Bezirk

Things plus Cloud does not equal IoT

IoT by default

IoT that tastes better

problem
Architecting the **IoT** (experienced by people)

Web

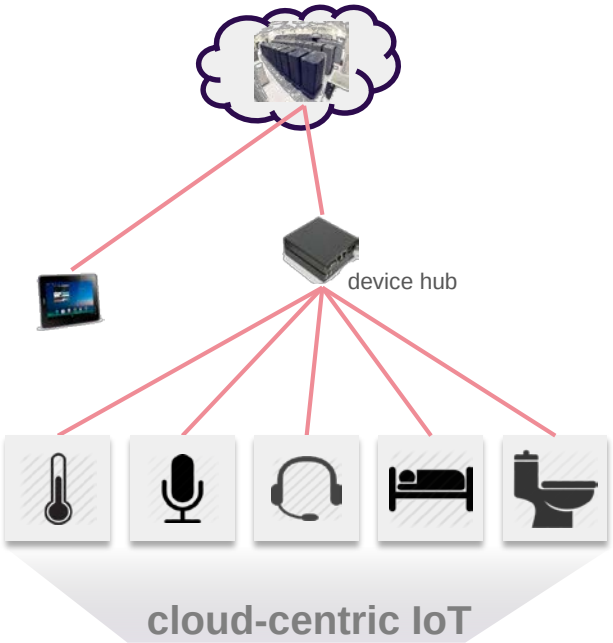
search Q&A

Things

Q&A personalized experience everywhere

Turn lights on
Why are they red?
Get me a coffee!

problem
Architecting the IoT



By default

- raw data pumped to the cloud for processing and analytics

Reality check

- responsiveness
- multi-vendor fragmentation
- rampant threats to privacy

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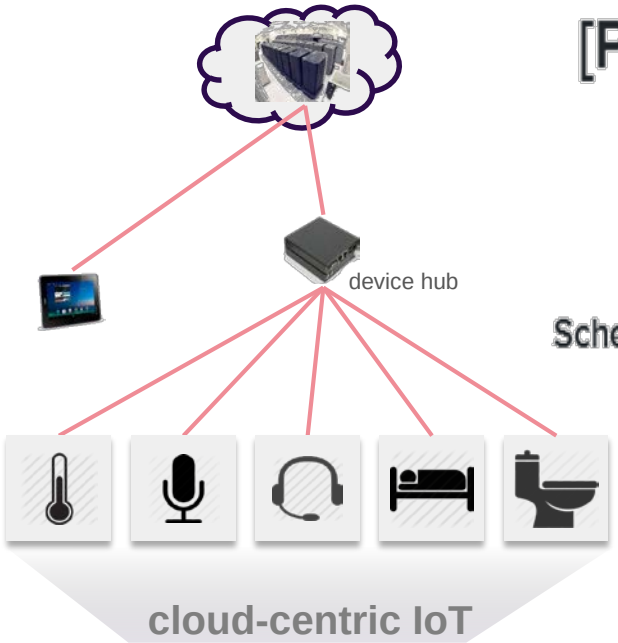
IoT by default **responsiveness**

