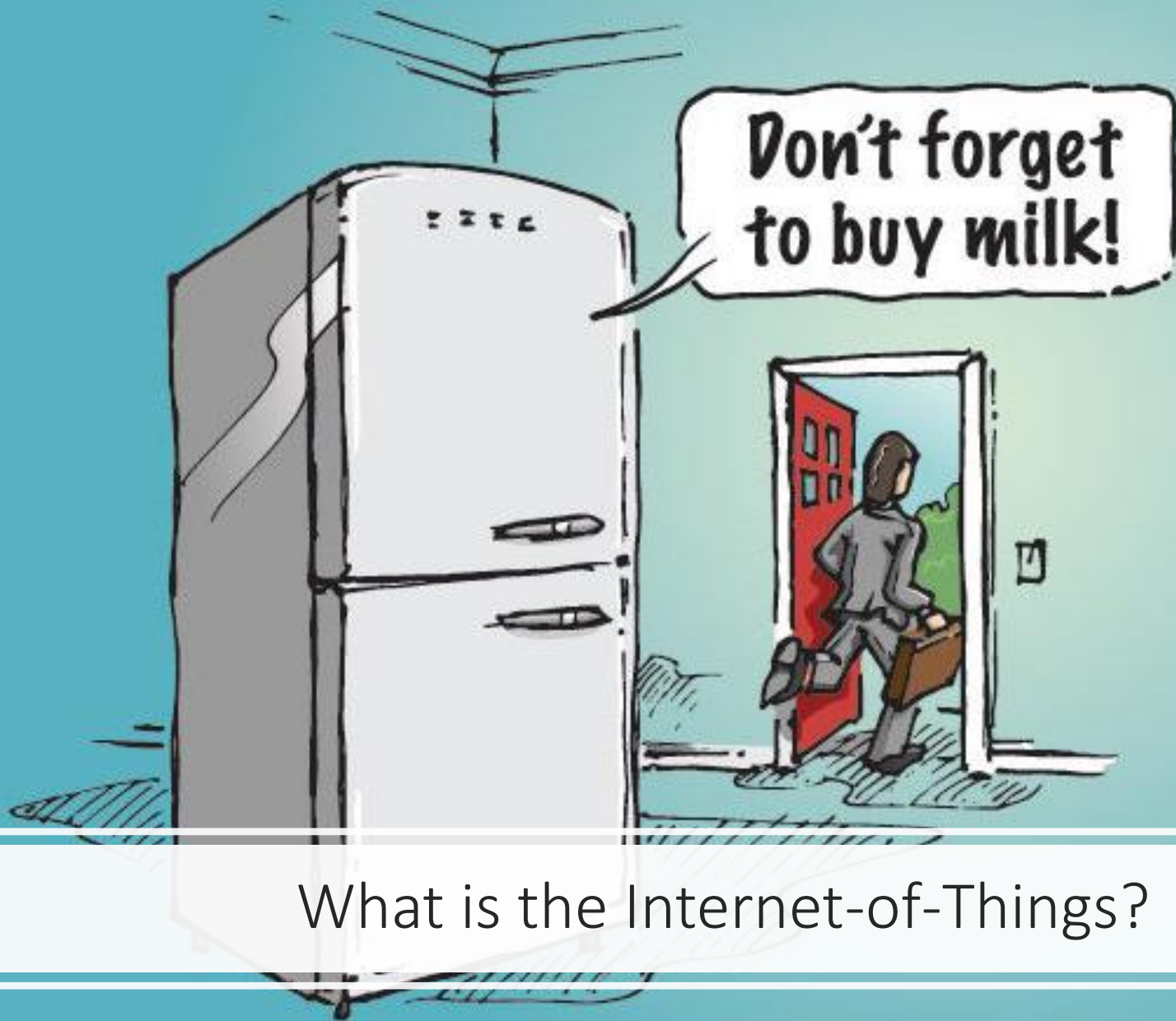


# Internet-of-Things (IoT)

Introduction



What is the Internet-of-Things?

