Lab 1: Big Red Internet Button

+

= IoT!

1. Press the button
2. Post something to the Internet

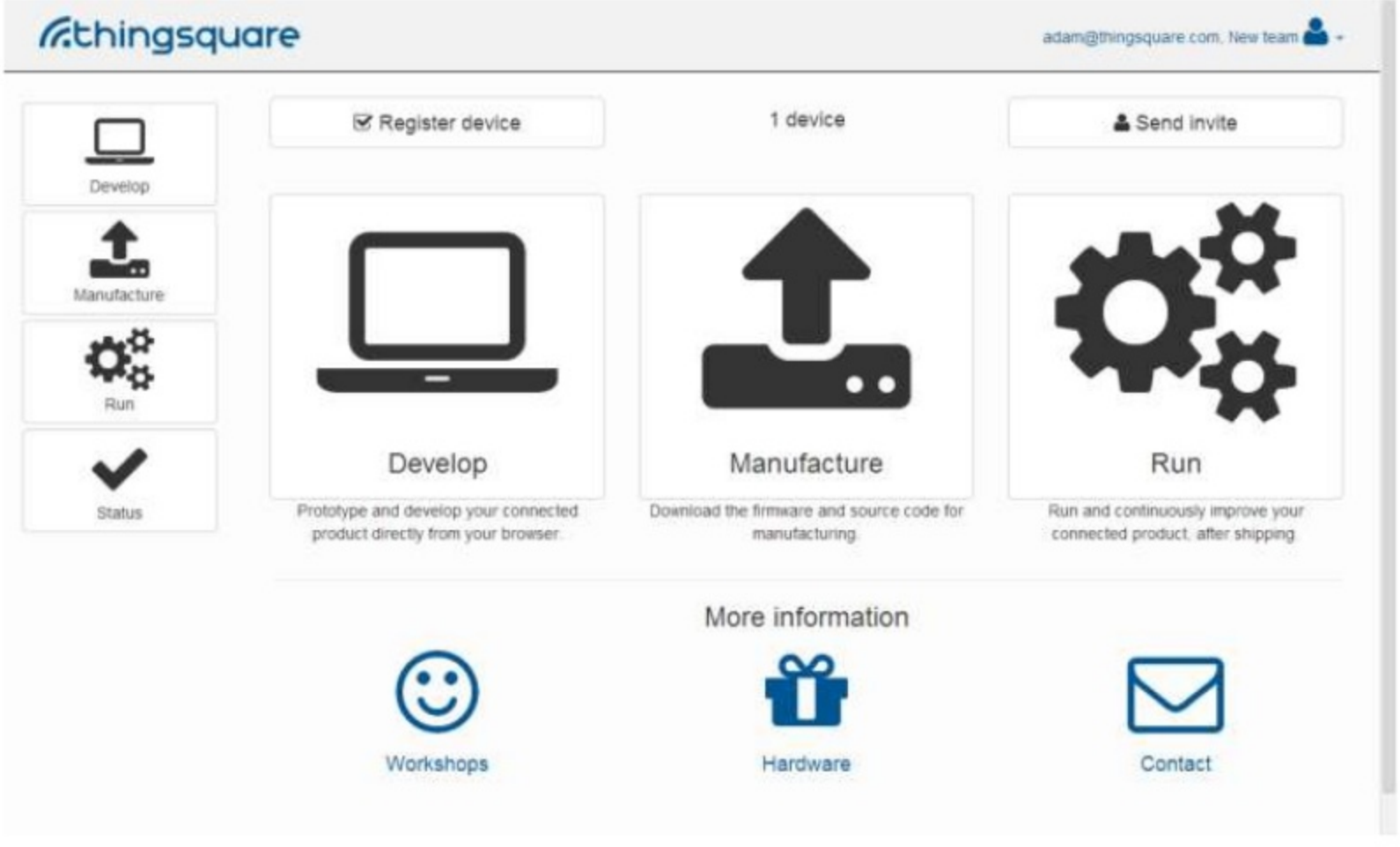
The Big Red Button

- Two connectors
  - Ground
  - Signal
- 12 v built-in LED

The Thingsquare kit

- CC2538 System-on-a-Chip board
  - The heart of it all
  - Runs Contiki
- Display board
  - LCD screen
  - JTAG debugger
- Ethernet router

The Thingsquare cloud



The Thingsquare cloud

- Connect your devices
- Program your devices from your browser
- Inspect the output

What we'll do

- Connect the button
- Upload a program that does:
  - Reads the button
  - Does an HTTP POST to http://requestb.in/
- Inspect the output

Set up your device

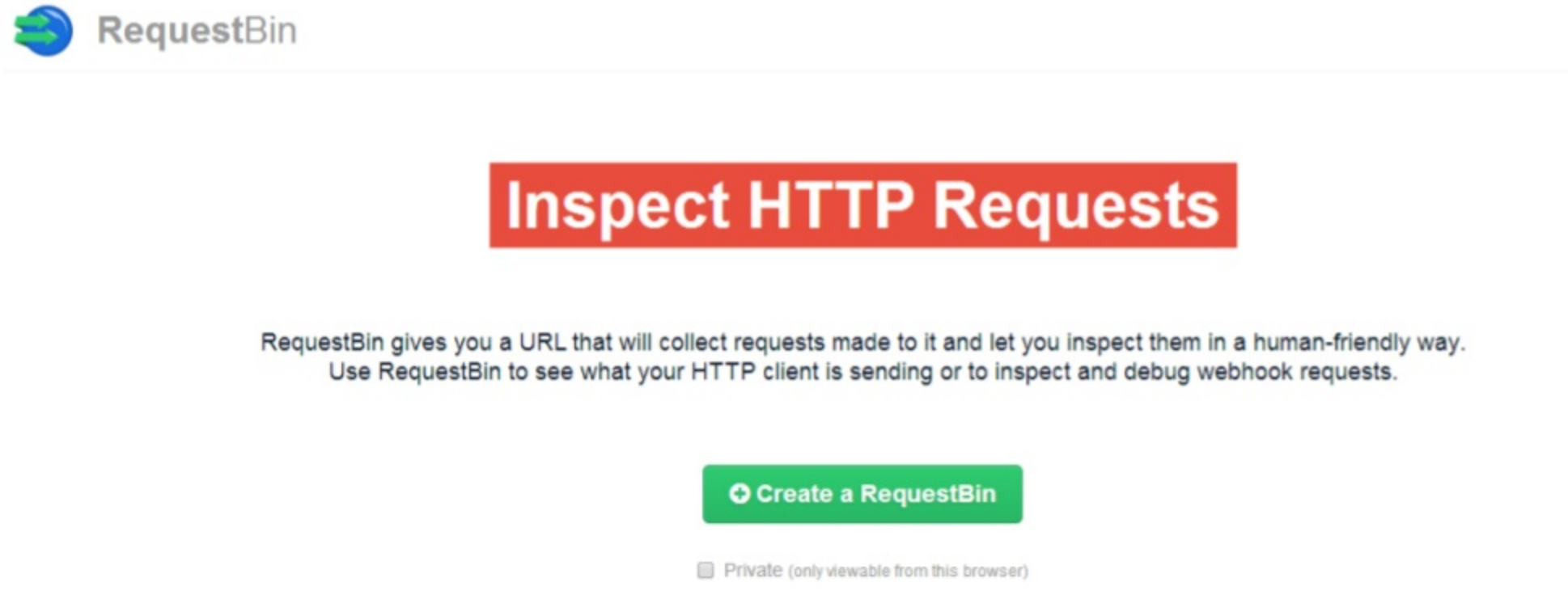
- Register the device with the Thingsquare cloud
- Give it a name
- Blink it

Set up the program

- Create a new app – call it something unique
  - Like adam-button.c
- Copy the contents of big-red-button.c
  - Don't worry about the contents for now – we'll go through all that

Set up a requestb.in

- Go to http://requestb.in/ and create a RequestBin



RequestBin URL

- Copy the RequestBin URL into the program:

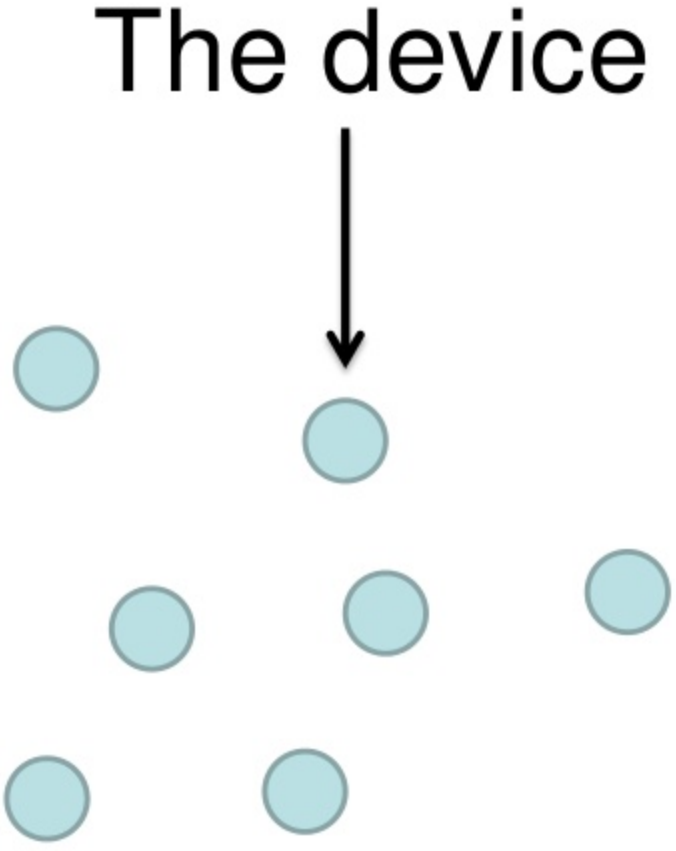
```
#define URL "http://requestb.in/abcdefghij"
```

