Internet of Things

Peeling back the layers

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What is the Internet Of Things?

Schematic Overview

No IP

IP Protocol

http

Web portal

http

(light bulb)

gateway

Internet modem (cpe)

Internet

*Only when on same wifi network
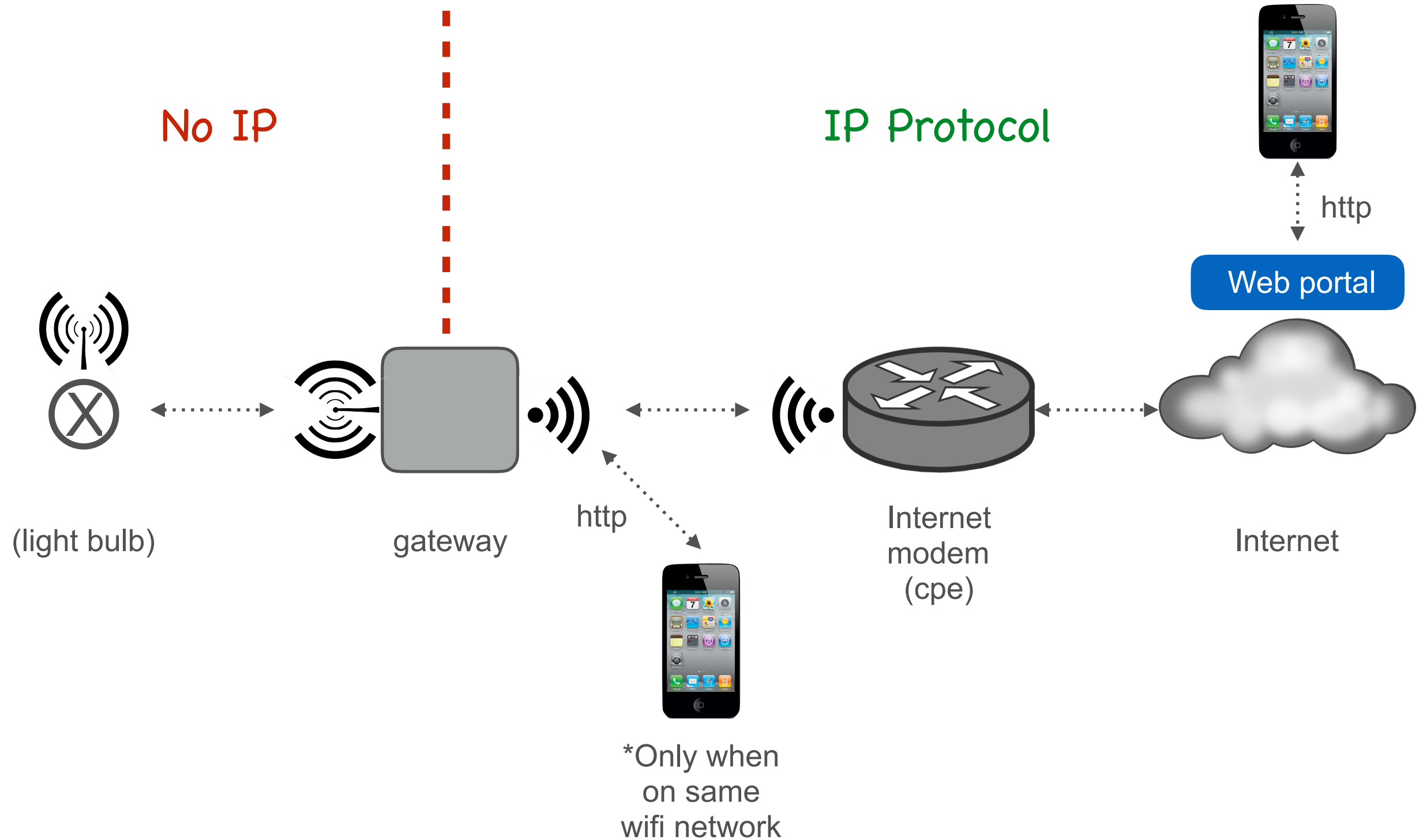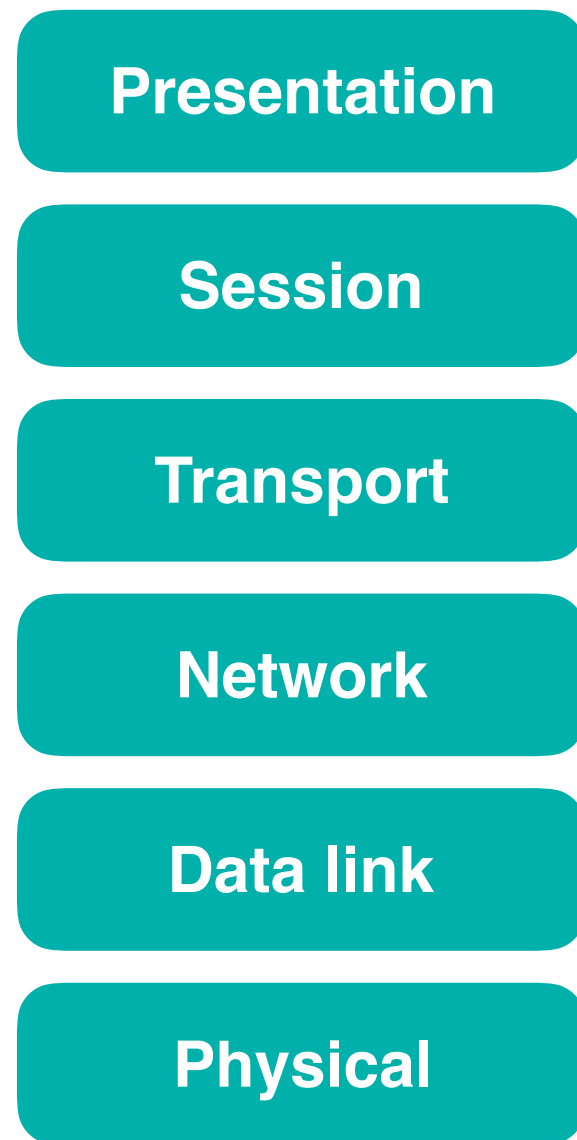
IP?

