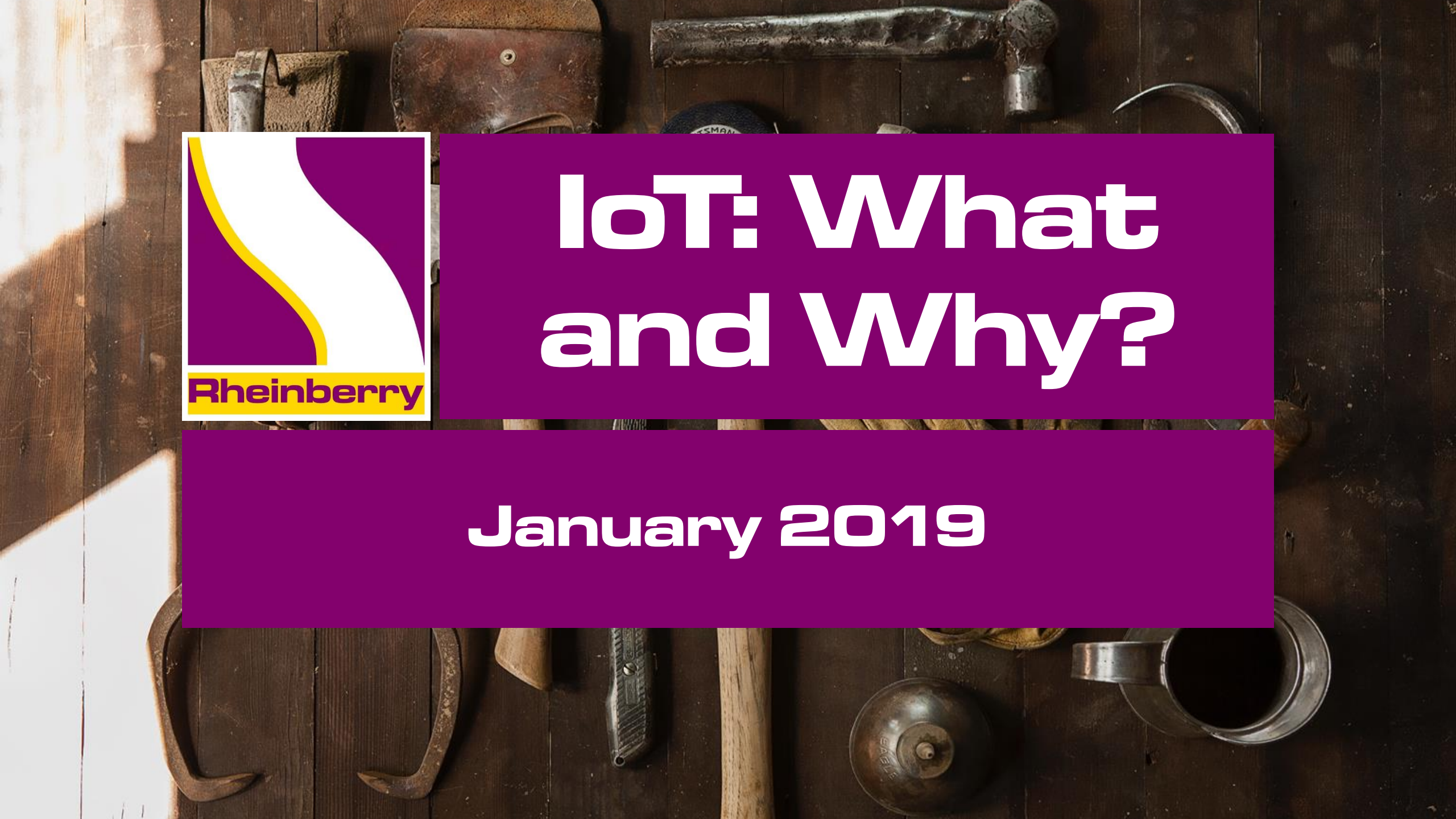


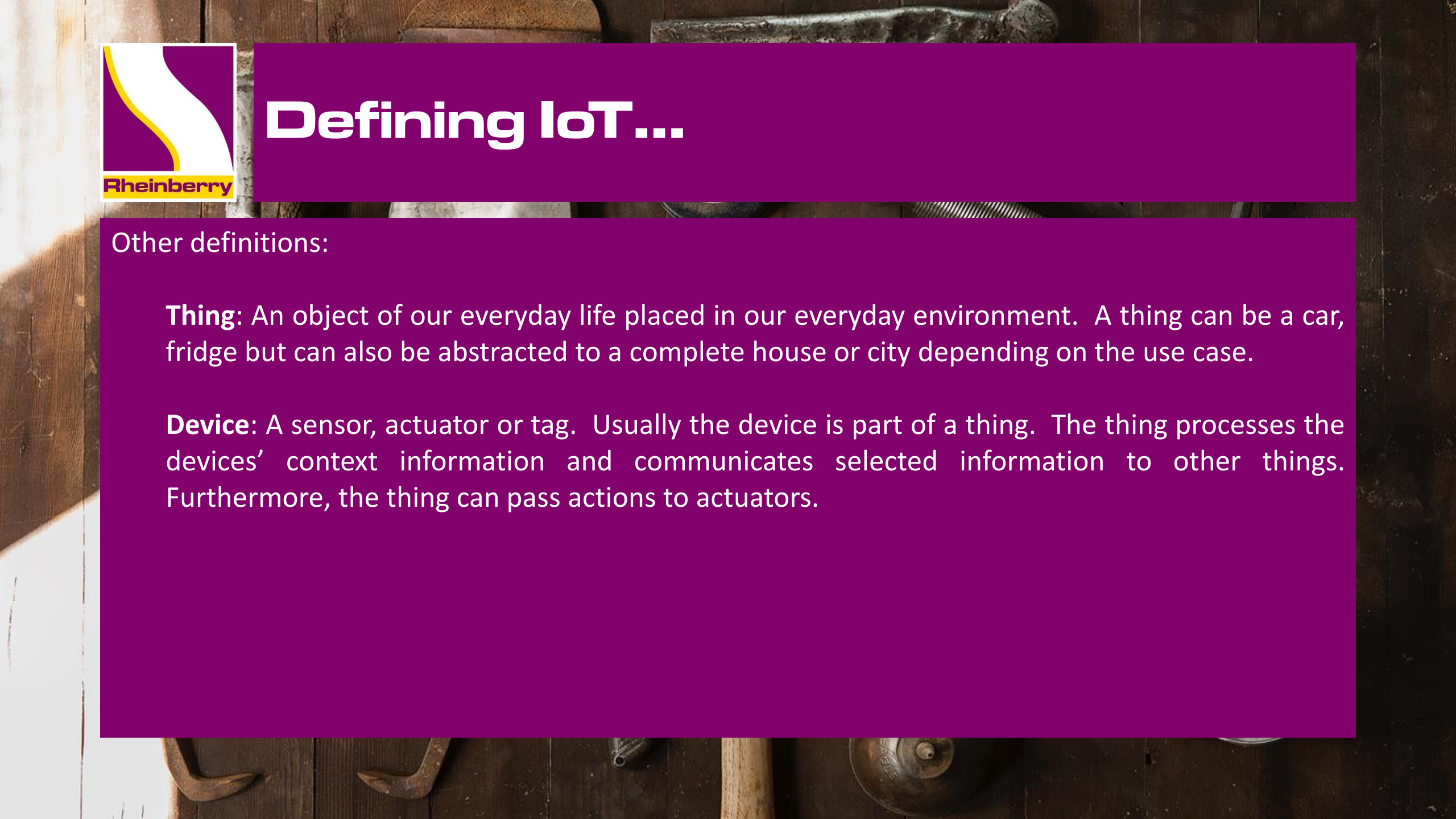
IoT: What and Why?

January 2019

Defining IoT…

The Internet of Things, IoT… Even technology researchers and commentators cannot agree on what it is. The most consistent is Gartner's definition below.

The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment. Gartner.



Defining IoT…

Other definitions:

Thing: An object of our everyday life placed in our everyday environment. A thing can be a car, fridge but can also be abstracted to a complete house or city depending on the use case.

