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Evolving
Telehealth
Technology

IoT For eHealth – Friend or Foe?



Docobo Background

Medical Device and Informatics Developer and Manufacturer

- Started as part of a European supported project in 2001
- Original brief was to devise a system to manage Hypertensive patients at home
- Basis for transformation to a system to manage patients with long term conditions
- This has grown to cover all aspects of remote care
- Now includes health intelligence profiling
- Opportunistic assessment of patients with risk complications



Applied telehealth delivering improvements in managed outcomes



Public health profiling

- Healthcare intelligence
- Wellness stratification



Residential care homes

Reduced emergency services
Reductions in hospital admissions



Preventative assessment

- Opportunist assessment
- Prognostic change indicators



Community care

Managing patients at home
Falls prevention



Pre/Post Hospital assessment

- Reduced bed loading
- Early discharge
- Post brain and spinal injury rehabilitation



Long term conditions

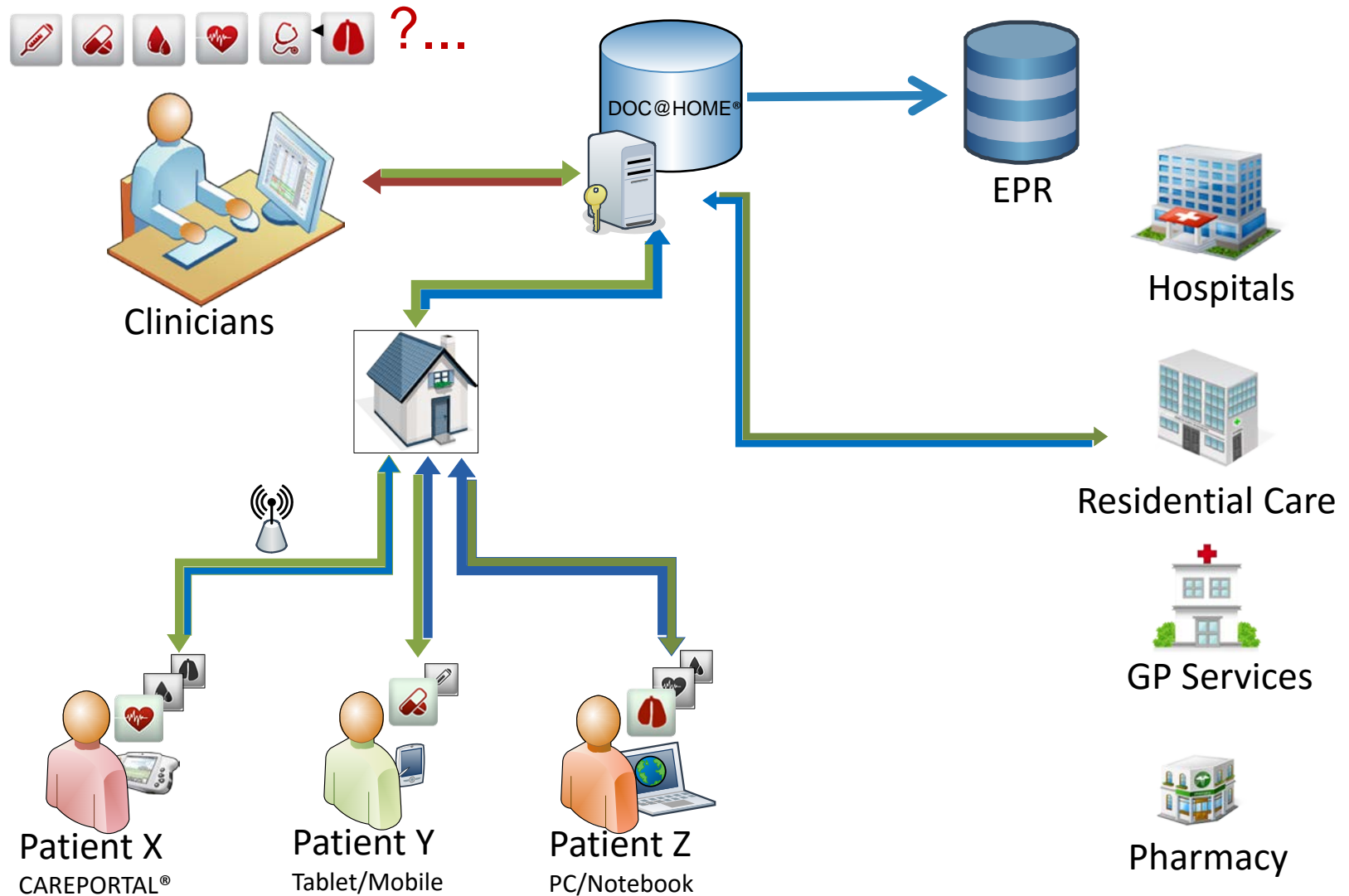
Management of patients at home
Medication concordance
Complex patient care