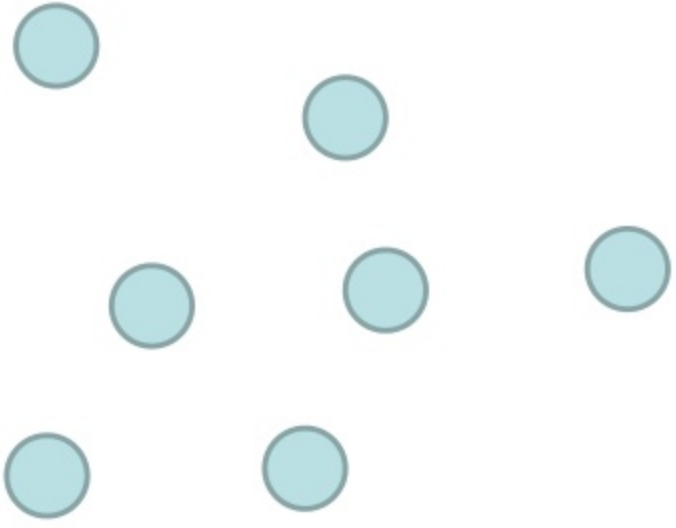
- Run the program
- Press the button
- Reload the requestb.in page
- See the result

What we just did

- Did an HTTP POST directly from the chip
- Posted data via a webhook to a cloud service

