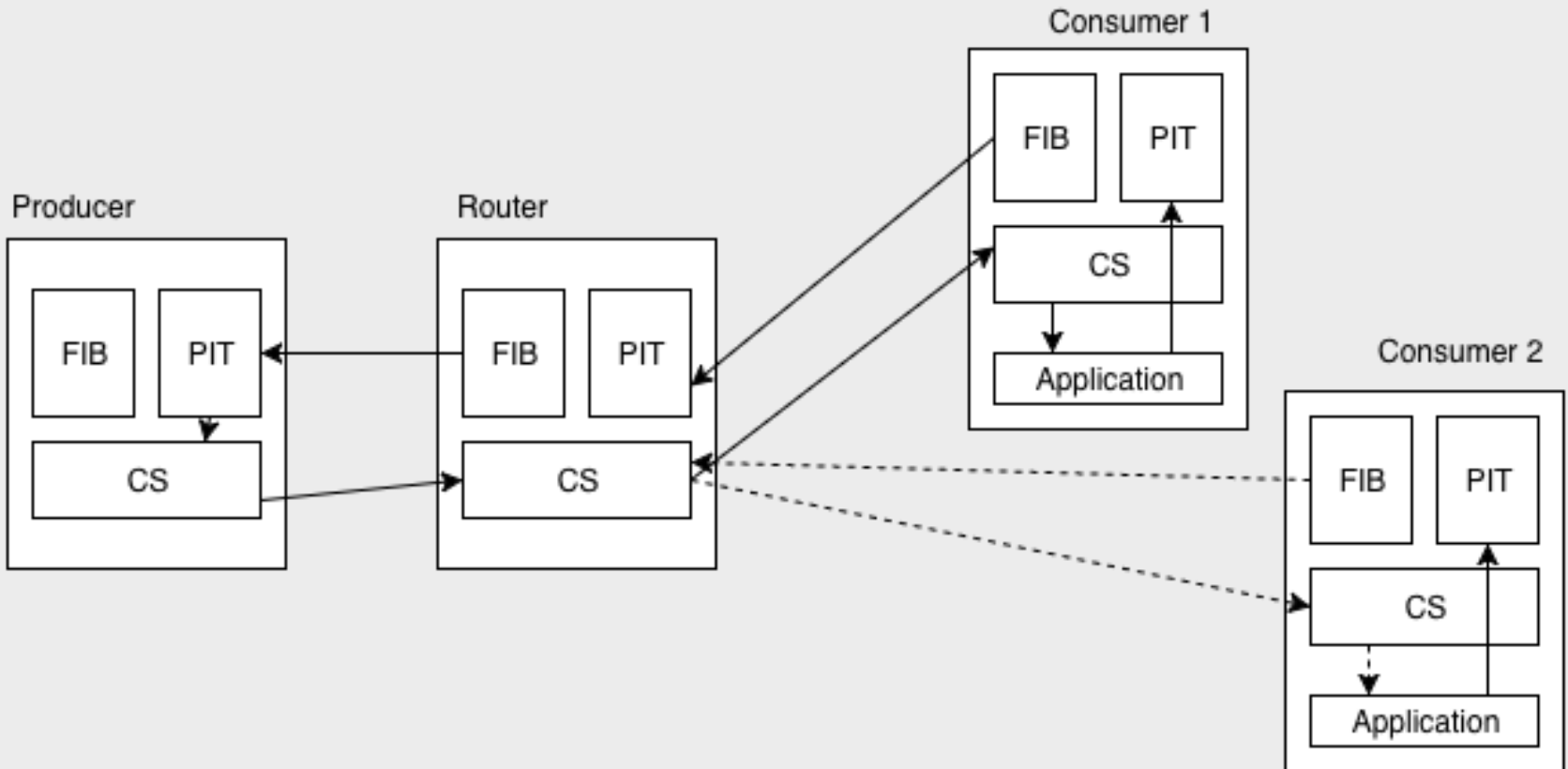
The basics

- Two packet types:
 - Interest
 - Data

Data structures

- Forwarding Information Base (FIB)
 - Used for Interest forwarding
- Pending Interest Table (PIT)
 - Used for Data forwarding
- Content Store (CS)
 - Cache for Data packets received