Reality check



[Partner Maintenance] Chamberlain MyQ garage doors

Scheduled Maintenance Report for Wink

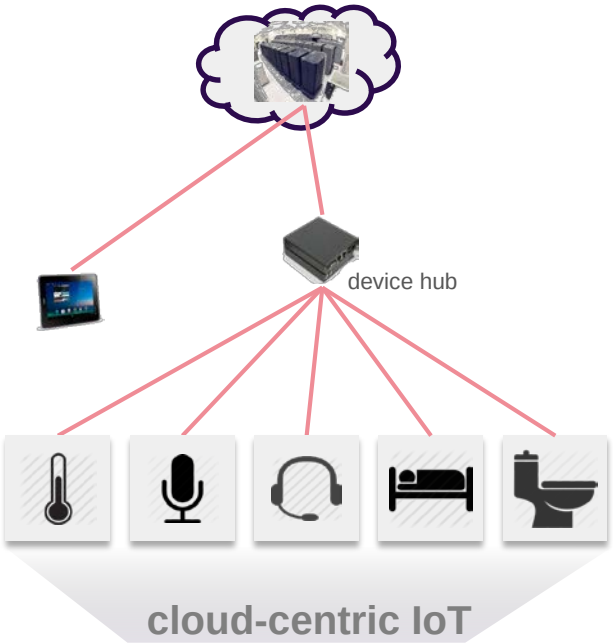
Scheduled

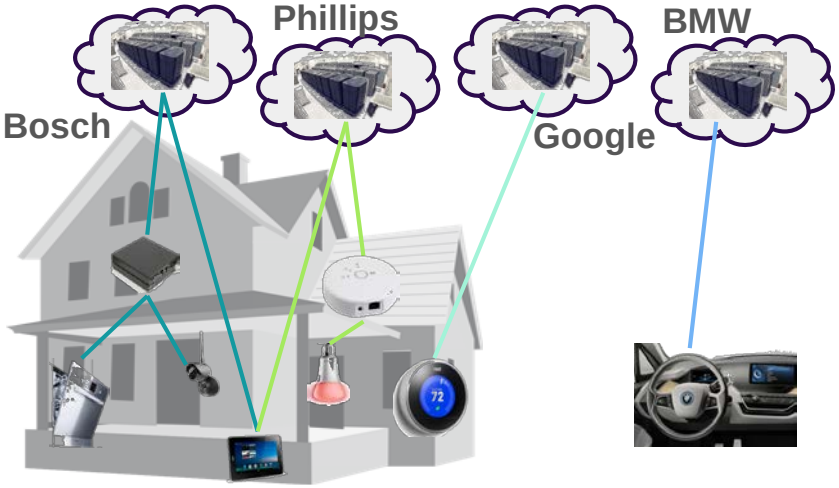
We've been informed that the Chamberlain MyQ garage door web services will be undergoing maintenance on Monday, Nov. 10 01:00 EST (Nov. 9, 22:00 PST). The maintenance is expected to last about 4 hours and users will not be able to use the Chamberlain garage doors from the app during this time.

Posted 3 months ago. Nov 08, 2014 - 22:52 UTC

IoT by default
multi-vendor **fragmentation**

Reality check





- mainstream **business models** revolve on the **value of data** for service providers
- **Data** becomes a business asset: little incentive to share

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IoT
not all **Data** is created equal

Public & corporate data:
weather, traffic,
shopping, customer support…

Social networks:
friends, pictures…

shared

owned

Owned devices:
energy usage,
maintenance diagnostics…

User experience:
how did you sleep?
what are you doing?
what are you asking?