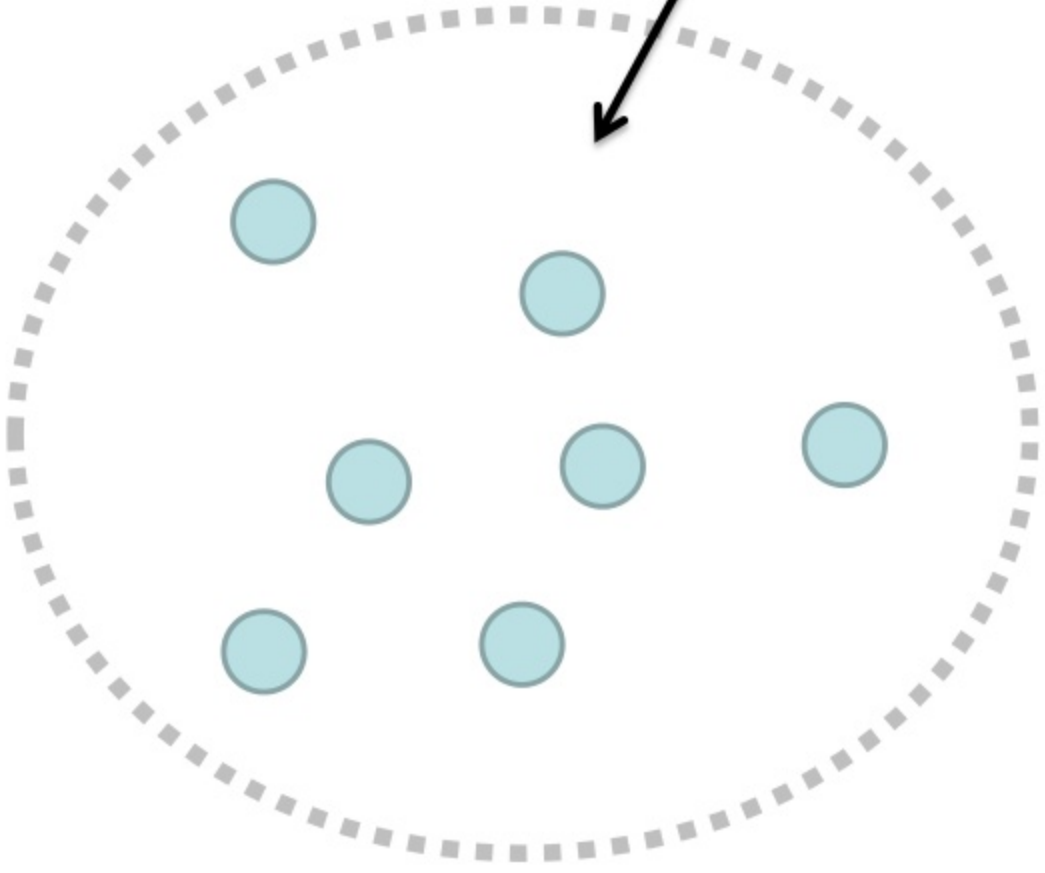
Connecting a device to the IoT


The device

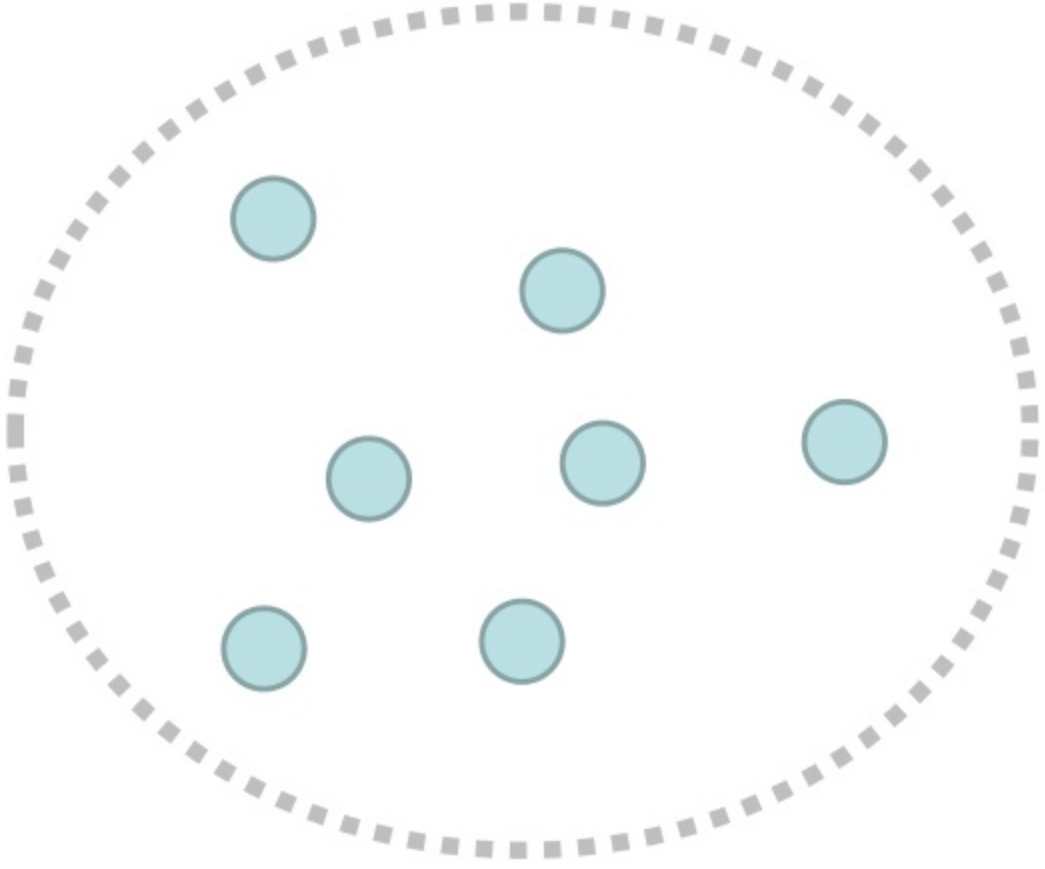


The Internet

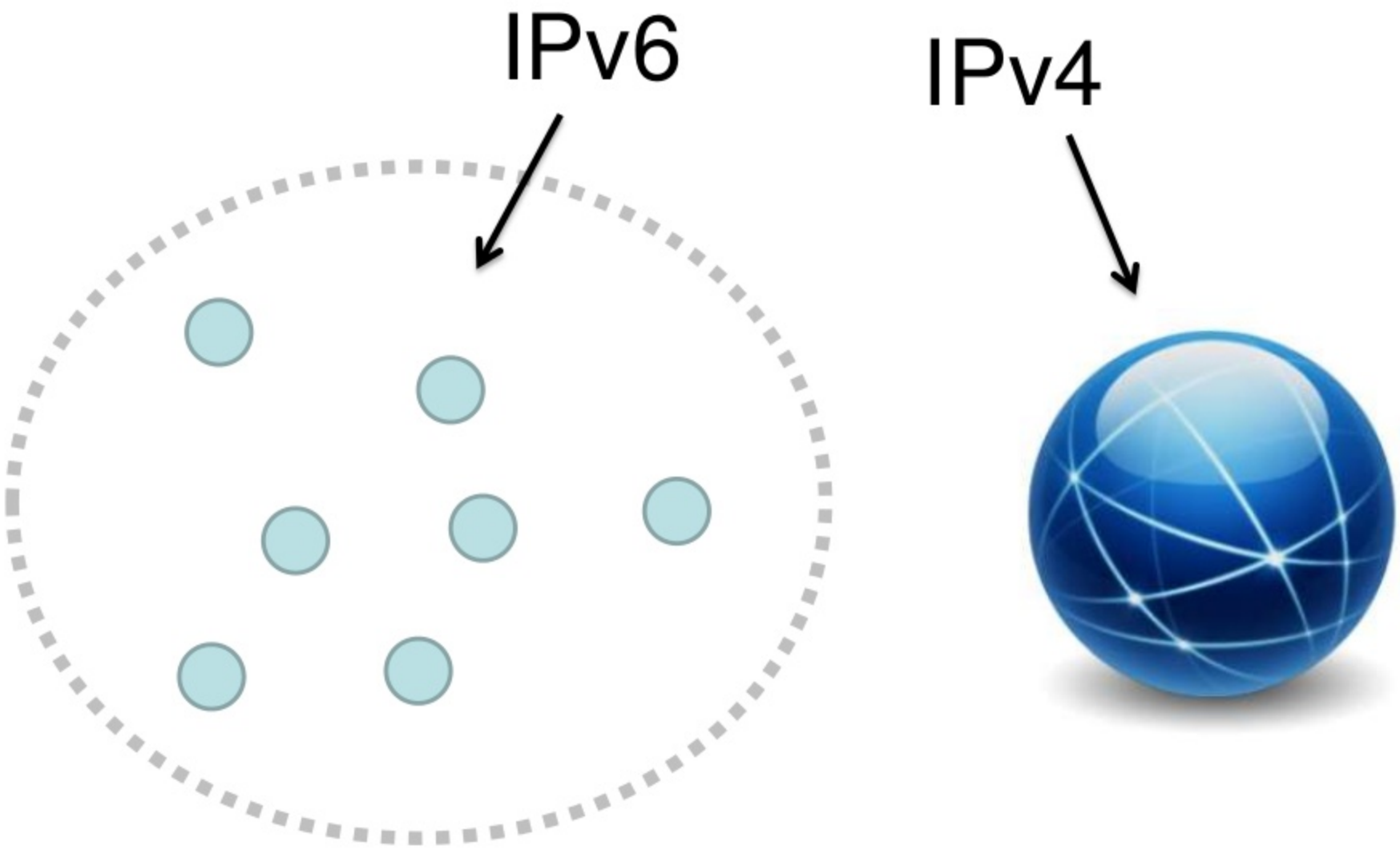
More Internet