Bluetooth®

(WiFi)

Not so smart watch
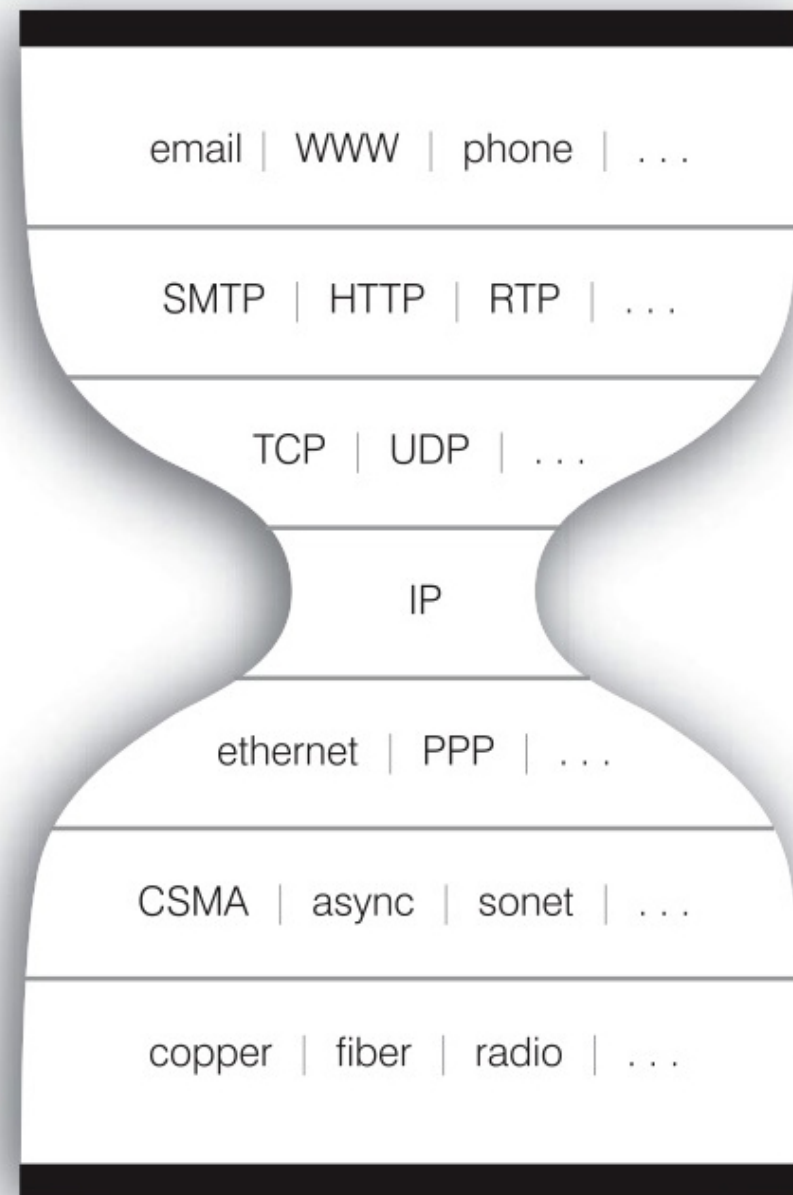
Wireless Personal Area Networks