## How Does My Fridge Do That?

- You are leaving the home (sense user)
- There's no milk in fridge (sense object)
- Use this information to make a decision (process)
- Inform user of decision (communicate)

You are leaving the home (sense user)

There's no milk in fridge (sense object)

- What type of sensor?
- Is milk needed?
- No milk or "little" milk? (prediction)

Use this information to make a decision (process)

Inform user of decision (notify)

# How Does My Fridge Do That?

You are leaving the home (sense user)

- What type of sensor?
- Distinguish between parent and child
- Identify reason for leaving home
- Identify other contexts (e.g., store hours)

There's no milk in fridge (sense object)

Use this information to make a decision (process)

Inform user of decision (notify)

# How Does My Fridge Do That?

You are leaving the home (sense user)

There's no milk in fridge (sense object)

**Use this information to make a decision (process)**

- Where is processor?
- What are the rules?
- Fixed rules versus dynamic rules (learning)

Inform user of decision (notify)

# How Does My Fridge Do That?

You are leaving the home (sense user)

There's no milk in fridge (sense object)

Use this information to make a decision (process)

Inform user of decision (notify)

- How?
- When?
- Privacy?
- Subtleness?
- Information overflow?

# How Does My Fridge Do That?

# Internet-of-Things (IoT)

Physical object (“thing”)

+

Controller (“brain”)

+

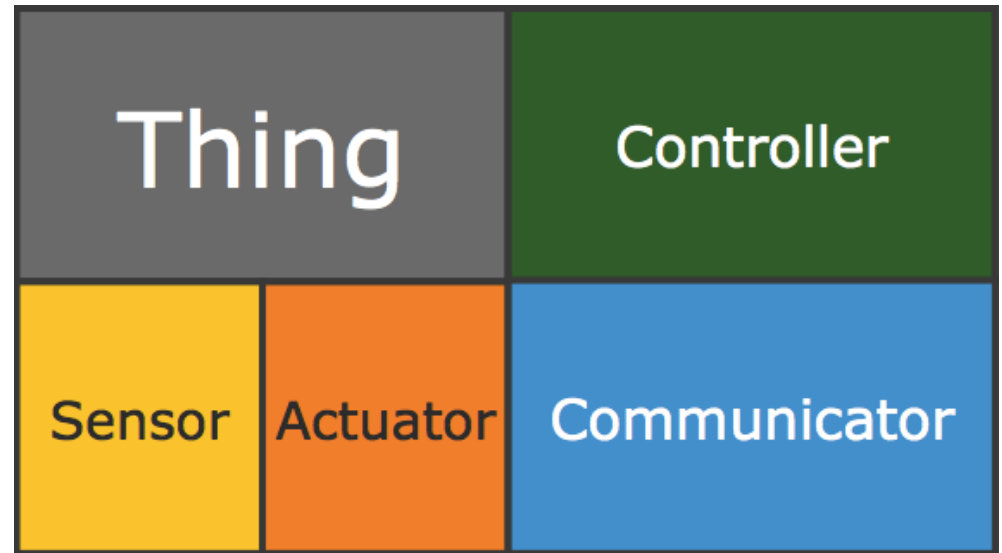
Sensors

+

Actuators

+

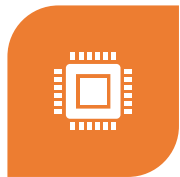
Networks (Internet)