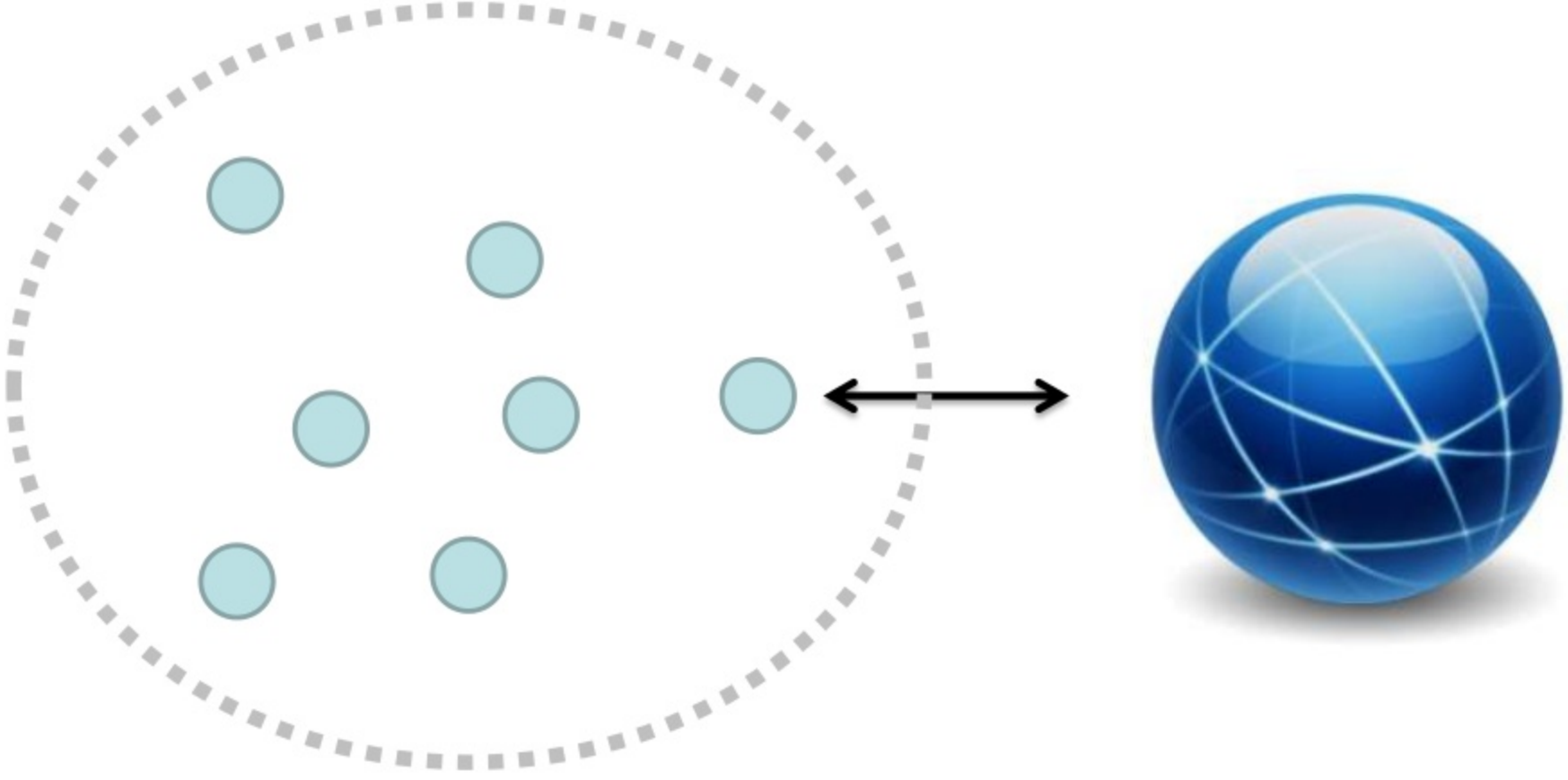


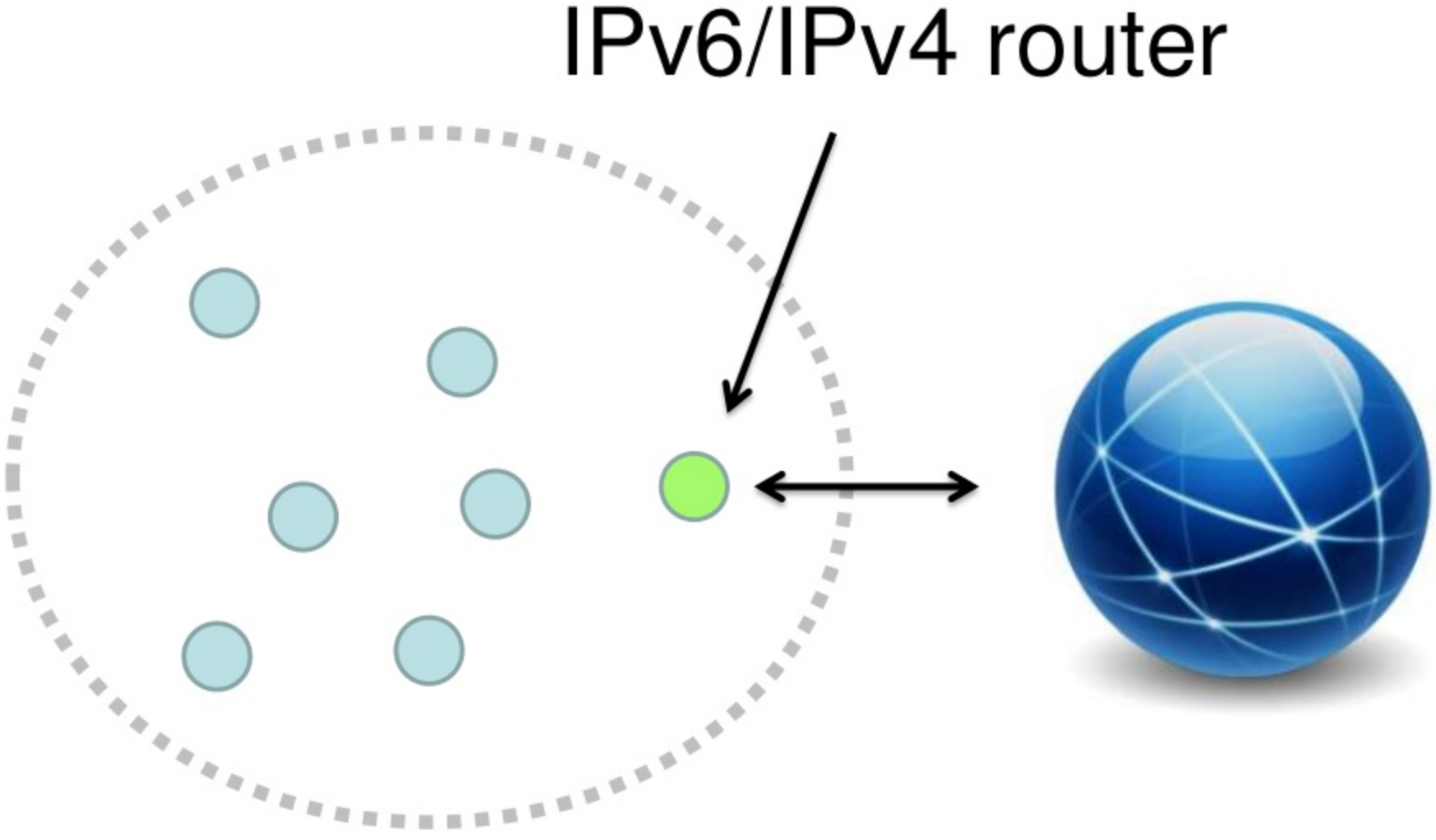
The Internet

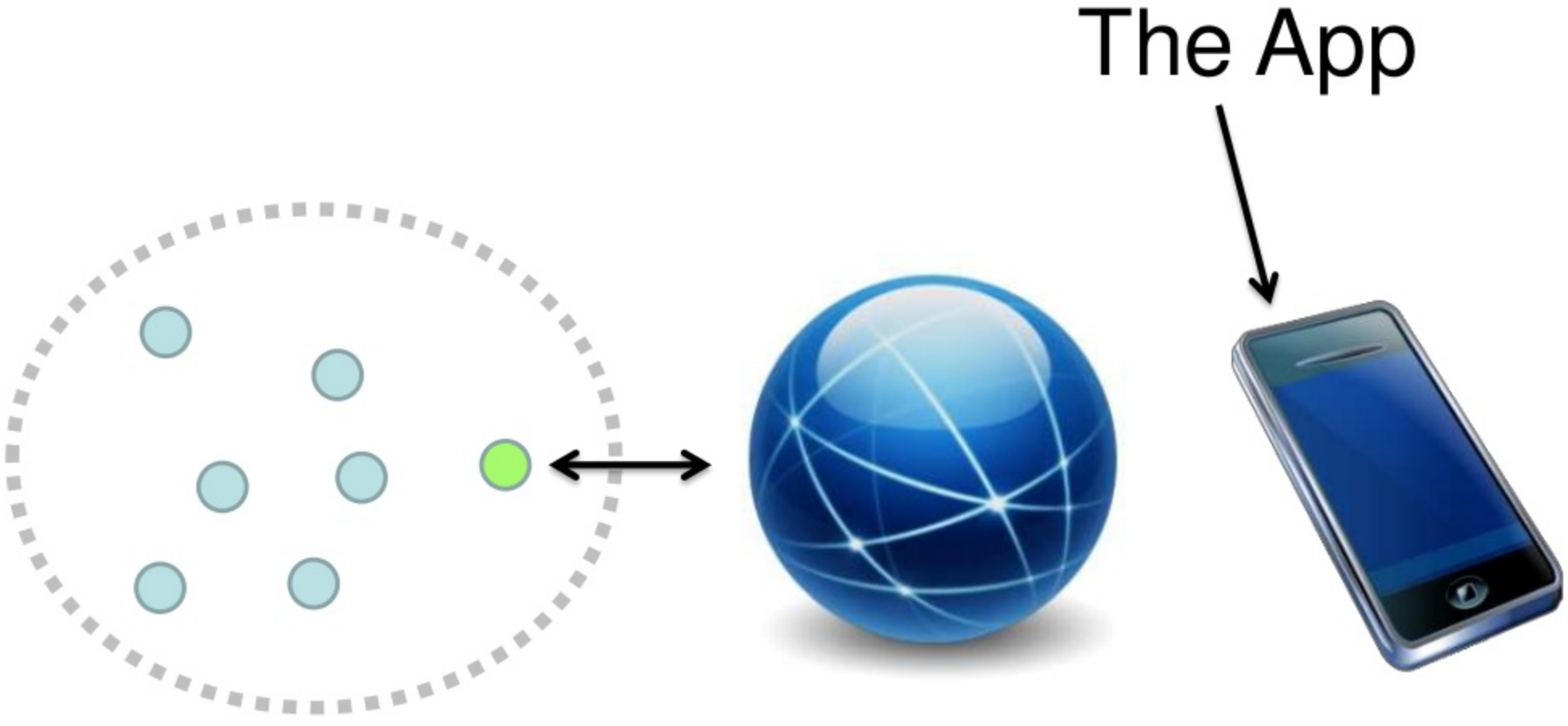


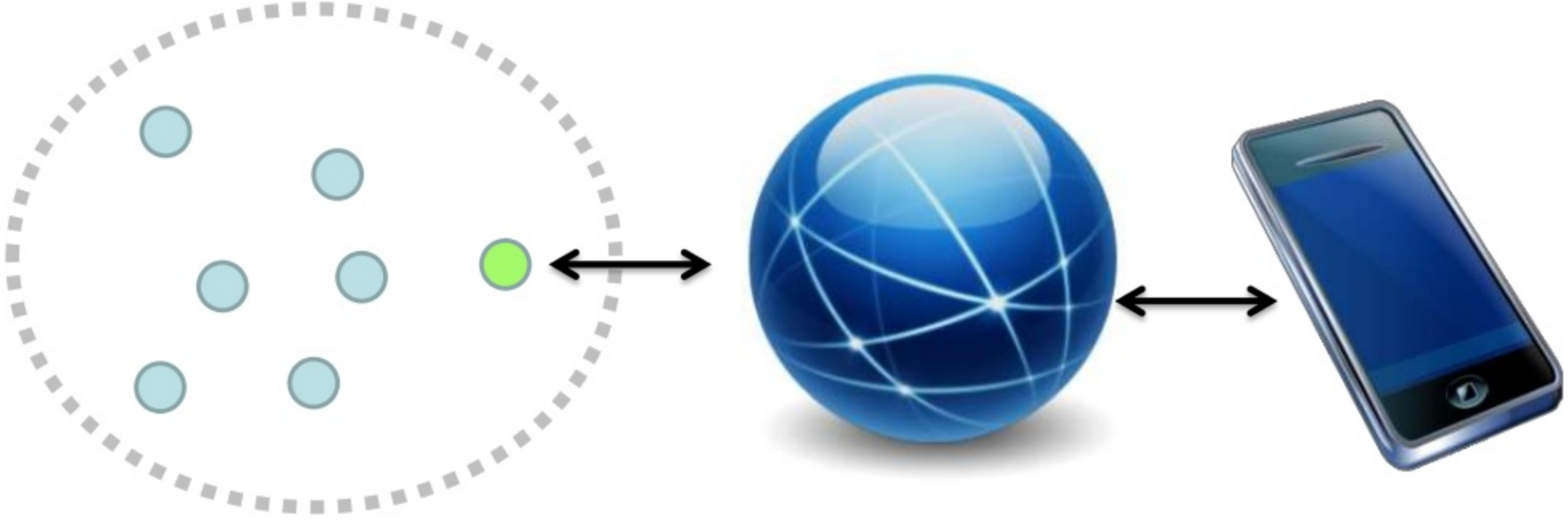
IPv4

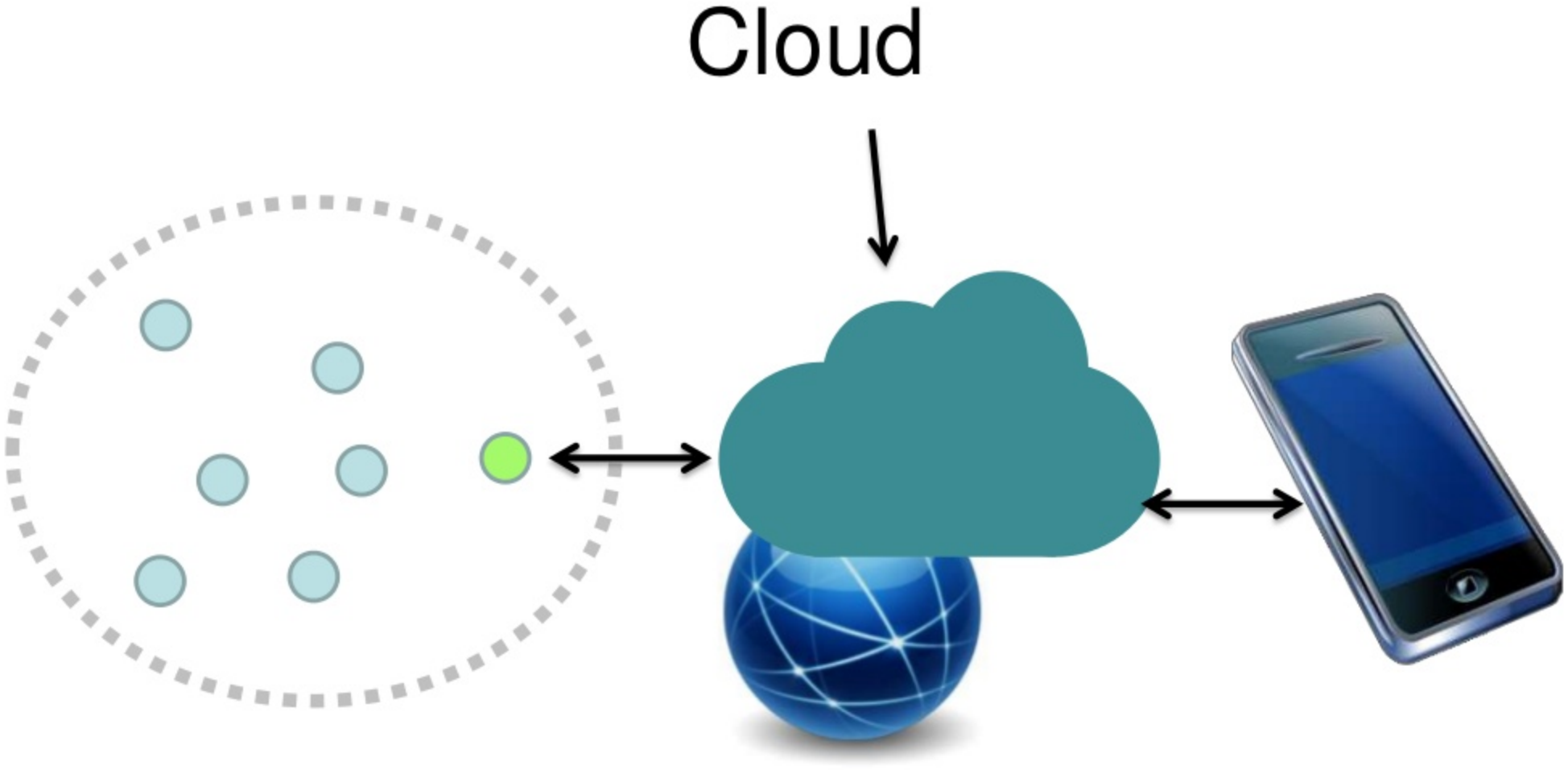

IPv6