- Low power radio in unlicensed spectrum

  - Limited range

  - Limited bandwidth

- Really personal (few meters)

  - Bluetooth, Zigbee, Z-Wave, ANT+

- Longer range (few kilometres)

  - LoRaWAN, DASH7, Nwave

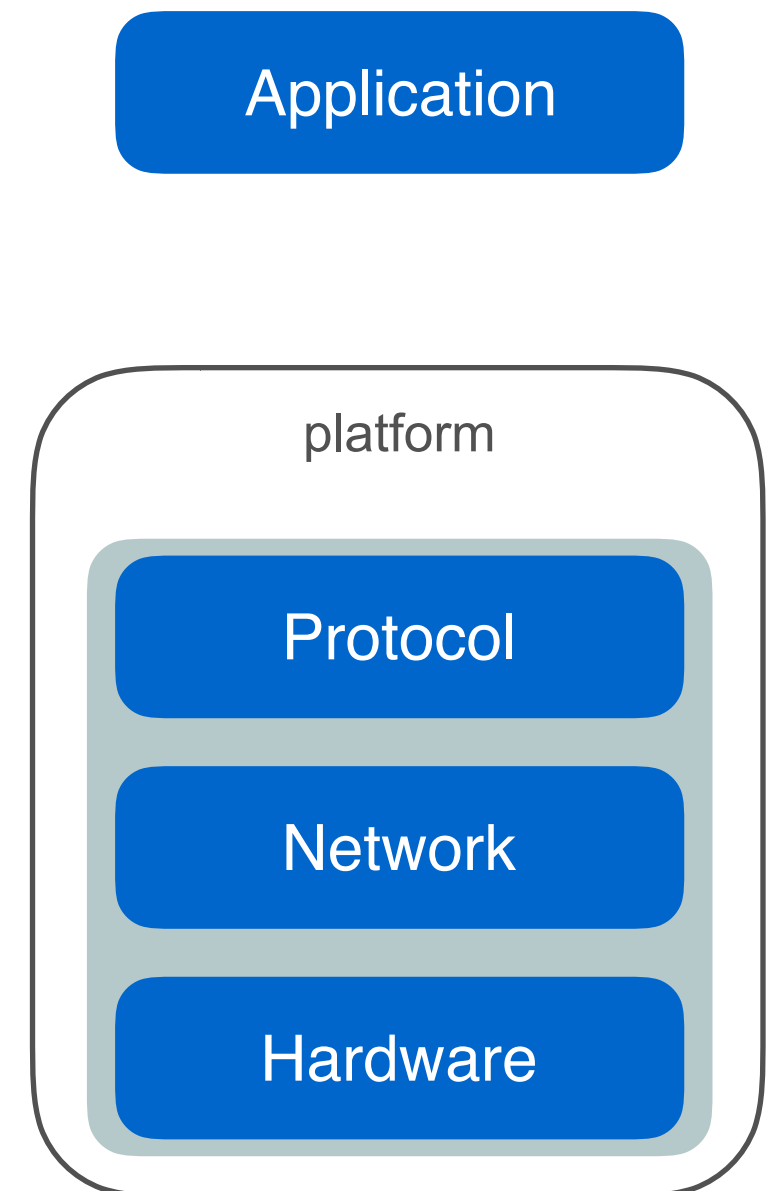- Most based on IEEE 802.15 open standards

IoT: Stacking It Up

| OSI | "Internet" | "IoT" |

OSI layers:
- Presentation
- Session
- Transport
- Network
- Data link
- Physical

"Internet" layers:
- email | WWW | phone | . . .
- SMTP | HTTP | RTP | . . .
- TCP | UDP | . . .
- IP
- ethernet | PPP | . . .
- CSMA | async | sonet | . . .
- copper | fiber | radio | . . .