things **you**

IoT

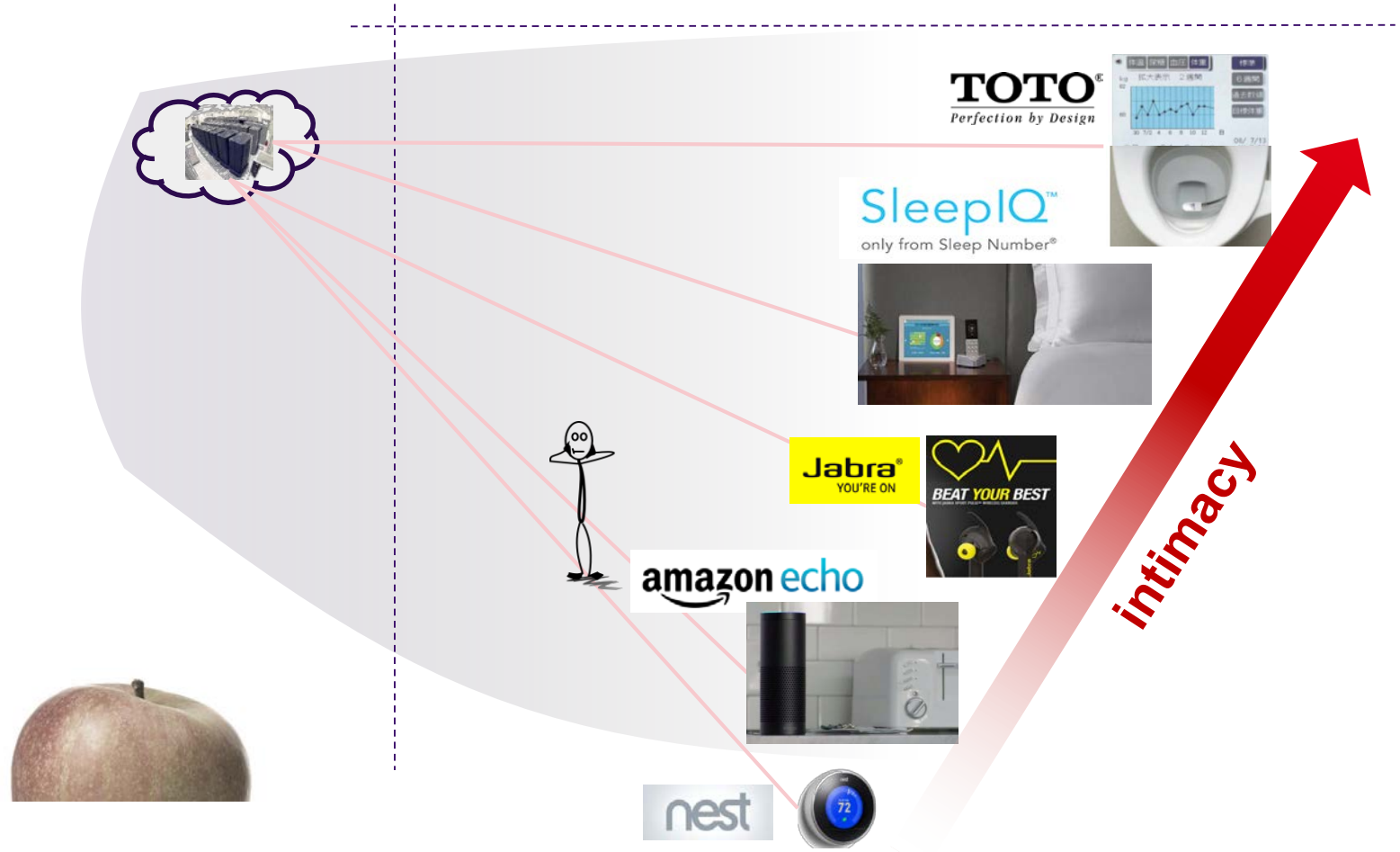
not all **Data** is created equal

but it **all** goes to the cloud

what does that mean to **you**?

