

# Challenges in the Internet of Things Realization

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# Home IoT 2015



Medication adherence



Health monitoring



Pet tracking



Object tracking



Child and elder monitoring



Food and nutrition tracking



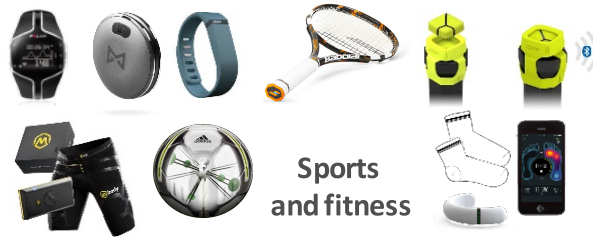
Behavior modification



Trip tracking and car health



Sleep tracking



Sports and fitness



Smart lighting



Home security



HOME



Smart appliances



Air conditioning and temperature control



Environmental sensors



Entertainment systems



Leak detection



Home automation



Garden, lawn and plant care



New devices and sensors

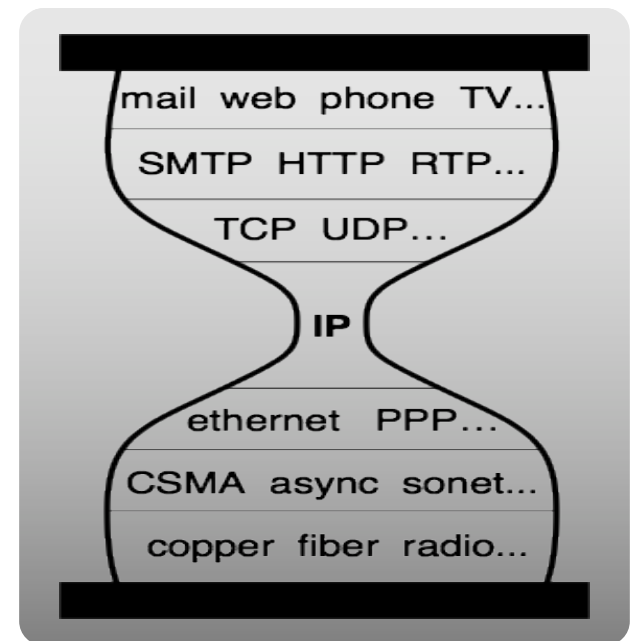
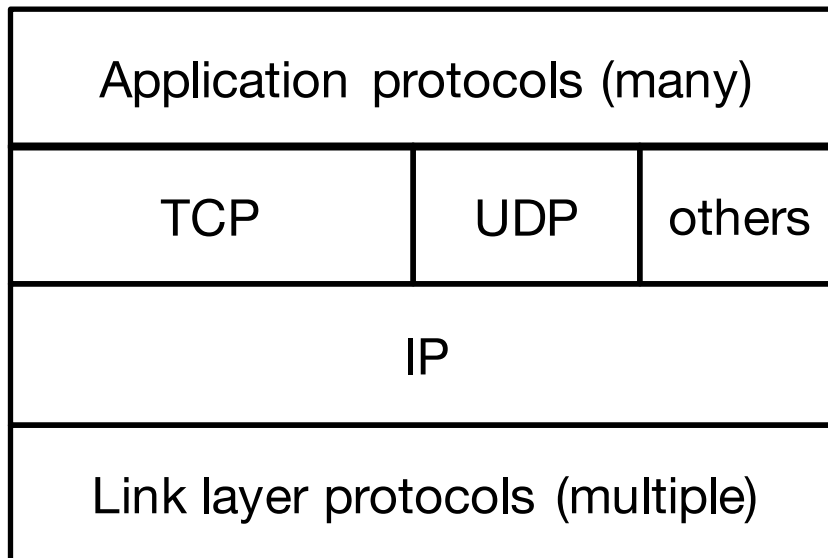
# Internet of Things need to be interconnected

In a way that is

- ◇ secure,
- ◇ scalable,
- ◇ Energy efficient, and
- ◇ easy to develop, easy to use

# IoT Interconnection

- ◇ What we have today: TCP/IP protocol suite
  - Which was developed back in 1970-1980s.



# How well TCP/IP meets the goal of

- ◇ Security and privacy ?
- ◇ Scalability ?
- ◇ Energy efficiency?
- ◇ Ease of development and usage ?

# A simple example

“bedroom temperature?”