IPv4

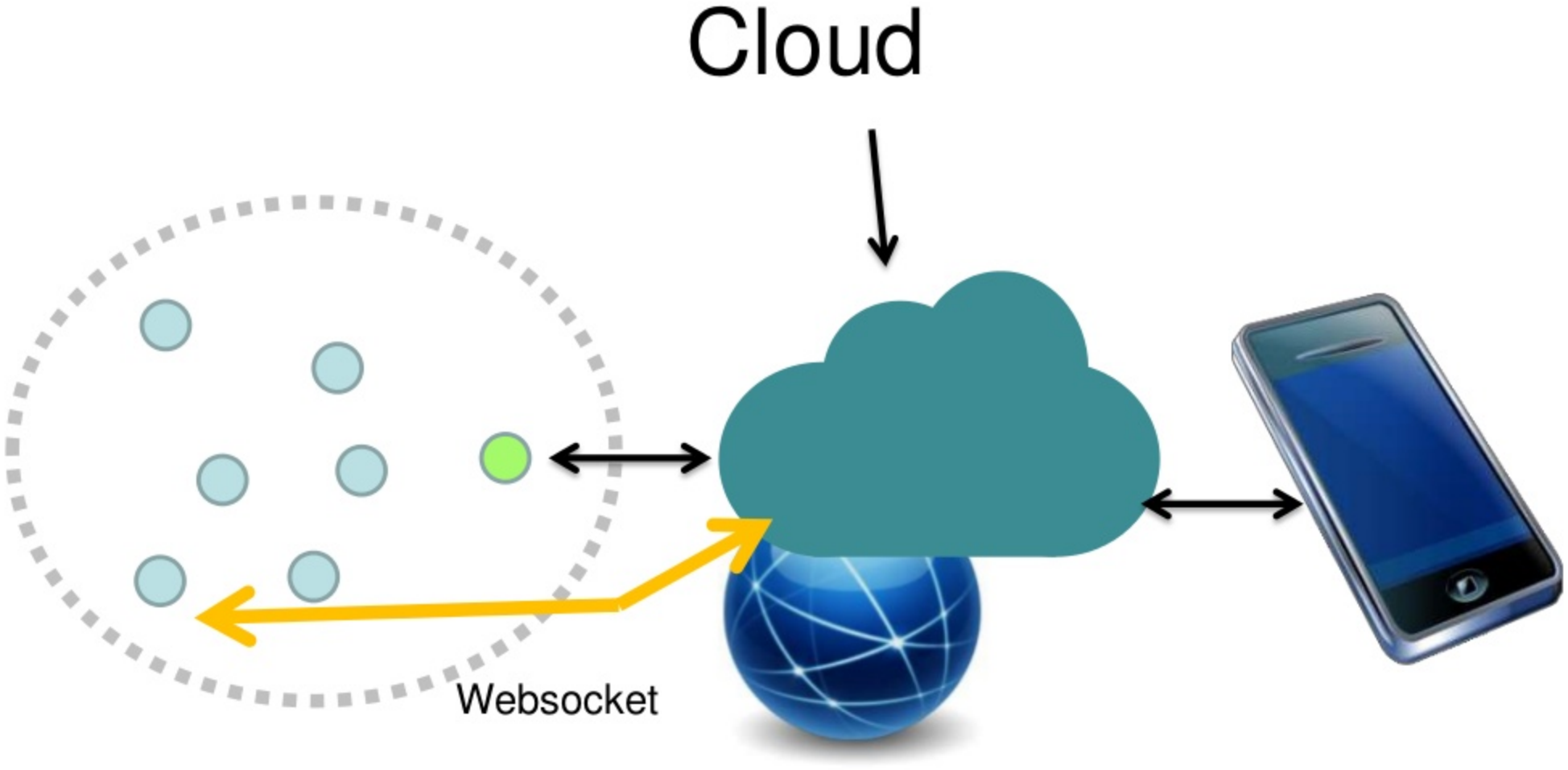


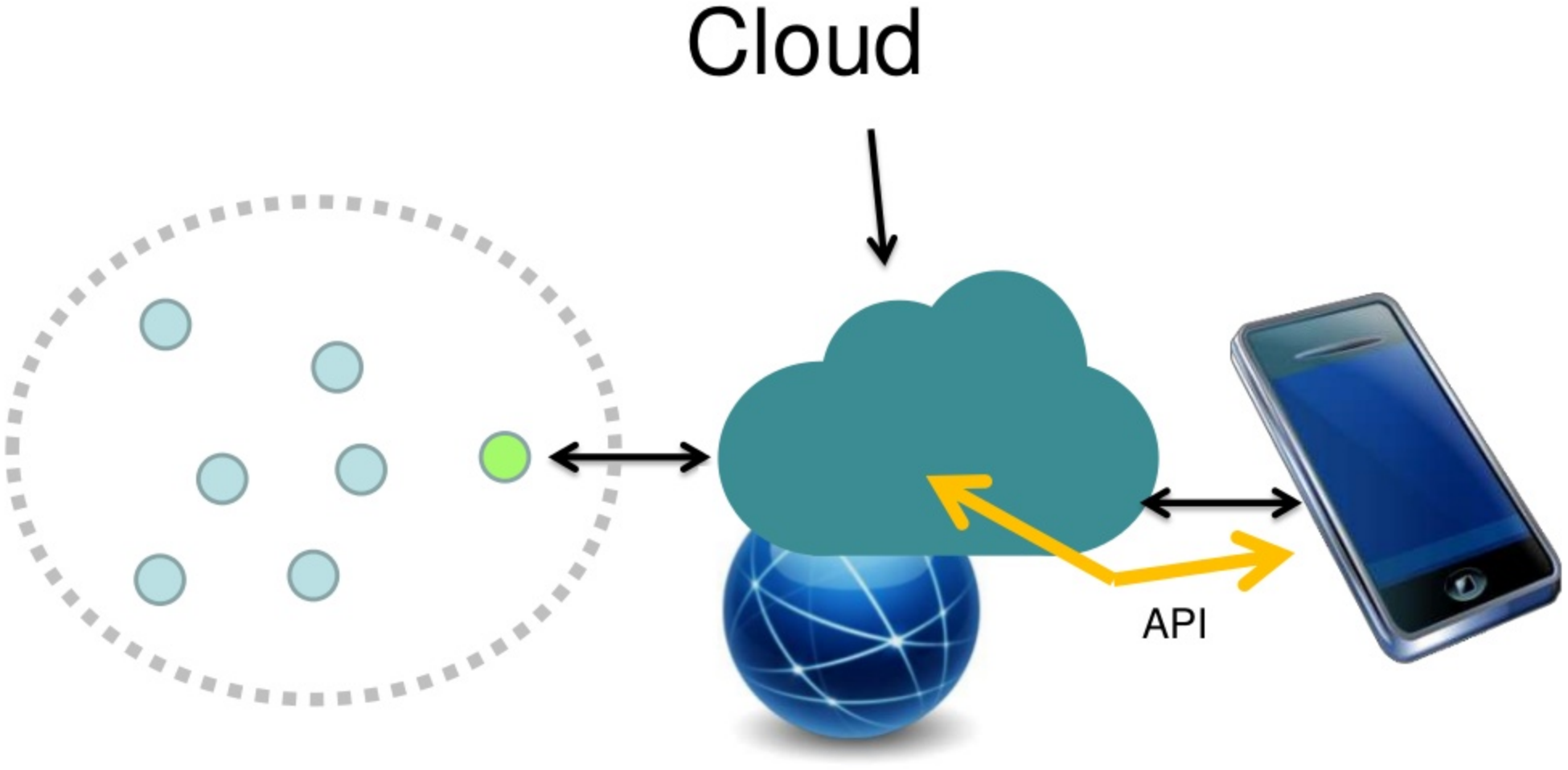

IPv6/IPv4 router


The App




Cloud


Cloud
Websocket

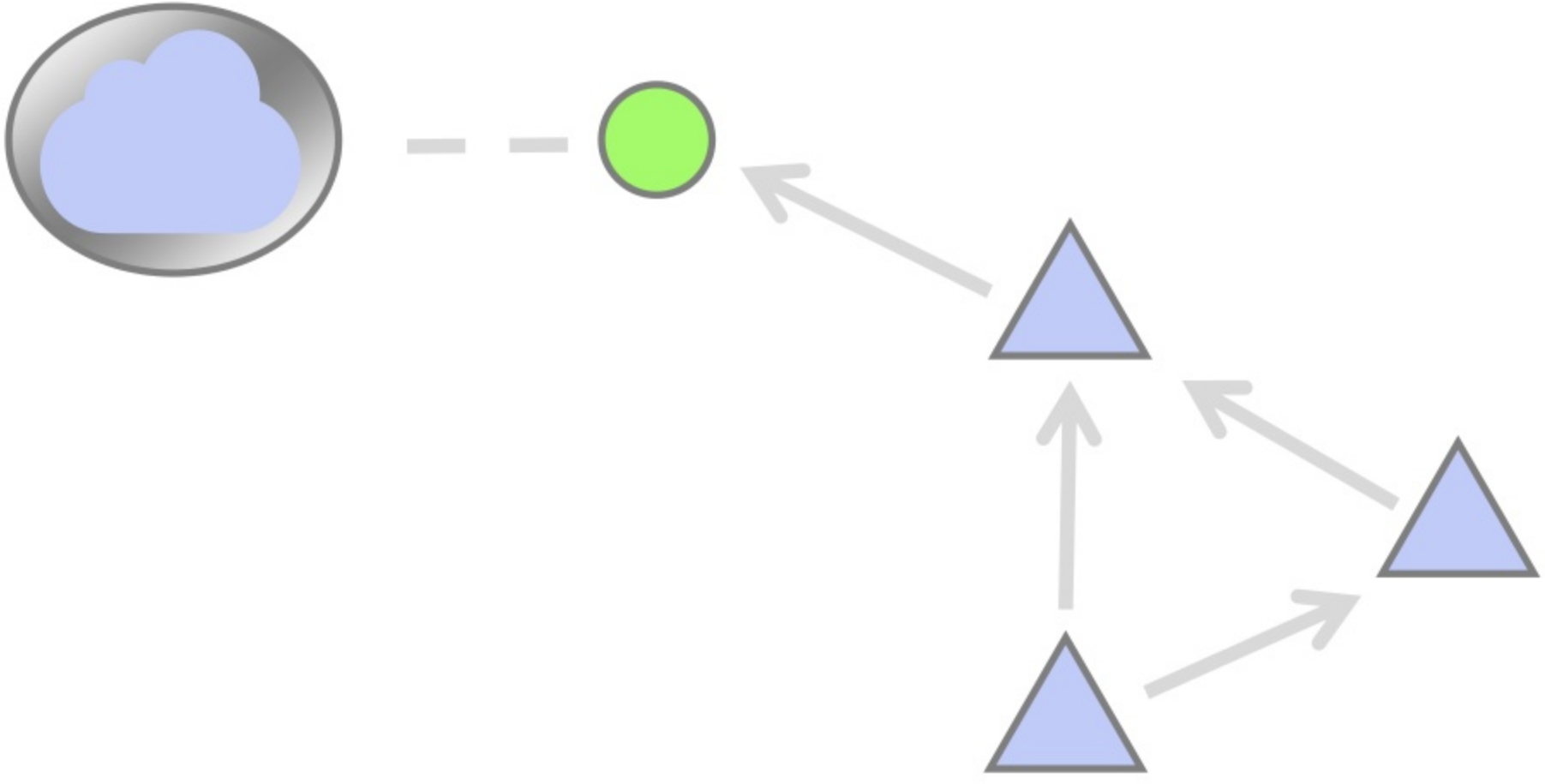

Cloud
API