Example



Naming

- Flatnames and Hierarchical naming
- Naming in CCN must be an exact match
- NDN allows ‘overmatching’
 - Interest for : /nl/uva/os3/serverroom
 - Will match : /nl/uva/os3

Forwarding

■ CCN

□ Interest

- Check HopLimit
- Check ContentStore
- Add PIT entry

■ NDN

□ Interest

- Check HopLimit
- Add PIT entry
- Check ContentStore

Routing

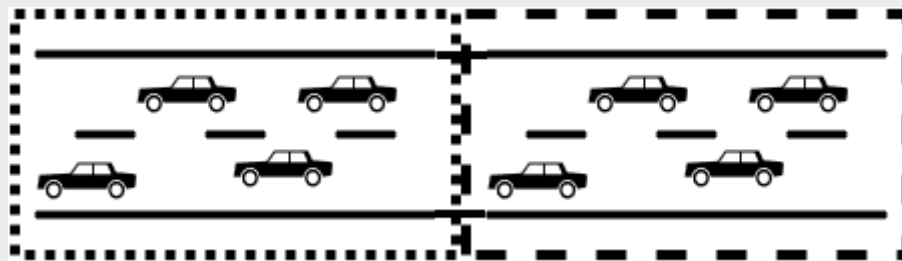
- Early research stage
- NDN implementation:
 - Named-data LinkState Routing (NLSR)

Differences

Type	CCNx 1.x	NDN
Naming	Must match exactly	Overmatching possible
Packet format	Fixed-size header	Variable-size header
Forwarding	First ContentStore check, then PIT Entry	First PIT Entry, then ContentStore check
Single name multiple objects	Likely to cause issues	Likely to cause issues
Routing	No routing implemented yet	Link state and static
Push-based possibilities	No overmatching	Overmatching
Data in Interest	Not possible	Not possible

Use case (1/2)

- Cars on highway
- Speed & Temperature from car sensors
- Access points where cars connect with
- Moving objects

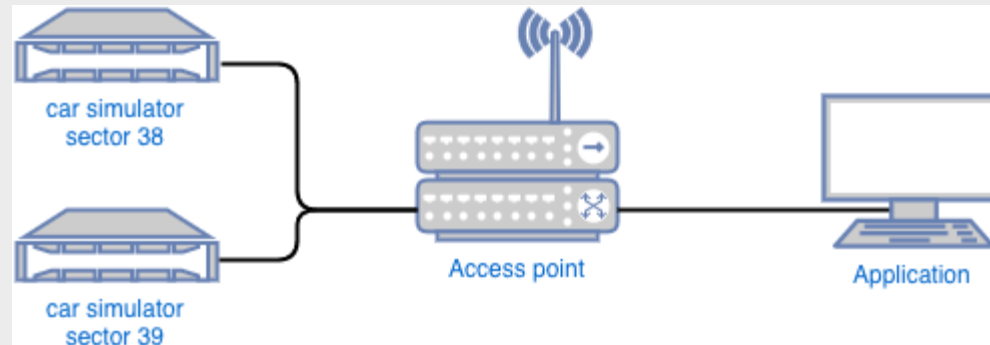


Use case (2/2)