IoT by default
rampant loss of **privacy**

Reality check



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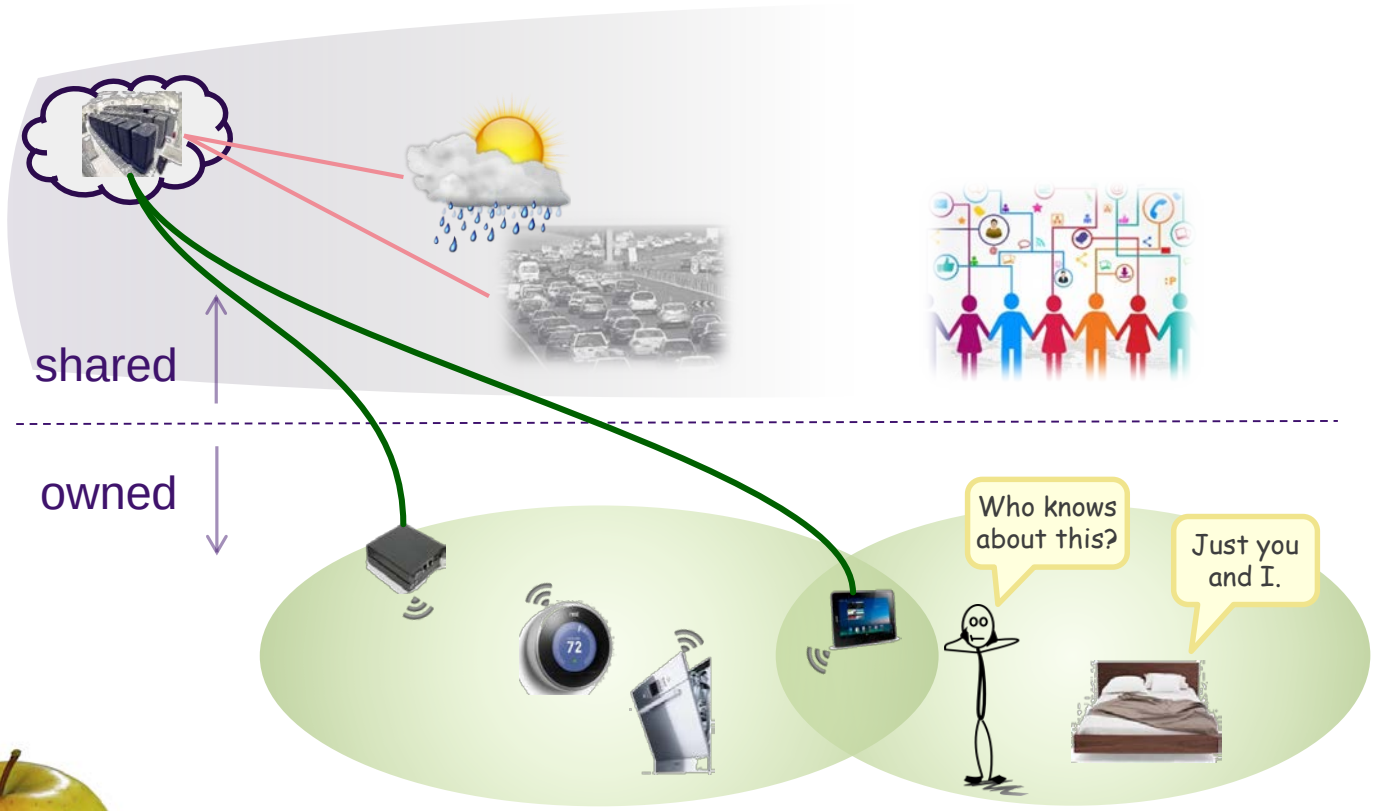
to the IoT what bio/organic is to agricultural products

IoT that tastes better



reclaim user-defined boundaries

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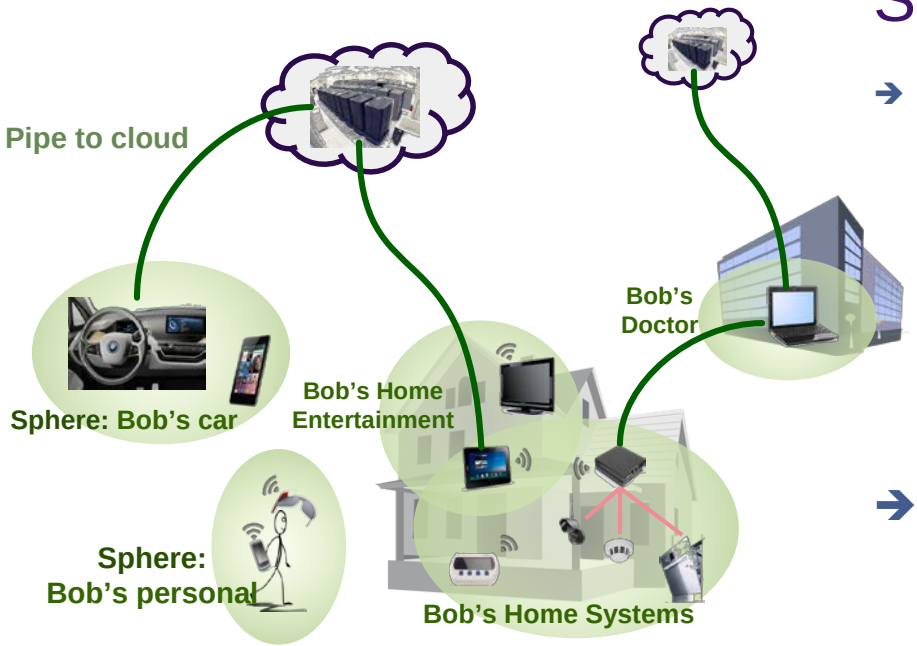
Architecting the IoT
Hub-and-spoke → System of Systems