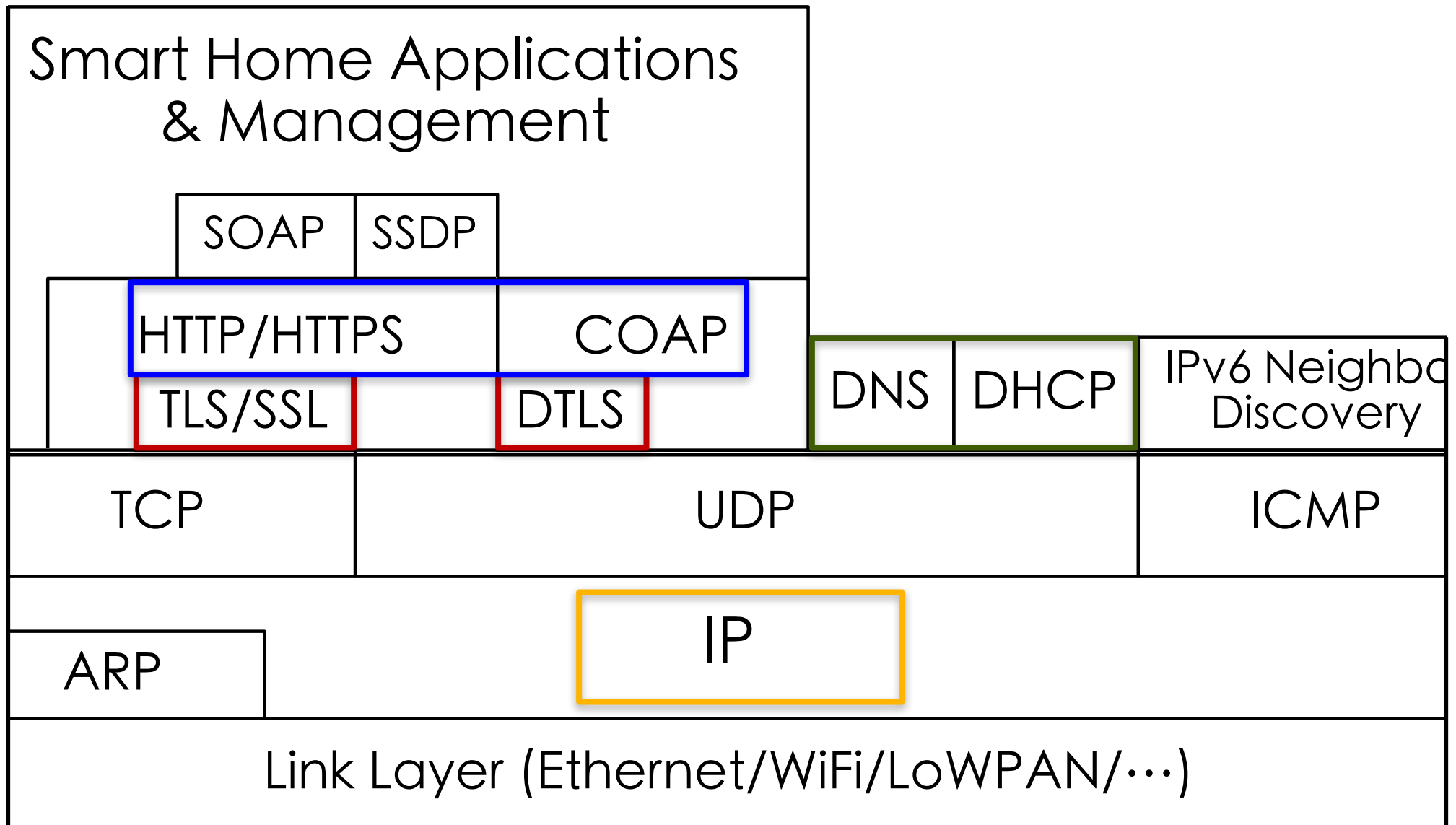
“Turn on air conditioning”



**A big mismatch between  
apps and protocol below**

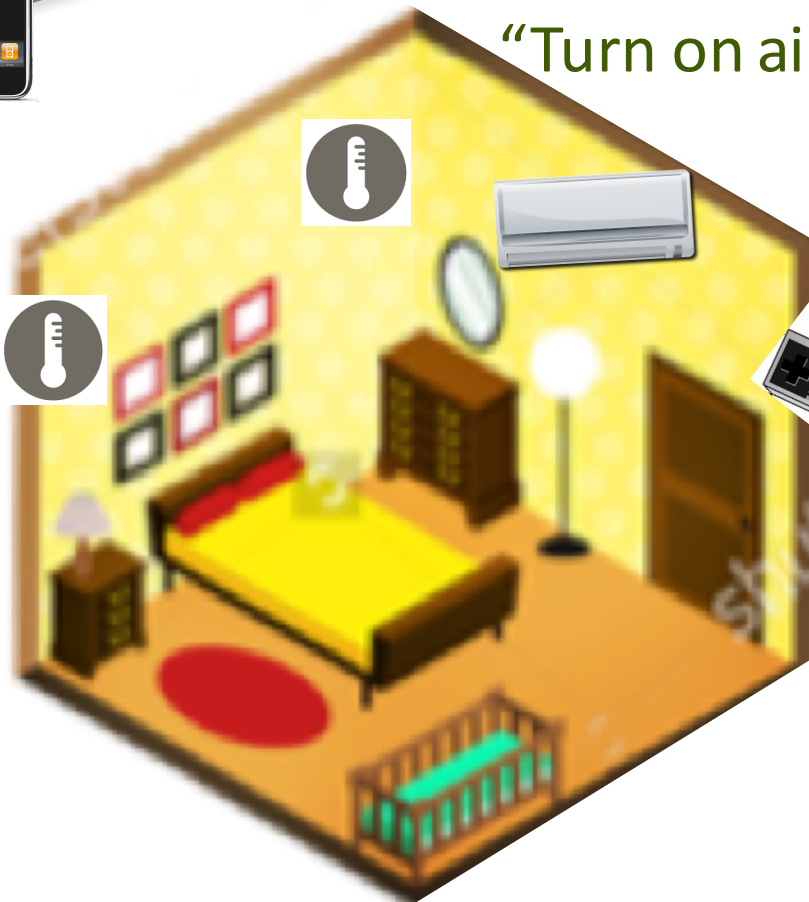
“Turn on air conditioning” “bedroom temperature?”		
TCP	UDP	others
IP		
Link layer protocols (multiple)		