"IoT":
- Application
- platform
 - Protocol
  - Network
  - Hardware

"Quite often there is no I in IoT"

To IP or Not To IP?

- Advantage or disadvantage?

  - IP is "expensive" on CPU, memory and battery life

  - Reachability can be a risk

  - Proprietary technology seen as competitive advantage

- Overlaps might also exist at other layers

  - Using wifi or other common network technology

  - Use of "Internet" protocols such as http

  - Translation to/from IP communication

Sharing Technology
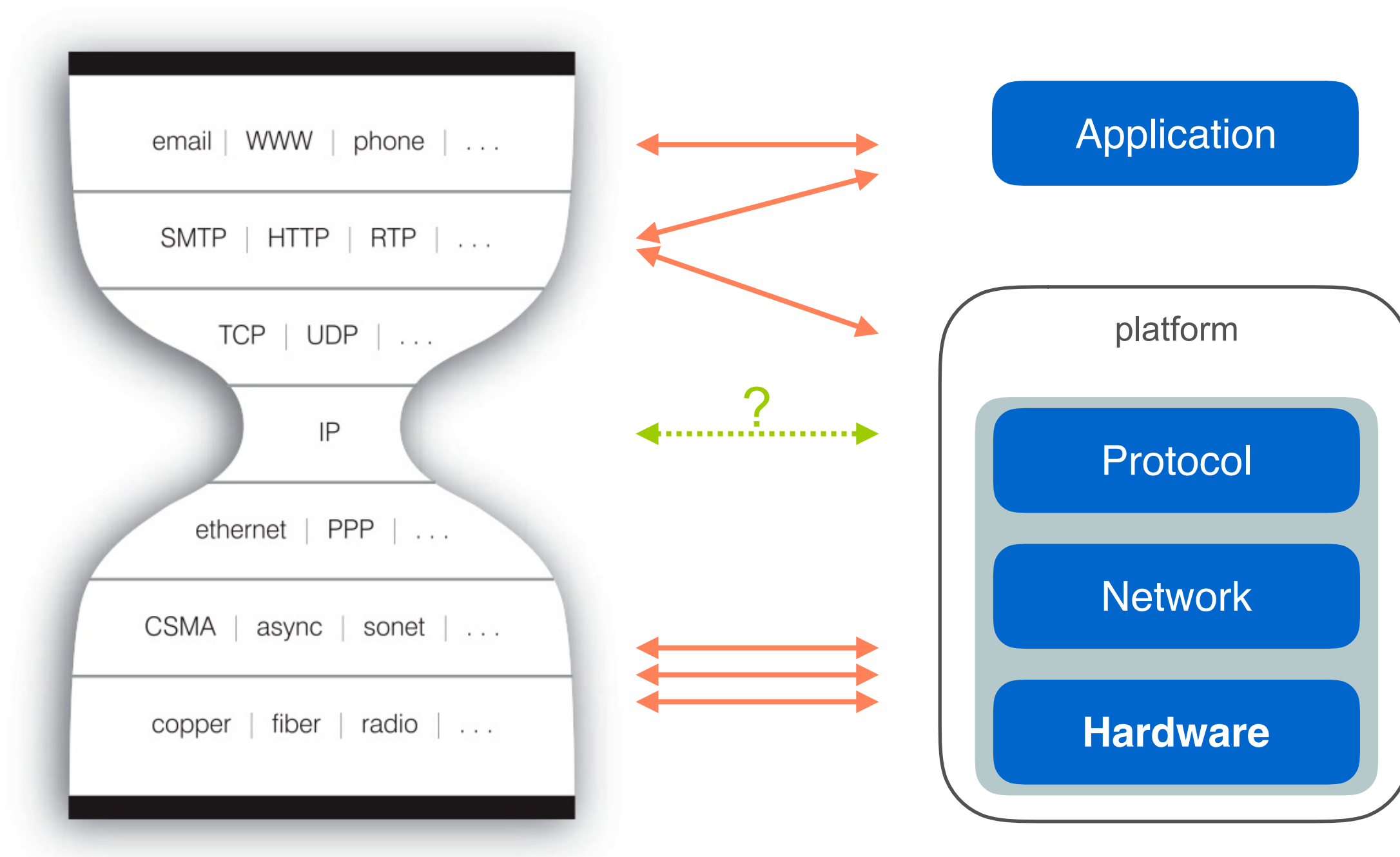
Designs Use Existing Technology

- Time to market is important

- "Packaged" solutions are cheap to use

  - Can have side effects

- Example: smart meter using 3G

  - Are you ever going to call it?