Device: A sensor, actuator or tag. Usually the device is part of a thing. The thing processes the devices' context information and communicates selected information to other things. Furthermore, the thing can pass actions to actuators.

What is IoT and Why are we doing this?

The '**What**' is the *definitions* and *technologies*.

The '**Why**' is the *value* and *benefits*.

What is **IoT**?

Technologies enabling connection to traditionally unconnected devices:

a) Receiving information from the devices

b) Where possible, controlling the device

What is IoT and Why are we doing this?

Examples of **IoT** devices that receive information, and respond to controls:

- Drinking Water dispensers;
- Lighting based on telemetrics;
- Heating systems;
- Conveyer belt systems;
- Driverless vehicles;
- Advertising boards.

What is IoT and Why are we doing this?

Why are we doing this?

IoT technology means we can now receive information about things that traditionally was impossible or impractical to achieve.

Therefore, the value and benefits are derived from the '**Information of Things**'.

IoT value is realised when we **liberate/harvest/converge/consume** the information from all these newly connected things.

What makes something IoT?

Some or all of the following attributes:

a) **Reduced size** - *e.g. traceable tags sewn into luggage, WiFi chip embedded into coffee machine*;

b) **Reduced power utilisation** - *e.g. Battery powered Access Control reader that holds its charge for 10 years*;

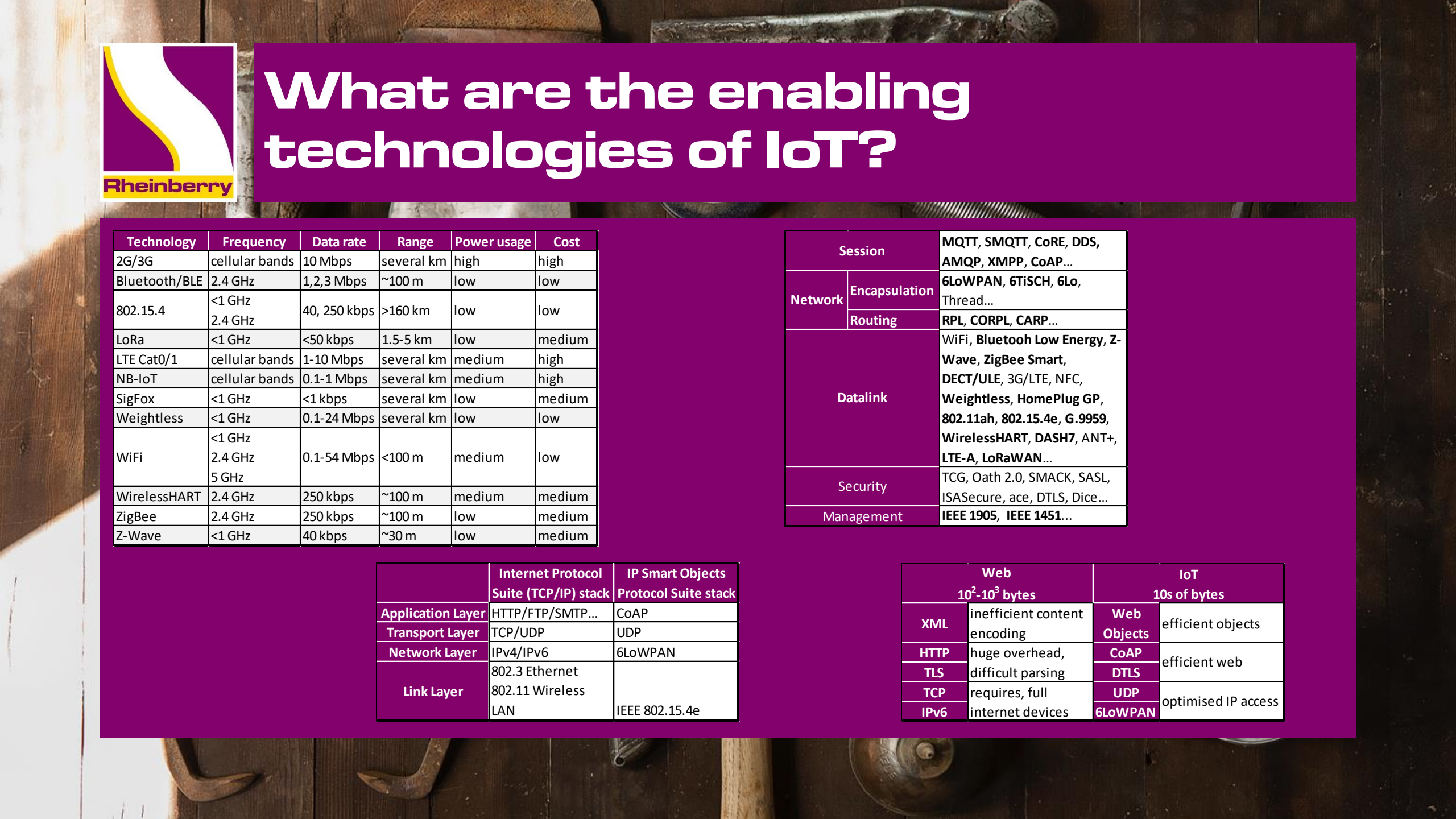
c) **Reduced network utilisation** - *e.g. water filter only sends warning when it is due to be replaced, or sensor that sends data every minute of every day, but only uses 1MB data a month*;