# TCP/IP-based IoT architecture

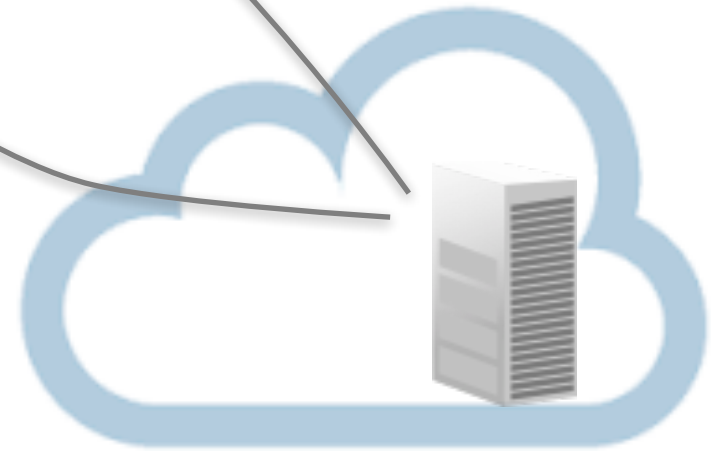


# In addition: who is talking to whom

“bedroom temperature?”



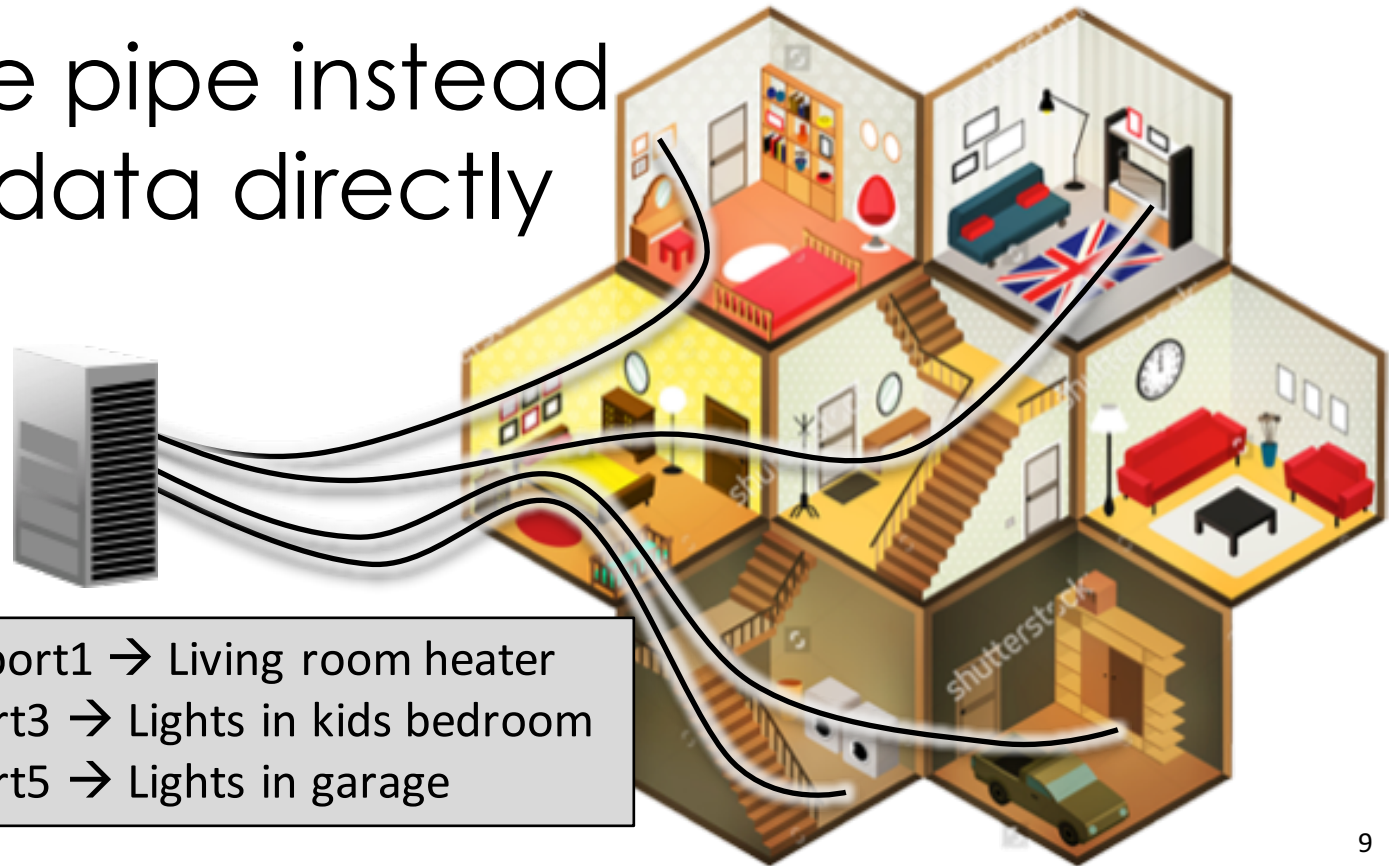
“Turn on air conditioning”