boundaries of confidentiality

Security model

- **Pipes between spheres / to cloud**
  secure channels for data & events
  - requested by services, authorized by users
  - policy enforced by middleware
    only authorized exchanges go through

- **Spheres of trust**
  - bring security to realm of users
    create sphere, *join* device…
  - **easy** user experience
    promote usability of security

Architecting the IoT
Hub-and-spoke → System of Systems

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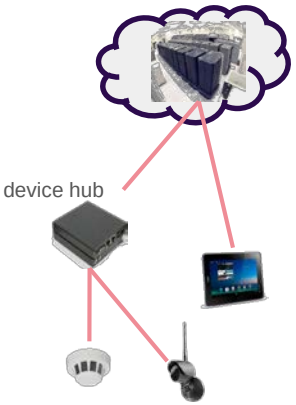
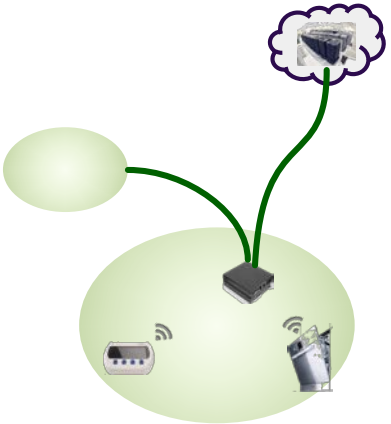
boundaries in topology



- **Internet:** successful apps run on general purpose computers and access remote services
  e.g. email, web browsing
- **IoT:** must a sensor/appliance shoulder the burden of a peer on the internet?
  e.g. access control…
  - a sensor/appliance does not communicate primarily with remote services



our claim	IoT topology should recognize and support two kinds of communication scopes: **local** and **remote**

IoT ≠ give every device an IP(v6) address

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Architecting the IoT
Topology ⇔ addressing a Thing