  - Do you need international roaming?

Names and Numbers

Expanding the Network of Networks

There Are Two Main Functions

- Act as an identifier

  - Who is talking

- Act as a locator

  - Get my message to the other side

Internet Routing

- Routing is open, free and non-hierarchical

  - Makes the infrastructure very dynamic and robust

  - Network core is very dumb

  - Everybody can join

- Driver to the Internet's success

  - Low cost of entry and participation

  - Lots of competition

  - Very efficient

IP Address Is a Locator

- The IP address represents a network location

- Structured around routing and forwarding

    - It changes when you change network

    - Can use pooling and sharing inside the network

- Function as identifier is very limited

    - Often can only be resolved ex-post

    - Very rapid decline due to IPv4 run out

Identification On the Internet

- Primary symbolic identifier is the DNS entry

  - Remains dynamic in nature

  - Unrelated entries can lead to same address or vice versa

- Application layer credentials

  - More stable and individual

  - Proprietary and often hard to trace

- Lower layer identifiers

  - MAC address, IMSI, IMEI

  - Physical such as port or cable

Special Role of IPv6

IPv6 Is Nothing Special

- Purpose and structure remain the same
  - Allocation and delegation of responsibility starts at RIR
  - Addressing Model based on routing structure
- Only difference is the size of things
  - Concept of individual addresses is gone
  - Every end-point can choose from billions of addresses

- Allows for creative use

Subnets vs Hosts

- Every IP address has two parts:
  - Subnet which indicates the network segment
  - Host portion which indicates a device in the segment

- In IPv4 an end-point gets a single address
  - Sharing is only option to expand (address translation)

- In IPv6 an end-point gets a subnet
  - Defaults to 64 bits, leaving 2^{64} options for host portion
  - A device can start its own delegation

Opportunities and Strengths

- The host portion can contain other numbers

  - Common solution is to embed the MAC address

  - Can use anything that fits in 64 bits, incl. IMSI and E.164

- Gateway devices can delegate

  - Use non-IP technology addresses as host portion

  - The Internet won't notice anything different

  - Provides for easy translation to/from non-IP networks

Weaknesses and Threats

- IPv6 is designed to be dynamic like IPv4

  - Networks or markets might have different routing requirements that do not fit the current structure

  - Dynamic addresses are expensive for CPU and battery

- Change of use brings side effects

  - Expanding regulation to meet public policy requirements

- Functional mis-use of IPv6 address space

  - Trying to use it as a fixed identifier

Finding a Fixed Identifier

- IPv6 is not your best option

  - Architecture demands IP addresses to be flexible

- E.164 and IMSI are getting scarce

  - Also might involve complex licensing

- IEEE offers a possible solution

  - You can get an OUI (Organizationally Unique Identifier)

  - Leaves 24 or 40 bits for organisation to assign

  - Proven and familiar system (ethernet, bluetooth)

Impact?

Evolutionary Impact of IoT

- Gradual shifts within existing use cases

  - More mobility and nomadic use

  - New use for existing protocols

  - New network structures

- Emerging requirements

  - Compatibility with non-IP technology

  - Meeting (new) public policy objectives

Network of networks is expanding at the edge with non-IP networks

Raise Awareness

- Connect with new industries and actors

- Explain who we are

  - And why we do things the way we do

- Show the value we can add

  - Collaboration

  - Experience

  - Resources

- Find out what is needed

Show Flexibility

- Be ready to accommodate to new use cases

- Think out of the box

- Change our perspective

Speed Is A Challenge

- This is a very competitive industry

- Time to market means everything

- They are not going to wait for you

Functional Approach Is Needed

- ● Old definitions might no longer be valid

- ● Traditional models might not fit

- ● Accept there are constraints

- ● Make it work together

Comments

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