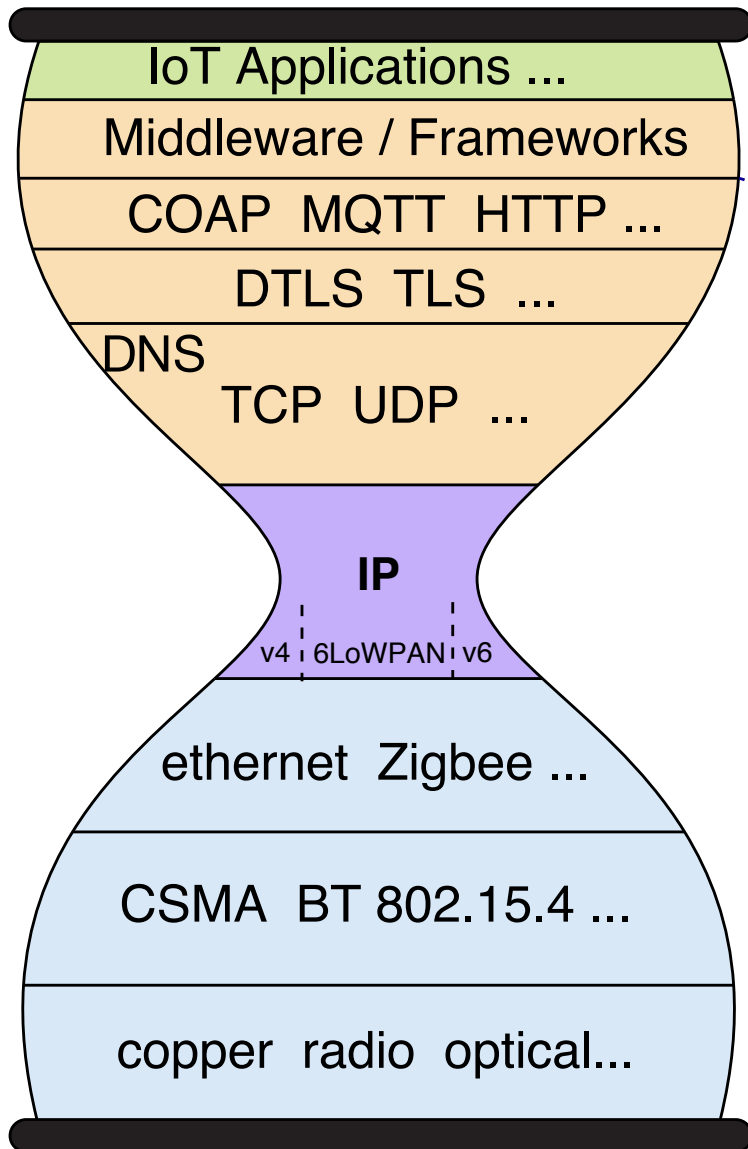
# Today's IoT over TCP/IP

- ◇ Point-to-point communication model
- ◇ Focus on devices associated with “things”, not the “things” directly
- ◇ Securing the pipe instead of securing data directly



1.1.1.1 → Heater controller, port1 → Living room heater  
1.1.2.1 → Light controller, port3 → Lights in kids bedroom  
1.1.3.2 → Light controller, port5 → Lights in garage

# Today's IoT over TCP/IP



- ◇ Lots of patch work to tweak TCP/IP protocol suite into IoT environment
- ◇ connection/session-based security
- ◇ Local actions via remote communications