# Related Areas/Terminology

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**EMBEDDED SYSTEMS:**  
NOT NECESSARILY  
CONNECTED



**SENSOR NETWORKS:**  
COLLECTION OF  
SENSOR DEVICES  
CONNECTED THROUGH  
WIRELESS CHANNELS



**CYBER-PHYSICAL  
SYSTEMS:** FOCUS ON  
INTERACTION  
BETWEEN PHYSICAL  
AND CYBER SYSTEMS



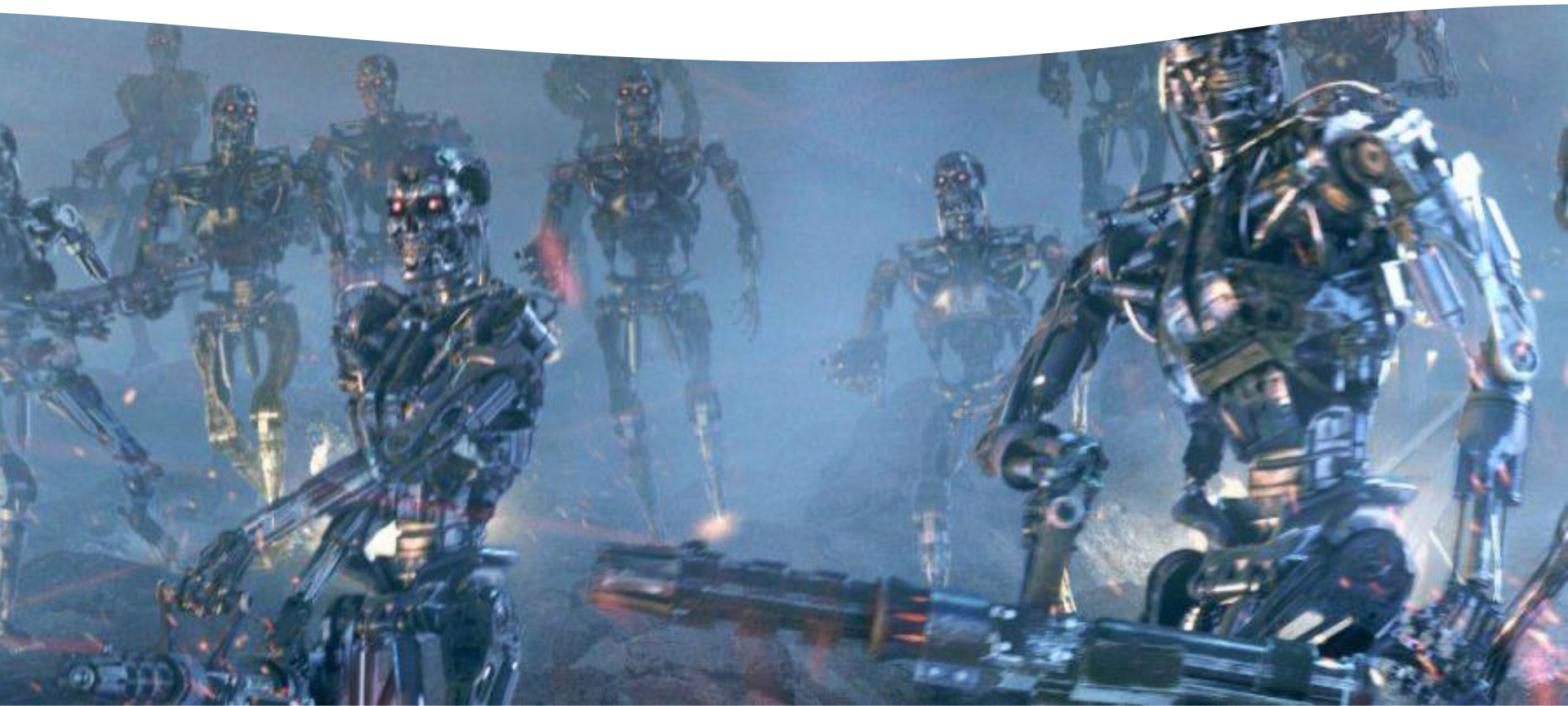
**REAL-TIME SYSTEMS:**  
FOCUS ON TIME  
CONSTRAINTS



**PERVASIVE/UBIQUITO  
US COMPUTING:**  
FOCUS ON  
ANYTIME/ANYWHERE  
COMPUTING

# Related Areas

- Machine-to-machine (M2M) communications
- Internet of Everything (Cisco Systems)
- “Skynet” (Terminator movie)



# “Internet-of-Things”

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Term coined by British entrepreneur Kevin Ashton, while working at MIT Auto-ID Labs

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Referred to (and envisioning) a future global network of objects connected specifically by RFID (radio-frequency identification)

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Complete automation of data collection

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First article about IoT in 2004 from MIT; called it ‘Internet 0’.