d) **Reduced cost** – e.g. *RFID label in boarding pass, lighting sensors that only need replacing once every 15 years*.

What are the enabling technologies of IoT?

a) **Constrained Protocols** (an IEEE term) - protocols and methods of transmission optimised for low-power, low-bandwidth, low-footprint devices.
An example of an Unconstrained or Traditional protocol is IPv4
A constrained equivalent of IPv4 would be 6LoWPAN

b) **Networks** – IoT optimised networks cater for low-bandwidth, long-distance connections.
Examples of traditional/non-IoT optimised networks are 802.11x Wi-fi and 4G
IoT optimised networks include:
- 802.11.4
- 5G/NB-IoT



What are the enabling technologies of IoT?

Technology	Frequency	Data rate	Range	Power usage	Cost
2G/3G	cellular bands	10 Mbps	several km	high	high
Bluetooth/BLE	2.4 GHz	1,2,3 Mbps	~100 m	low	low
802.15.4	<1 GHz 2.4 GHz	40, 250 kbps	>160 km	low	low
LoRa	<1 GHz	<50 kbps	1.5-5 km	low	medium
LTE Cat0/1	cellular bands	1-10 Mbps	several km	medium	high
NB-IoT	cellular bands	0.1-1 Mbps	several km	medium	high
SigFox	<1 GHz	<1 kbps	several km	low	medium
Weightless	<1 GHz	0.1-24 Mbps	several km	low	low
WiFi	<1 GHz 2.4 GHz 5 GHz	0.1-54 Mbps	<100 m	medium	low
WirelessHART	2.4 GHz	250 kbps	~100 m	medium	medium
ZigBee	2.4 GHz	250 kbps	~100 m	low	medium
Z-Wave	<1 GHz	40 kbps	~30 m	low	medium

Session		**MQTT**, **SMQTT**, **CoRE**, **DDS**, **AMQP**, **XMPP**, **CoAP**…
Network	**Encapsulation**	**6LoWPAN**, **6TiSCH**, **6Lo**, Thread…
	Routing	**RPL**, **CORPL**, **CARP**…
Datalink		WiFi, **Bluetooh Low Energy**, **Z-Wave**, **ZigBee Smart**, **DECT/ULE**, 3G/LTE, NFC, **Weightless**, **HomePlug GP**, **802.11ah**, **802.15.4e**, **G.9959**, **WirelessHART**, **DASH7**, ANT+, **LTE-A**, **LoRaWAN**…
Security		TCG, Oath 2.0, SMACK, SASL, ISASecure, ace, DTLS, Dice…
Management		**IEEE 1905**, **IEEE 1451**…

	Internet Protocol Suite (TCP/IP) stack	IP Smart Objects Protocol Suite stack
Application Layer	HTTP/FTP/SMTP…	CoAP
Transport Layer	TCP/UDP	UDP
Network Layer	IPv4/IPv6	6LoWPAN
Link Layer	802.3 Ethernet 802.11 Wireless LAN	IEEE 802.15.4e