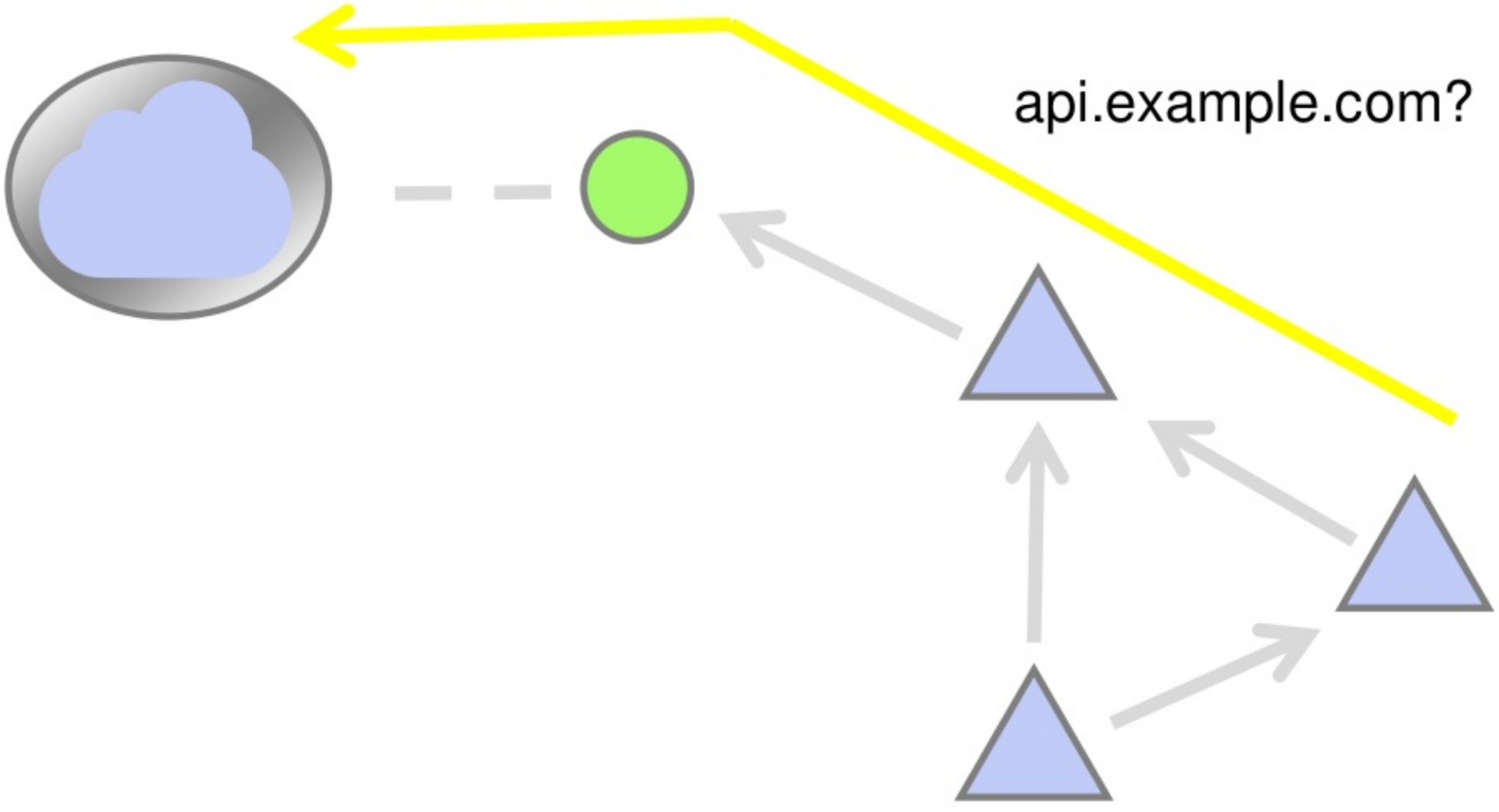
IPv6 to IPv4 translation: NAT64

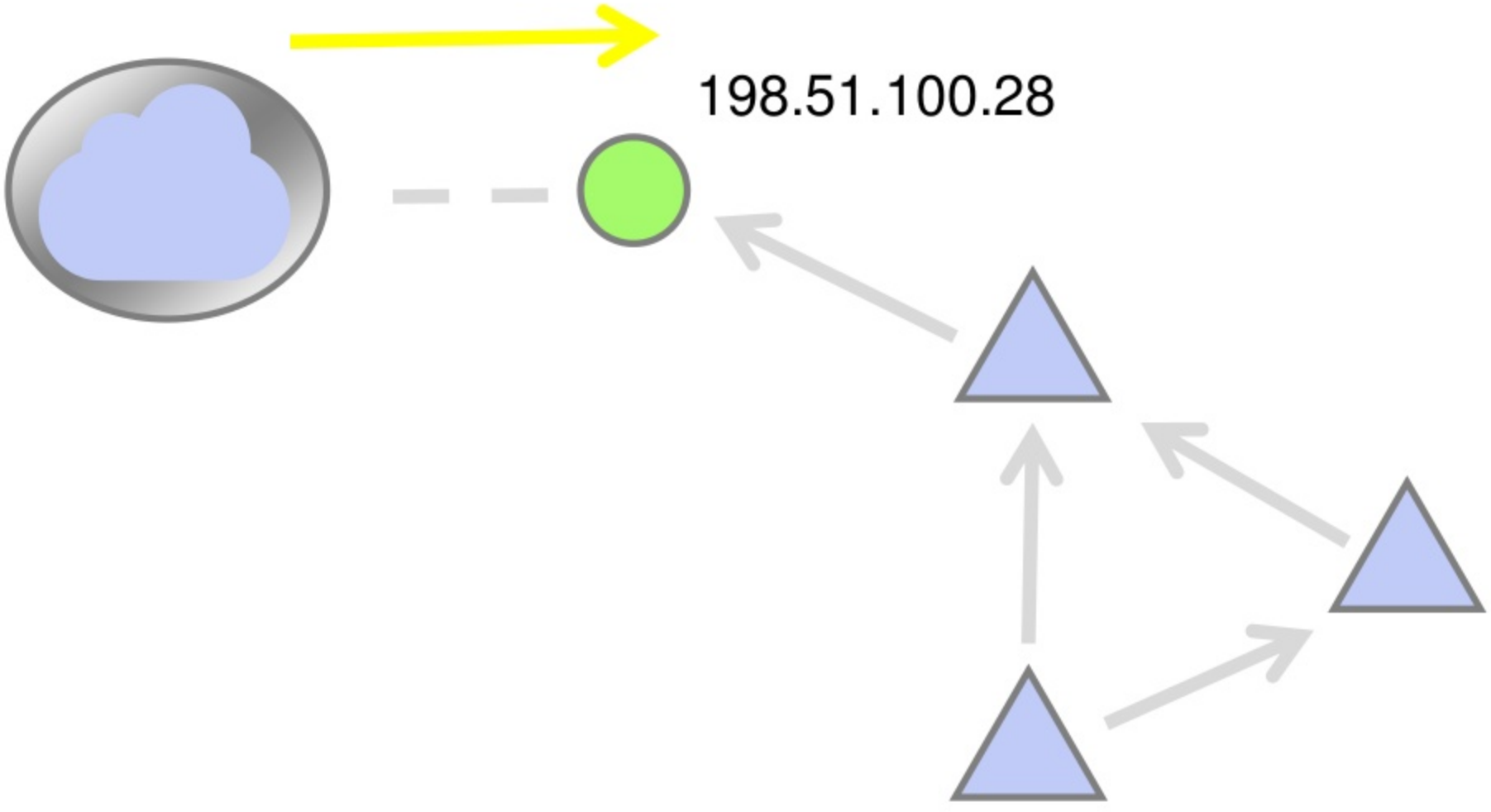
- Translate IPv4 addresses to IPv6 addresses
  - 192.168.1.1 becomes ::ffff:192.168.1.1
  - Remember the port numbers