Does not seem an elegant design

**How we ended up here**

Can we do a better job

The world looked like this when TCP/IP was developed

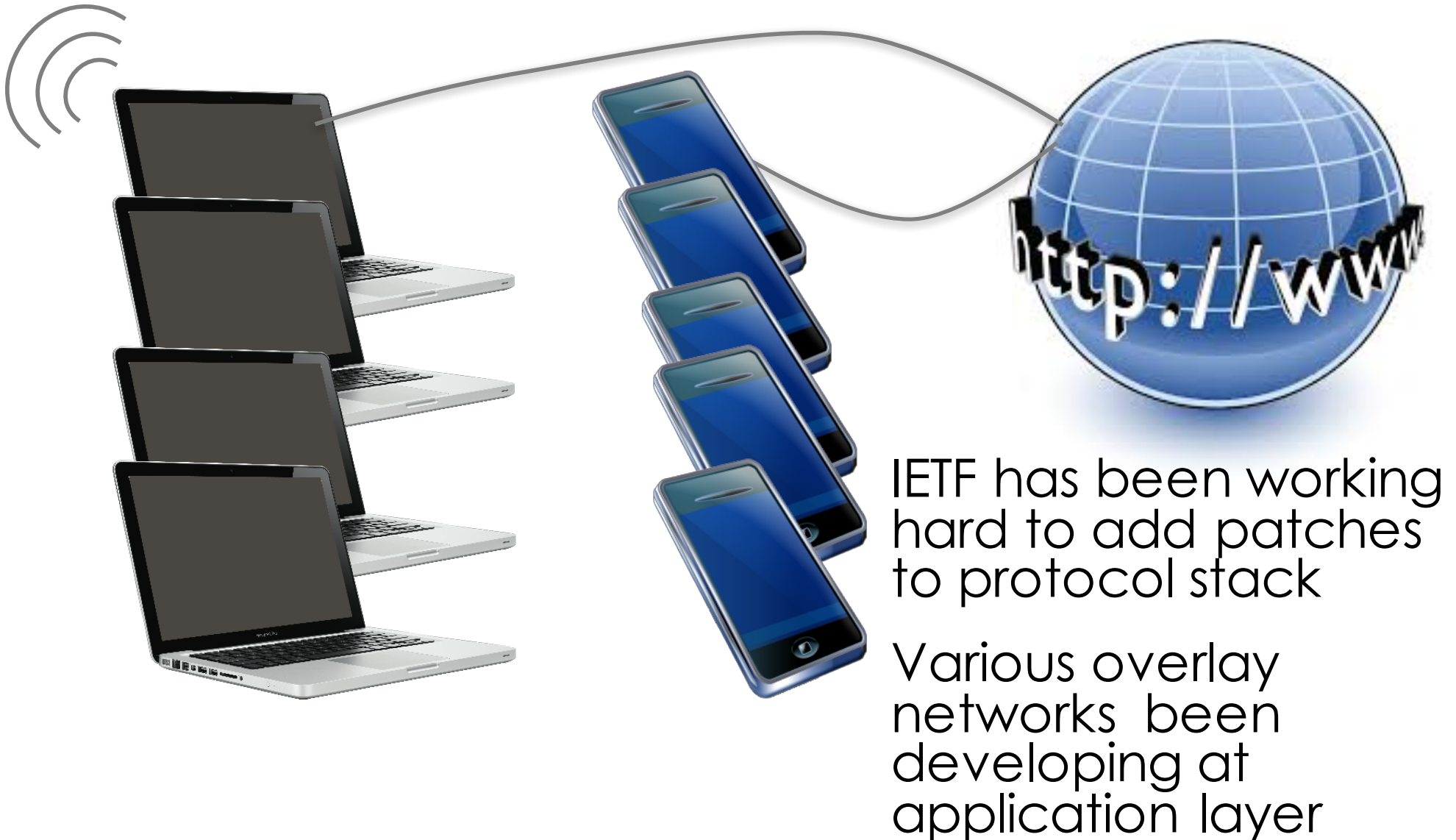


# The world looked like this when TCP/IP was developed

- ◇ (small #) Large computers, wired connectivity
- ◇ Networking was modeled after telephone conversations
- TCP/IP protocol stack defined its own namespace and delivery semantics
  - Use address to deliver packets to a location
  - Worked out pretty well for the original usage

# The world has change

The protocol stack has not



# Patching becoming increasingly difficult



Smart lighting



Home automation



Home security

IoT is fundamentally different from all other apps before it

- many more devices
- constrained processing power, memory size, battery life, and intermittent connectivity
- too critical to go without strong security