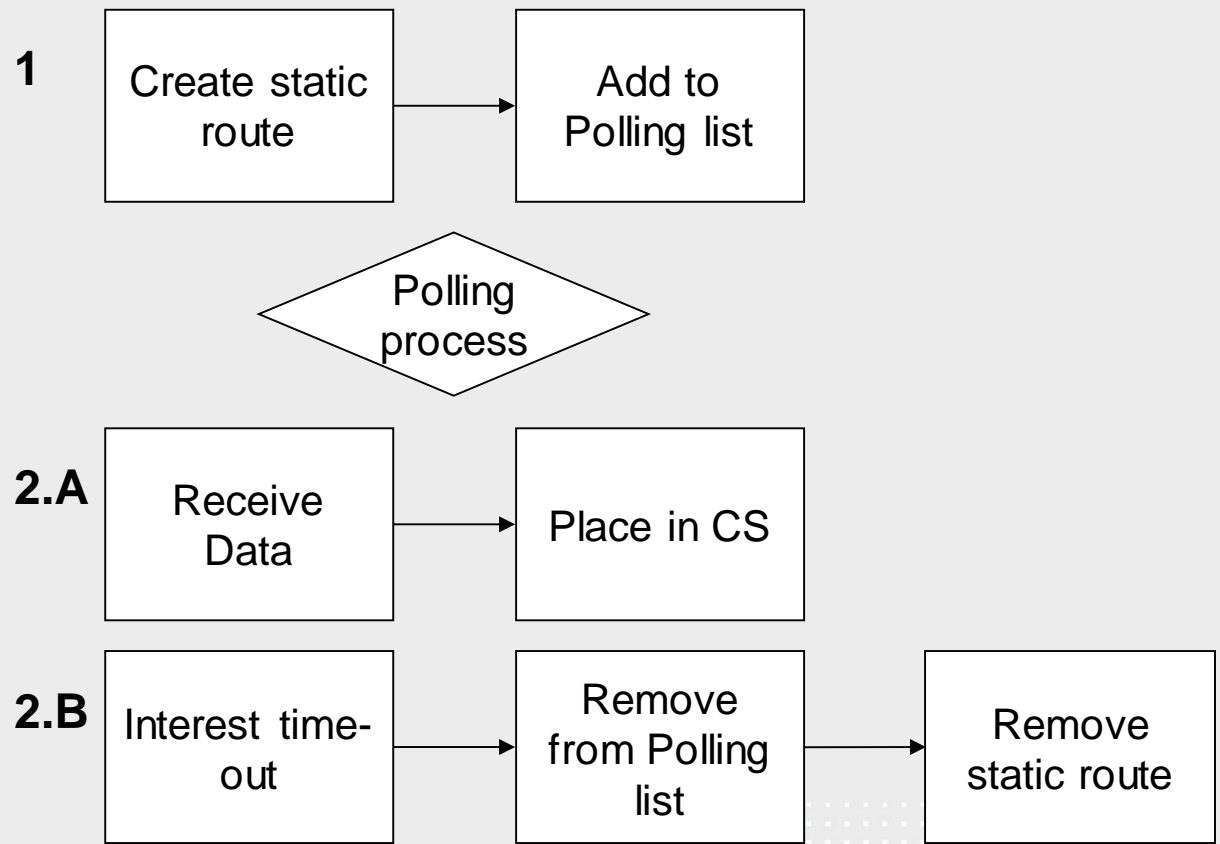
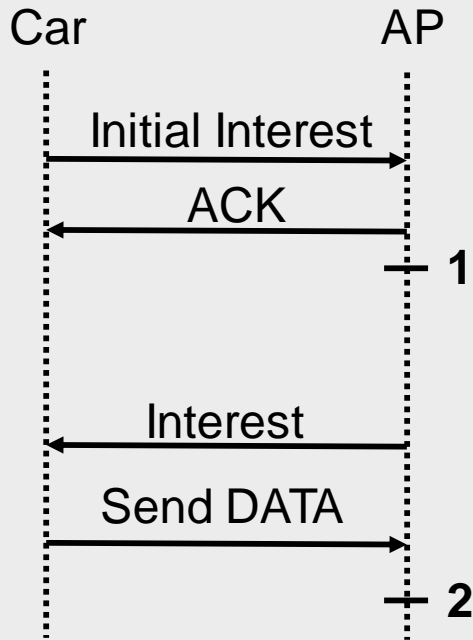
- Requirements/constraints
 - Network connection
 - Naming
 - Routing
 - Push based communication
 - Data aggregation