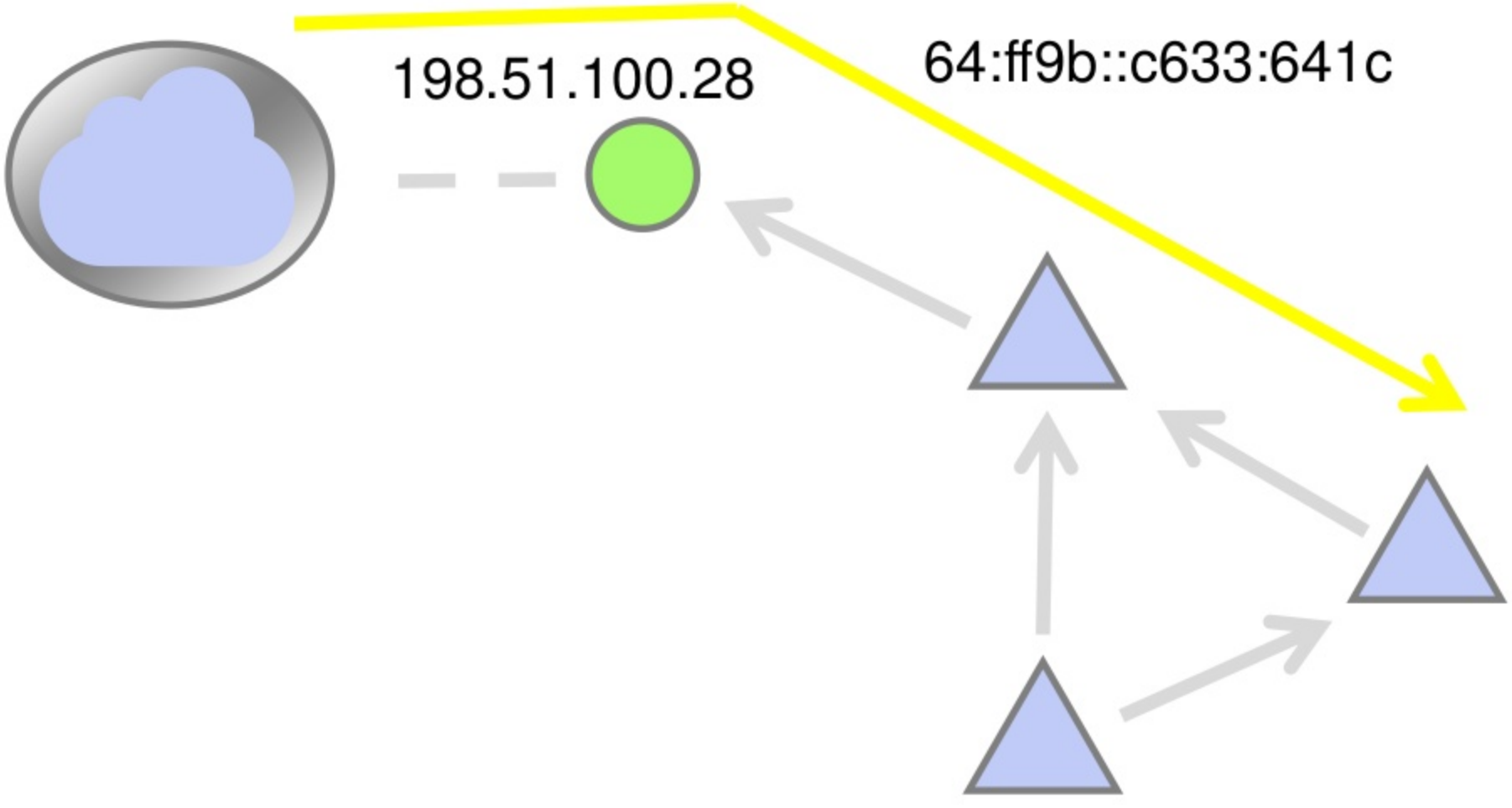
DNS64

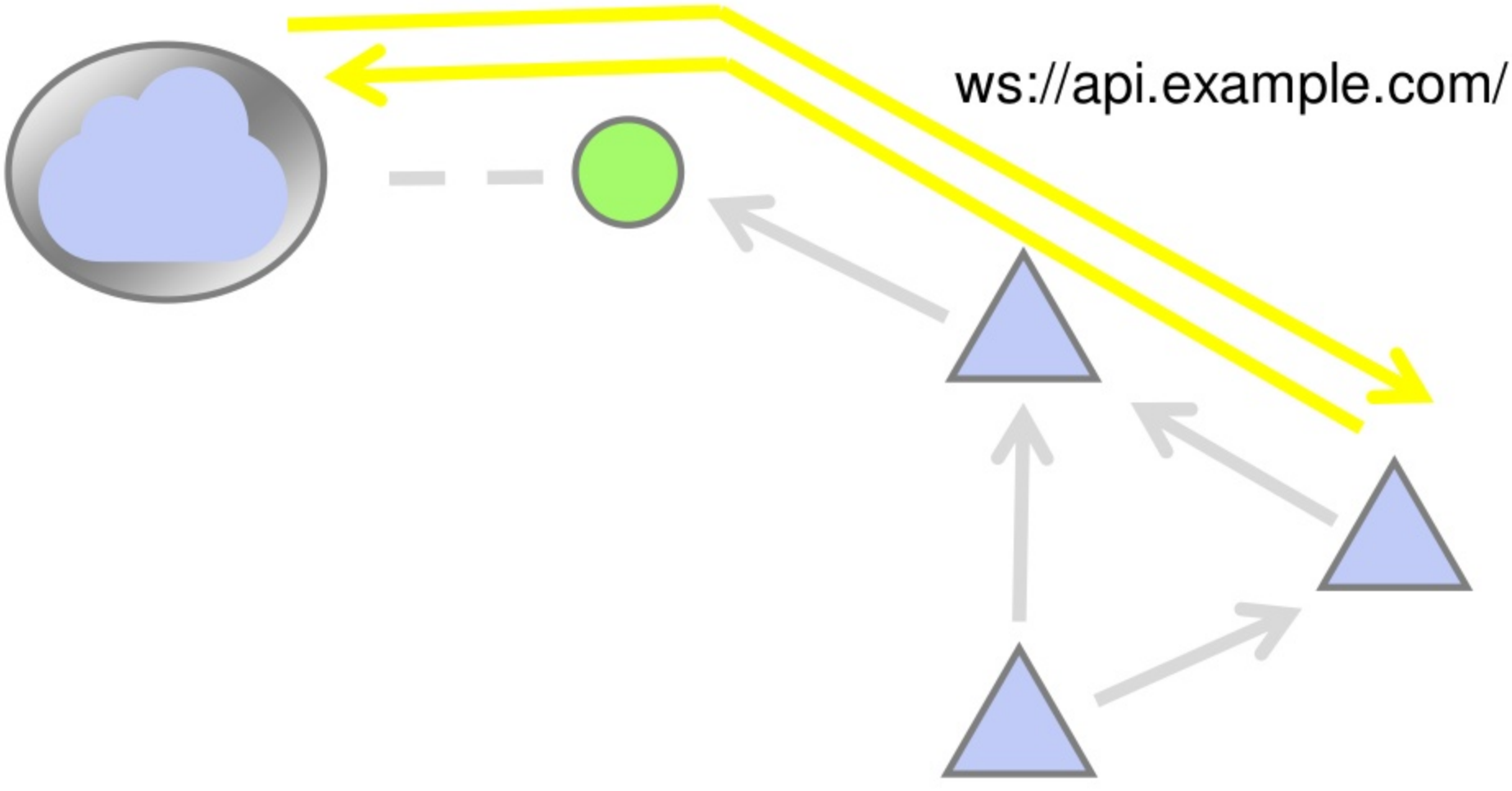
- Translate DNS names to IPv6-mapped IPv4 address




api.example.com?


198.51.100.28


198.51.100.28
64:ff9b::c633:641c


ws://api.example.com/

The IPv6 mesh

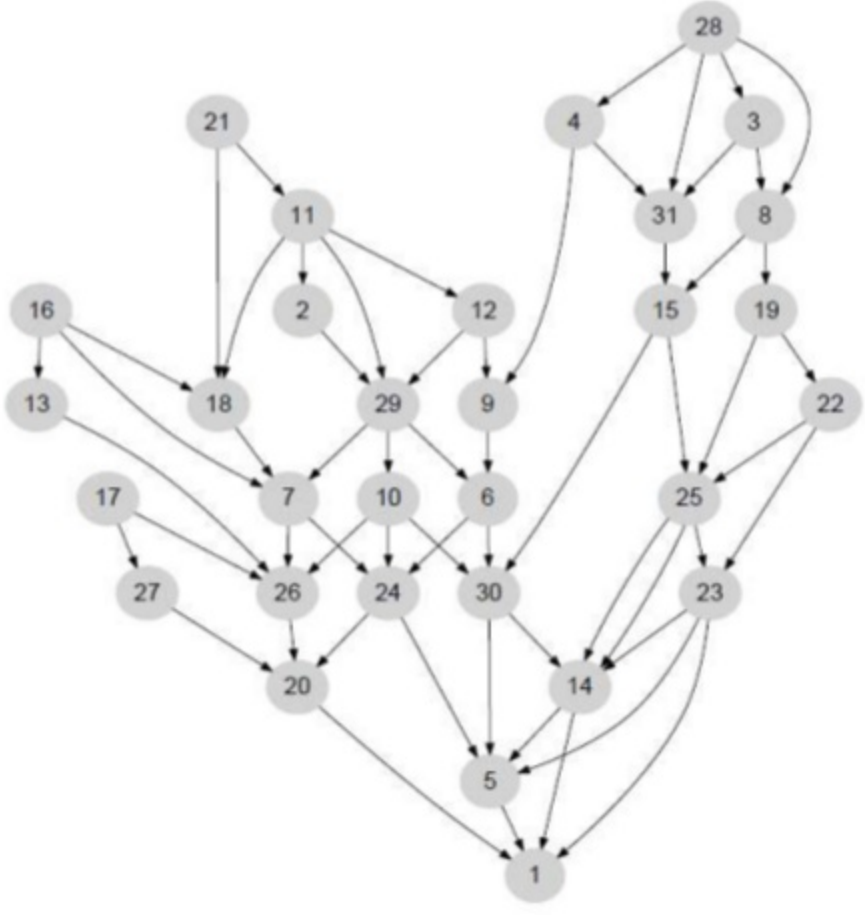
IPv6 primer

- Addresses are really long
  - 128 bits
- Example
  - fe80::1234:abcd:5678:ef01
- A device has several IPv6 addresses

The IPv6 mesh

- Contiki automatically forms a wireless IPv6 network
  - Routing protocol called RPL
- The Ethernet router is the root of the network

A RPL Directed Acyclic Graph



The RPL DAG

- Every DAG has a DAG ID
  - The IPv6 address of the root
- Every DAG has a version number

Let's look at the RPL mesh!