landscape of addressing schemas

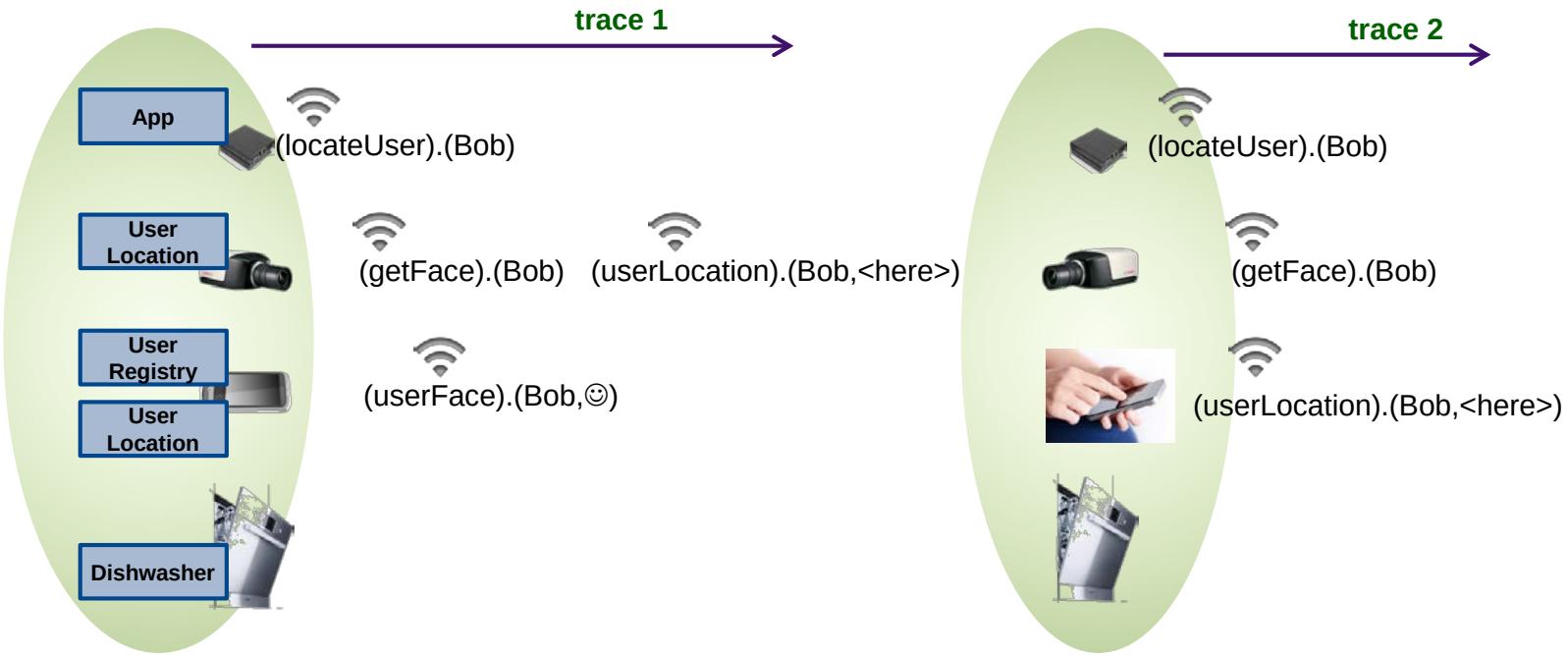
address	applications	who receives
node e.g. 172.16.254.1 (IPv4)	Internet routing: IPv4 (1981), IPv6 (1998) LANs: Bluetooth, WiFi…	identified node sender must know recipient's address
geo e.g. (40.426, -79.965, 500) (lat, long, radius)	sensor networks, safety & disaster response, transportation	whoever is in the area
topic label e.g. "user location"	pub/sub: Java Messaging Service (message centric), Data Distribution Service (data centric)	whoever subscribes to the topic

network def.

application defined

different addressing schemas solve different problems

Architectural Practice
Addressing by Intention
Communication within topological boundaries



- how a request is resolved depends on the **status** of the environment
- no need to scale unique internet addressing to *every* device

Architectural Practice
Promote **decentralized IoT**

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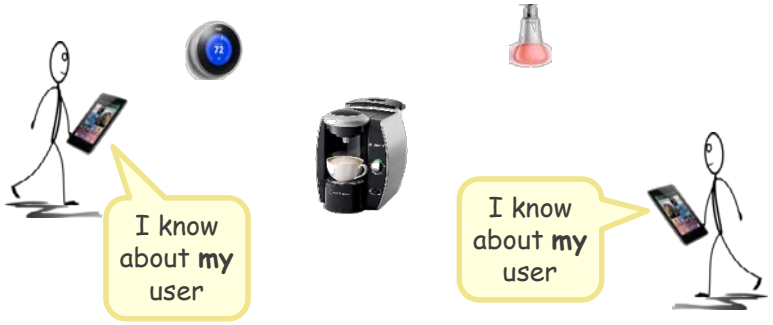

personalized experience

everywhere

Turn lights on
Why are they red?
Get me a coffee!