Proof of Concept (1/4)

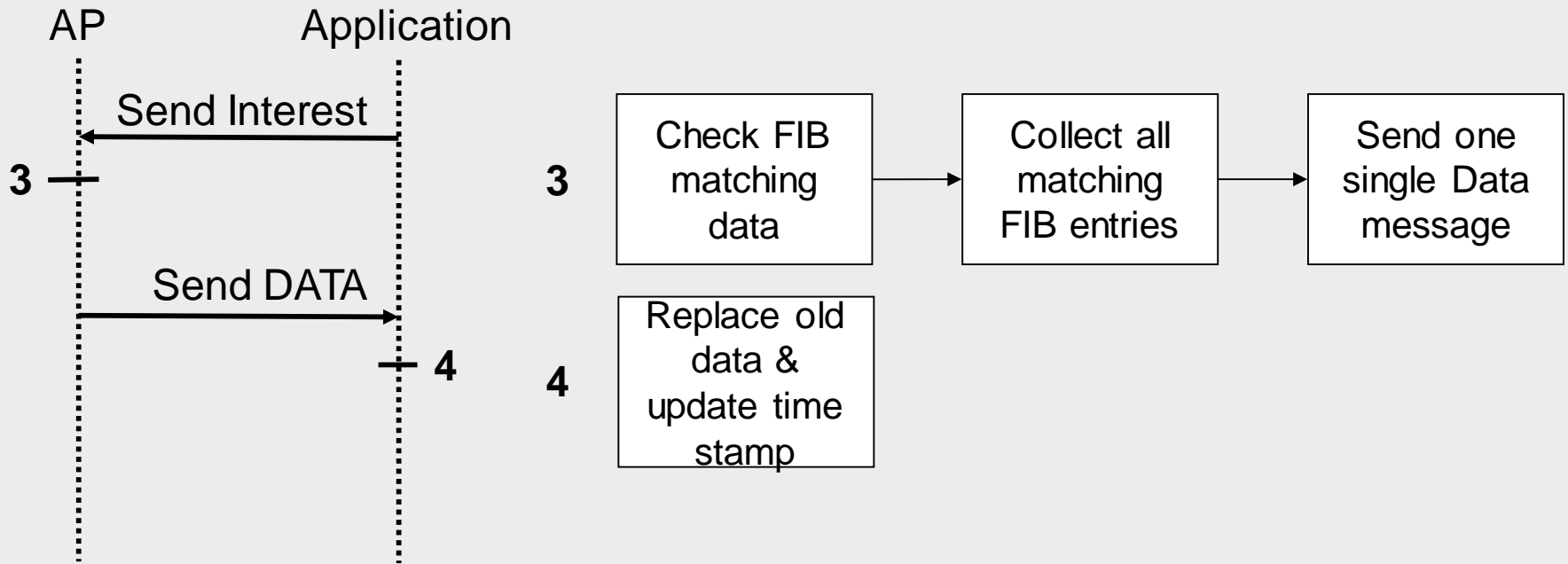
- Only for NDN
- Python (PyNDN)



Proof of concept (2/4)



Proof of concept (3/4)



Proof of concept (4/4)

- Array with data that is sent back
- Sector with speed from all cars

```
{  
  "s39": {  
    "speed": ["165", "127", "125", "129", "128", "127"]  
  },  
  "s38": {  
    "speed": ["165", "133", "127", "131", "145"]  
  }  
}
```

Conclusion

- Both very similar
- Use case specific
 - NDN turned out better for our use case
- Push communication not possible (by design)

Future Work

- Feasibility of sending data inside an Interest packet
- Influence of forwarding with constrained devices



Thanks for your attention