- Go to Status -> Mesh on the kit display

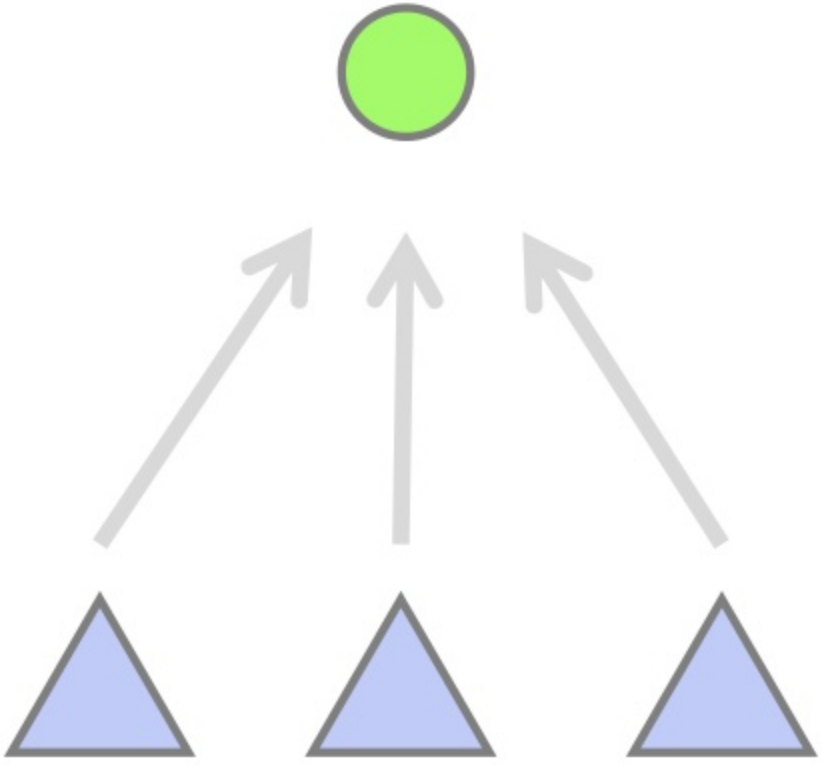
The Mesh display

- The DAG ID
- The parent IPv6 address
- The DAG version
- RPL rank
- Number of neighbors
- Number of routes
- Estimated number of hops
- ETX: RPL link quality indicator
- RSSI: Received Signal Strength Indicator

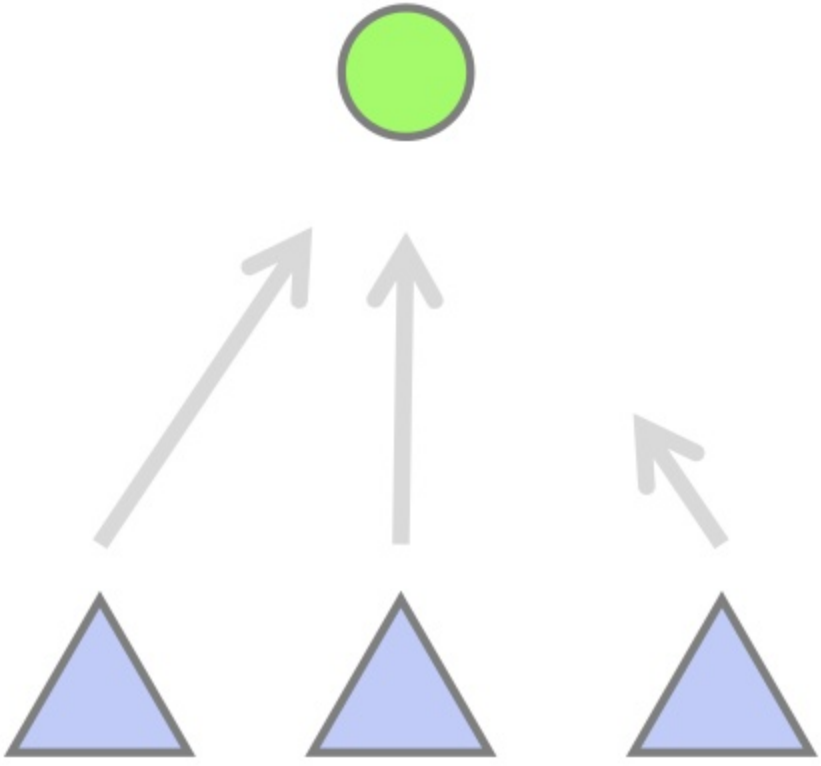
Hands-on experimentation

- Cusp your hand over the antenna
- Watch the ETX go up
- Might choose another parent
- Hop count will then increase

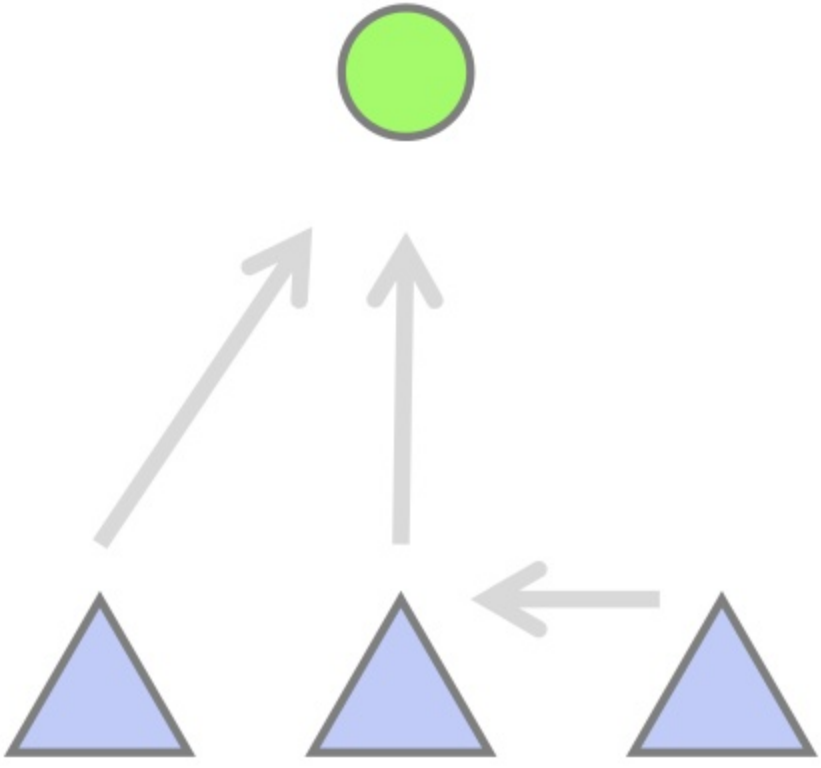
This is what happened



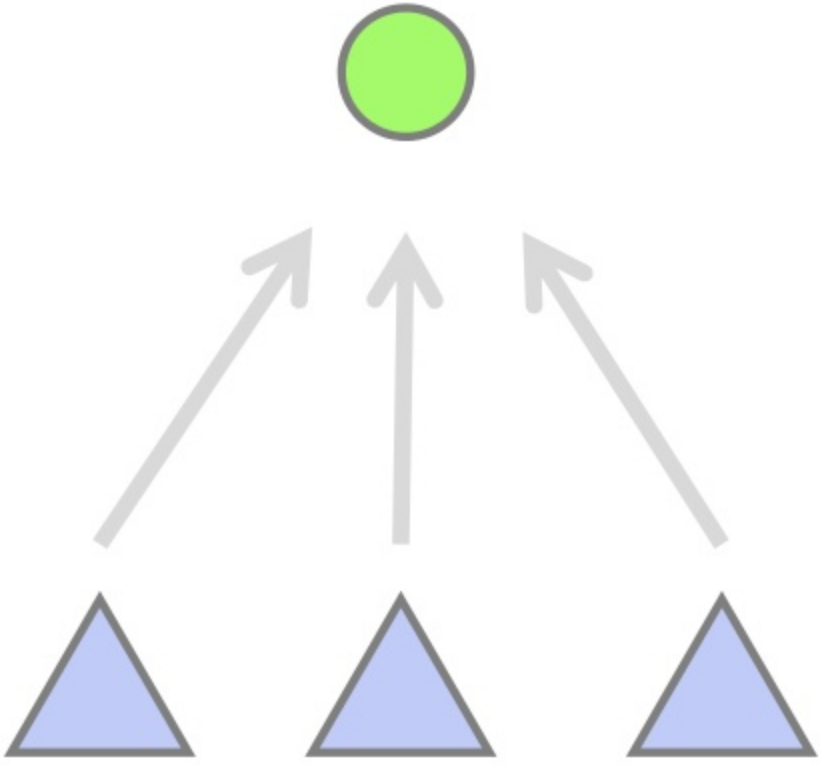
Our hand stopped the radio signals



A better route was found



Eventually the network recovers



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http://thingsquare.com