Current efforts: tweak IPv6 to fit into IoT, heavy reliance on cloud



Does not seem an elegant design

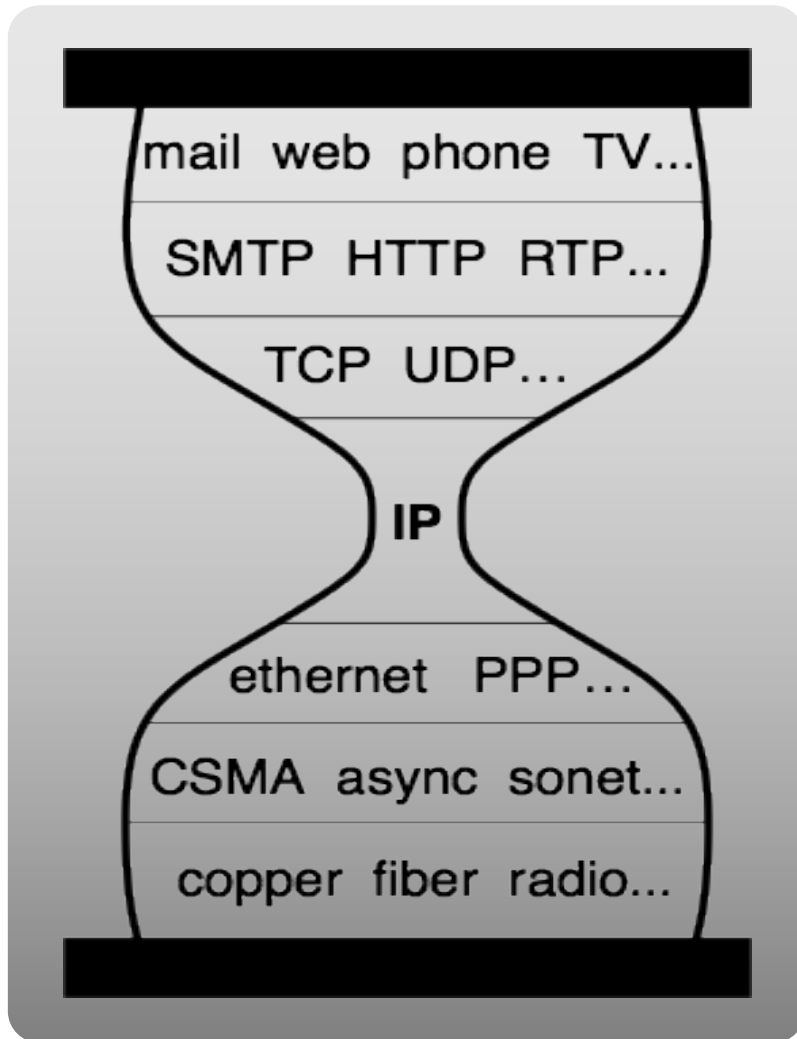
How we end up here

**Can we do a better job?**

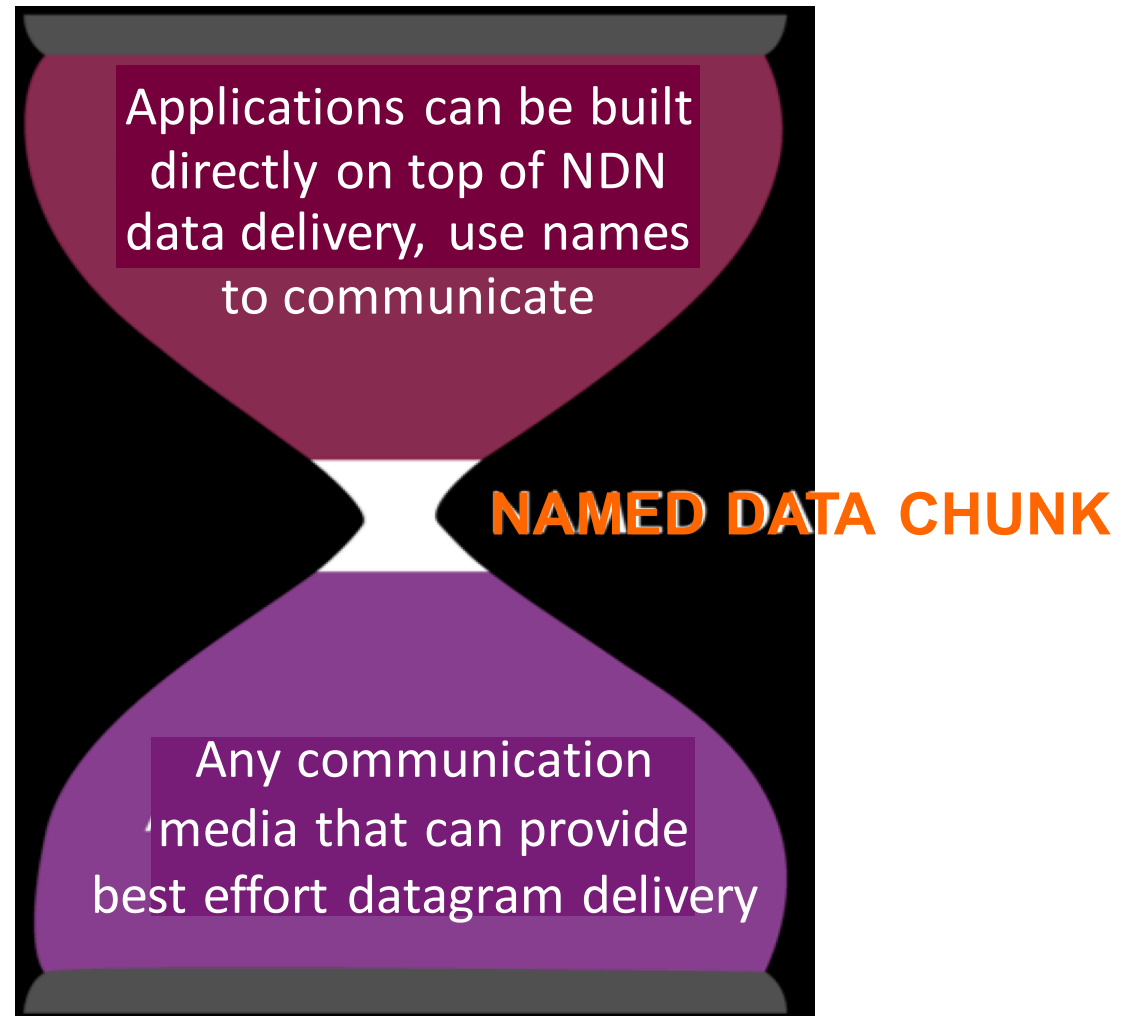


# Named Data Networking (NDN)

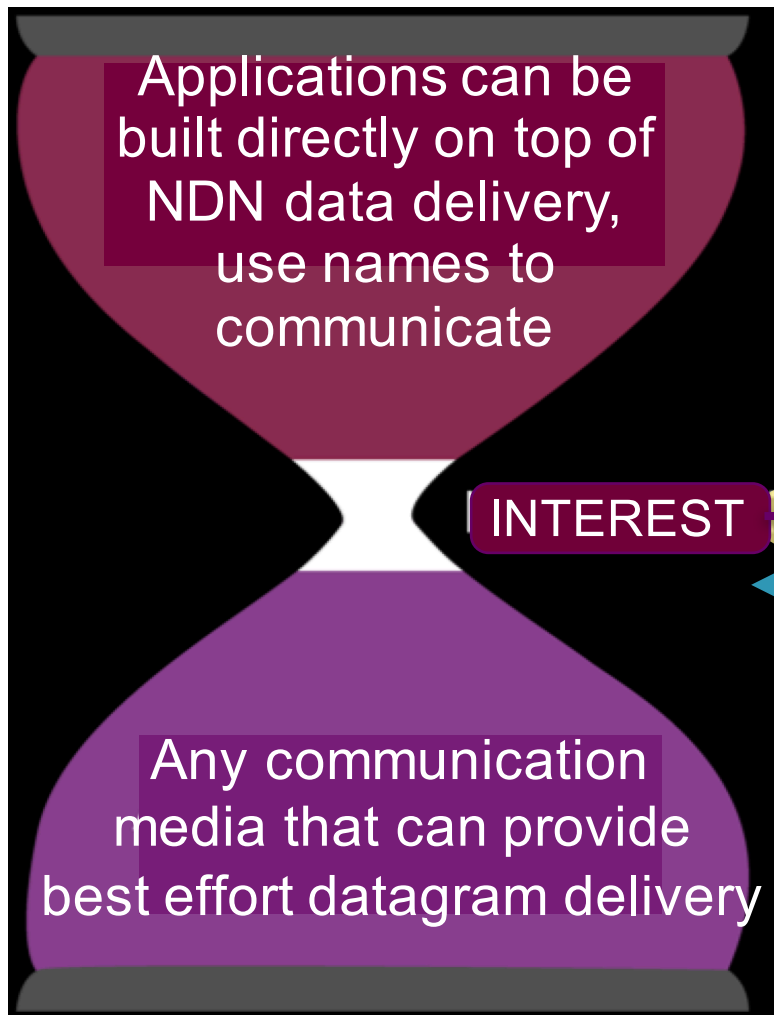
TCP/IP



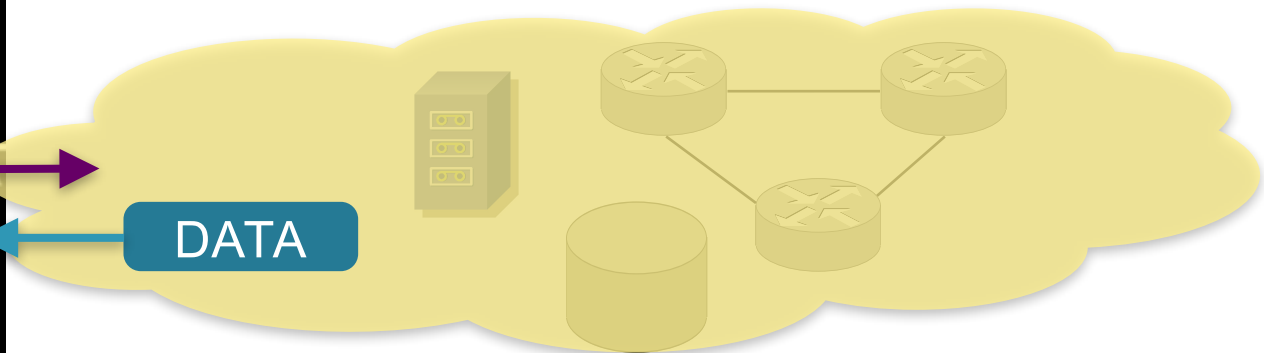
NDN



# How NDN works



- › Abstracting away the notion of “node”; simply fetching *data* by names



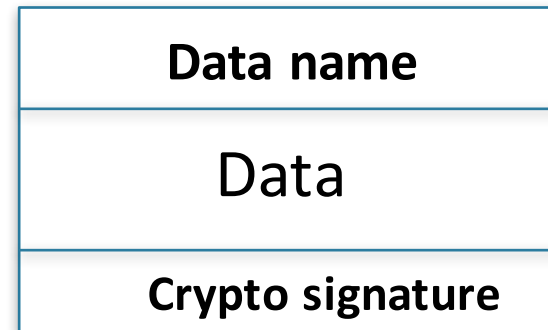
- › Leaving the questions of both *where* and *how* to get the data to the system to decide

# Fetching Named Data

Interest packet



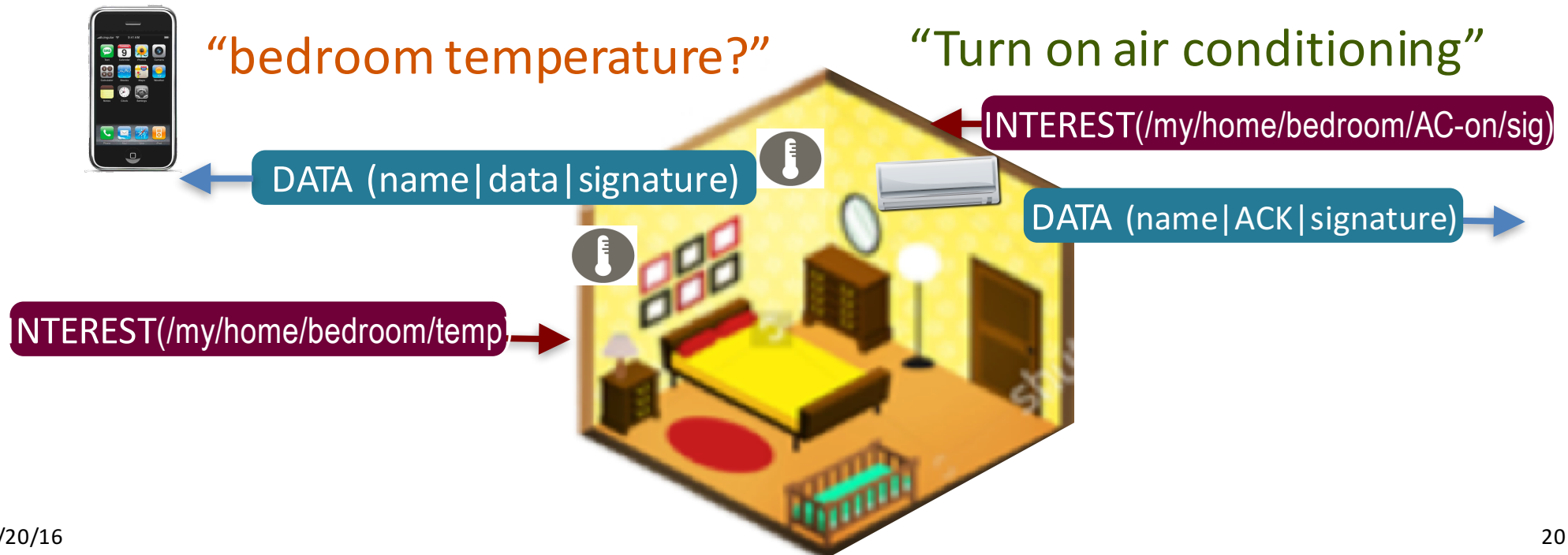