Interoperation Protocols

open, multivendor

Addressing by intention

dynamic & resilient

Spheres & Pipes

private & secure

---

brokerless pub-sub

impromptu comms.
no single-point-of failure

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Architectural Practice
decentralized → emphasizes Protocols

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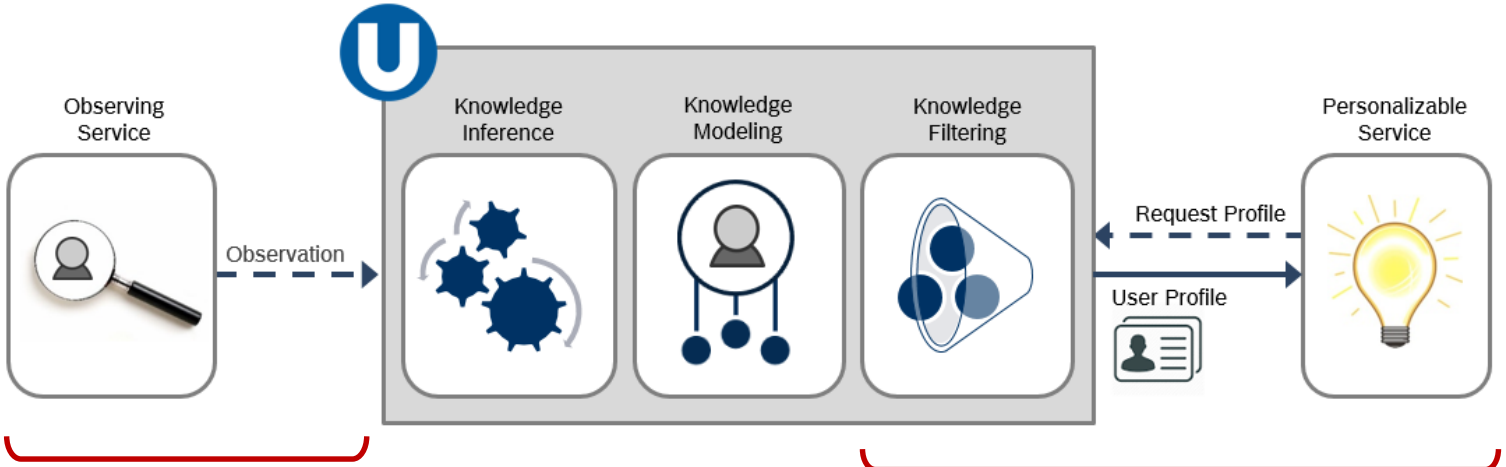
example: learning how user engages the environment



Dragonfly

Penguin

- External service observes the user's lighting choices (e.g., yellow lights on), and the context in which the choices occurred
- External service shares these observations within the network (and with U)

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Architectural Practice
decentralized → emphasize Protocols

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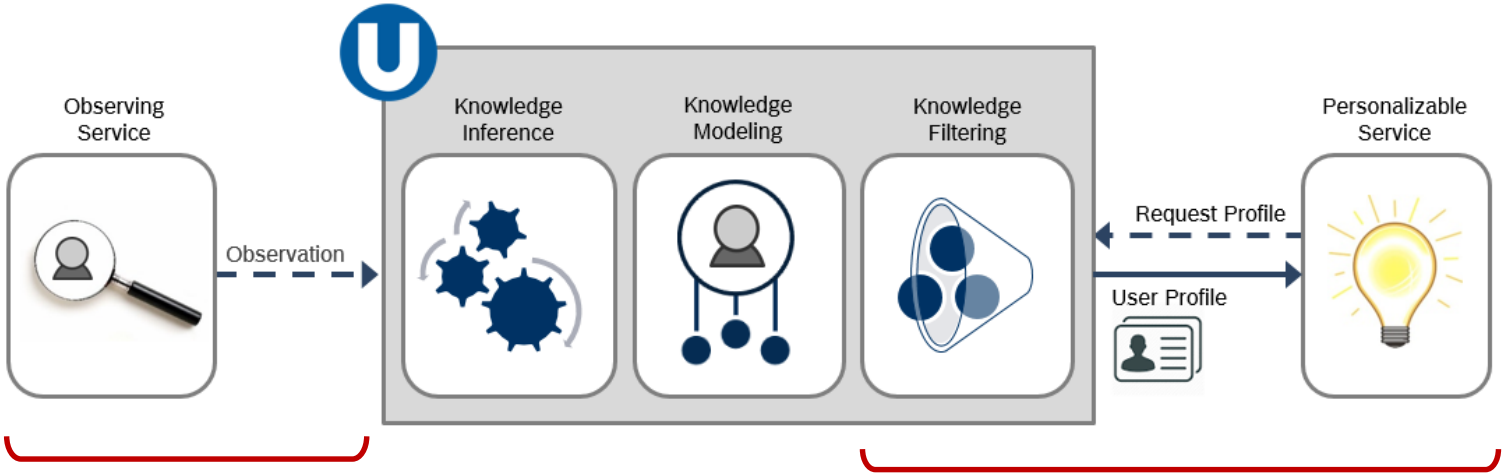
example: tailored *user profile* upon request