# Internet-of-Things Vision & Growth

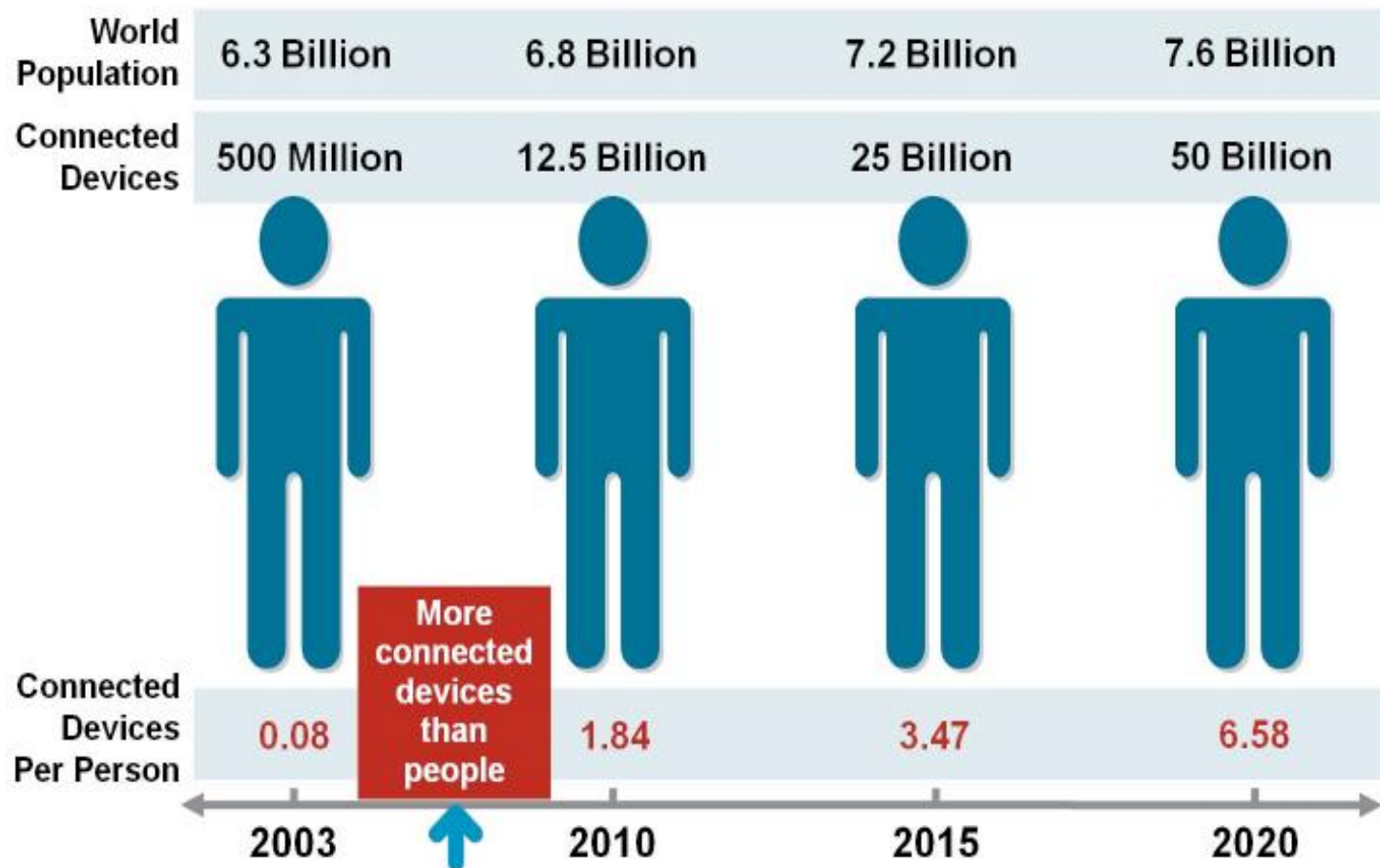
## THE INTERNET OF THINGS

Connected devices (billions)



	15 billion	28 billion	CAGR 2015–2021
Cellular IoT	0.4	1.5	27%
Non-cellular IoT	4.2	14.2	22%
PC/laptop/tablet	1.7	1.8	1%
Mobile phones	7.1	8.6	3%
Fixed phones	1.3	1.4	0%

# Internet-of-Things Vision & Growth



Source: Cisco IBSG, April 2011

# What is IoT

- Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with [electronics](#), [software](#), [sensors](#), [actuators](#), and [connectivity](#) which enables these things to connect, [collect](#) and exchange [data](#)<sup>1</sup>.
- IoT refer to the connection of devices to the Internet.

<sup>1</sup>[https://en.wikipedia.org/wiki/Internet\\_of\\_things](https://en.wikipedia.org/wiki/Internet_of_things)