data packet



- ◇ Web semantics at network layer
- ◇ Names are expressive
- ◇ Requested data may come from anywhere
  - Wireless, wire, storage, or processing unit all look the same in terms of getting requested data

# IoT over NDN

- ◇ Name “things” and operate on “things”
- ◇ Focus on data associated with things, not devices
- ◇ Secure data directly



# A good idea, can it get deployed?

Follow the footstep of IP rollout

- ◇ Developing useful applications
- ◇ Developing a community
- ◇ Edge-in

## NAMED DATA NETWORKING

Project

Architecture

Codebase

Testbed

Publications

Discussion



### NDNCOMM 2015 / HACKATHON

Watch the archived livestream and see presentation slides from the 2nd NDN Community Meeting (NDNcomm) and Hackathon in September 2015.



### TUTORIAL VIDEOS

Watch tutorial videos about the NDN project and NDN technologies.

[Read More](#)



### THE NDN TESTBED IS GROWING

The NDN research testbed is a shared resource created for research purposes, that now includes nodes in Asia and Europe.



### NDN VIDEO FAQ

Questions about NDN answered on video by faculty, students, staff researchers, and colleagues.

[Read More](#)

# Take-Away

- ◇ IP's way of networking does not fit well in IoT environment
- ◇ Future of IoT lies in recognizing the right communication abstraction  
**named data**