Penguin

- Receive request - service requests the profile of a user
- Filter knowledge - U decides what user knowledge is relevant for the service.
- Encode knowledge - U encodes the relevant knowledge into a profile and sends to the requesting service

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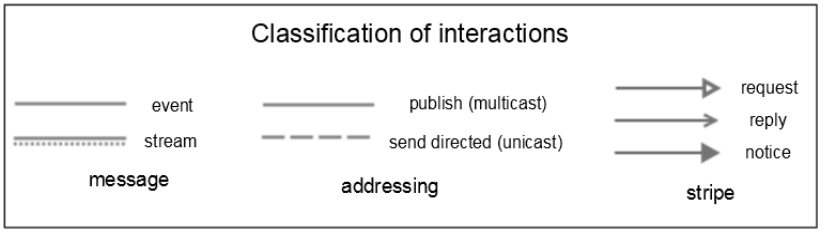
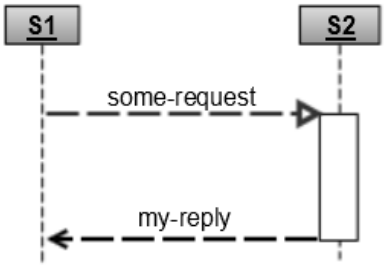
Architectural Practice

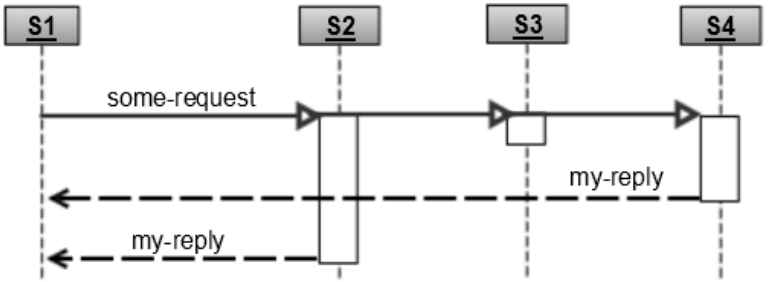
Addr. by Intention → Rich forms of request-reply



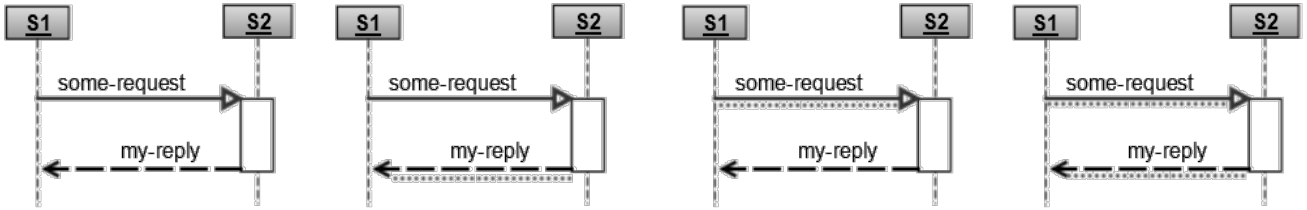
Classic request-reply



Group request-reply



Combinations of event/stream request-reply



Open developers' community
http://www.bezirk.com