Web 10^2-10^3 bytes		IoT 10s of bytes	
XML	inefficient content encoding	**Web Objects**	efficient objects
HTTP	huge overhead, difficult parsing	**CoAP**	efficient web
TLS		**DTLS**	
TCP	requires, full internet devices	**UDP**	optimised IP access
IPv6		**6LoWPAN**	

IoT system definitions

To apply necessary governance to systems and solutions, it is useful to split these into 3 categories:

1. **Traditional/non-IoT System** – e.g. laptops connecting to a 802.11 WiFi network, sending emails and connecting to the Internet, or a CAT5 IPv4 networked locker that opens when a user logs into it;
2. **IoT Extended System** – e.g. CCTV solution that incorporates high-bandwidth, wired cameras over IPv4, alongside long-life battery motion-detection devices that connect to a LPWAN;
3. **IoT Optimised System** – e.g. waste bins with embedded sensors to detect capacity, which send an alert to request they are emptied.

What is IoT, and what isn't?

1. CCTV

What does it do? Cameras sense (view) their surroundings and report back information (video) to operators.

What technologies does it employ? Cameras require 'Unconstrained' or heavy protocols and networks, IPv4, or 802.11x.

Is it IoT? Using our definitions, *No* – it would be classed as 'Traditional' because it does not employ IoT optimised attributes.

What is IoT, and what isn't?

2. Access Control

What does it do? Allows staff access to secured areas of the facility depending on their requirements.

What technologies does it employ? Access Control readers are CAT5 IP connected readers, but they don't generate/require high amounts of bandwidth.

Is it IoT? Using our definitions, *No* – it would be classed as 'Traditional' because although the readers aren't 'chatty', they still operate over a traditional IPv4 network and use fixed cabling.

What is IoT, and what isn't?

3. SCADA

What does it do? Reports information on the system health and metrics of electromechanical devices.

What technologies does it employ? PLCs are CAT5 cabled or connected via 802.11x Wi-fi using IPv4 for communication to backend systems.

Is it IoT? Using our definitions, *No* – it would be classed as 'Traditional' because it does not employ IoT optimised attributes.

What is IoT, and what isn't?

4. Trackable Trollies

What does it do? Trollies are fitted with devices that allow their locations to be tracked and identified within the facility.

What technologies does it employ? Trollies are embedded with a small, un-intrusive sensor which connects to a low power network to send infrequent updates regarding location to the system's operators.

Is it IoT? Using our definitions, *Yes* – this would be classed as an IoT Optimised System because it employs some or all of the IoT attributes, such as low power consumption, low bandwidth networks, un-intrusive sensor.

The Scope: What Matters and Why…

There are two work streams that form an IoT strategy:

1. **The What**: *This is how we define, govern and enable IoT technology & solutions*;
2. **The Why**: *This how we derive value from the Information of Things*.

The Scope: What Matters and Why…

1. **The What**: *define, govern and enable IoT technology & solutions*.

An IoT Strategy should not concern itself with ‘Traditional’ or ‘Non-IoT’ systems that should already conform to existing standards of communications, security, information management, etc.

The ‘**What**’ work stream will define the patterns, standards and principles for governing what IoT protocols, technologies, security etc should be used and how they should be deployed.

The Scope: What Matters and Why…

2. **The Why**: *derive value from the Information of Things*.

The '**Why**' is less concerned whether something is IoT or not.
The '**Why**' is more concerned with what value we can derive from *Things*.
The '**Why**' will always ask questions such as:

- *Why do we need this Information?*
- *How valuable is this information?*
- *Is the value of the Information worth the investment?*

The '**Why**' work stream focuses on models and patterns of how information can be liberated from systems, and how techniques such as AI and Machine Learning can improve views, decision making and analysis.

Rheinberry – an introduction...

- Rheinberry provides decades of IT and Digital expertise
- Formed by experienced IT and business consultants
- Expertise across aviation, telecoms, utilities, retail, finance, pharmaceuticals and engineering
- Delivery focussed & flexible
- Provision of seasoned consultants providing programme & project management, business & technical analysis, architecture and strategy
- IBM Business Partner
- Siemens MindSphere Partner

www.rheinberry.com
info@rheinberry.com