About The Presentation

- The concept of the internet of Things is something that is suddenly at the forefront of next generation technologies with the idea of millions of connected sensors providing a rich source of data to benefit our everyday lives.
- This presentation discusses the issues of IoT when operating in a medically regulated environment, the potential benefits and the possible pitfalls

The Regulated Medical Environment

Docobo Doc@HOME Telehealth System Overview



What is Telehealth?

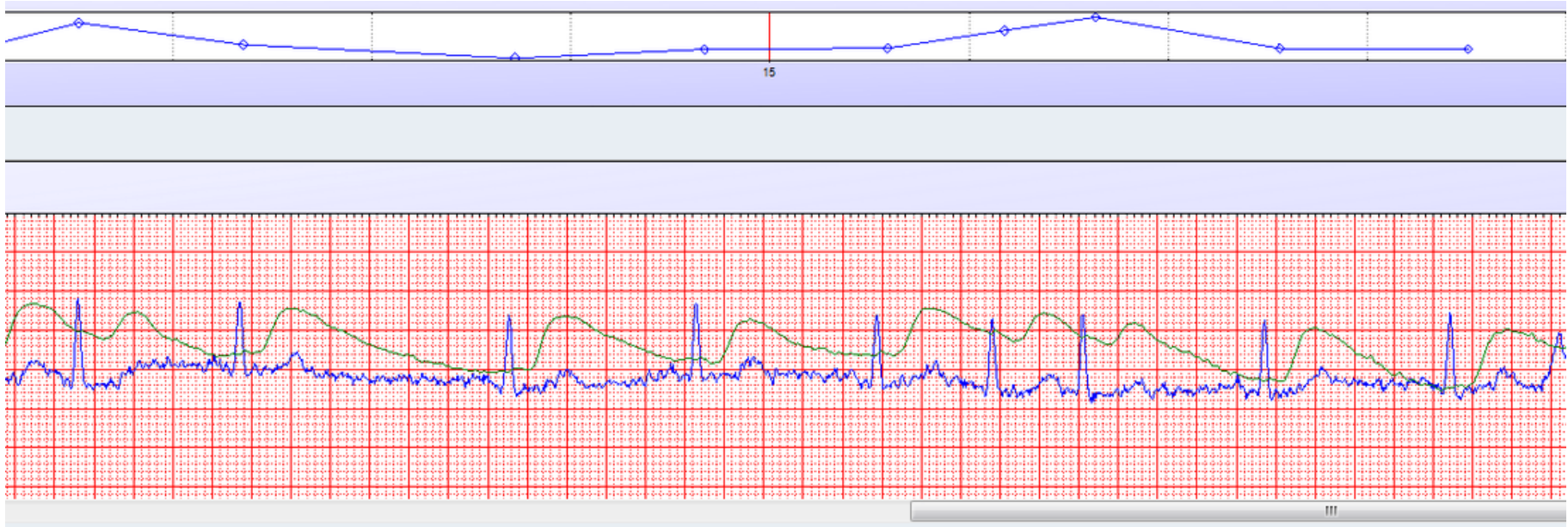
- Remotely monitoring vital signs and lifestyle of patients on a regular basis and as frequently as the patient's condition requires
- Passing and sharing this information to appropriate clinicians to allow early intervention; on going management of patients
- How are your patients today?
- Regulated Medical environment

CarePortal – Patient support



- **Android User Interface**
 - Allows richer graphic experience
 - Enables access to wide range of Android Apps
- **Multi Comms options**
 - GPRS/3G/4G/WiFi/Ethernet/POTS
- **Fit for purpose**
 - Class IIa Medical Device
 - [Doc@HOME System is a Class Ia Medical Device]
 - ECG and Cardiac output
 - No Leads, always on
 - Multi-Patient – Care Homes and Screening
- **Self Help Educational content**
 - Patients 4 Week Display
 - “Static” Information - Information Browser
 - Dynamic” Information – presented in response to answers given
- **Text and Video Messages**
 - Ensures contact is maintained
 - Educational videos

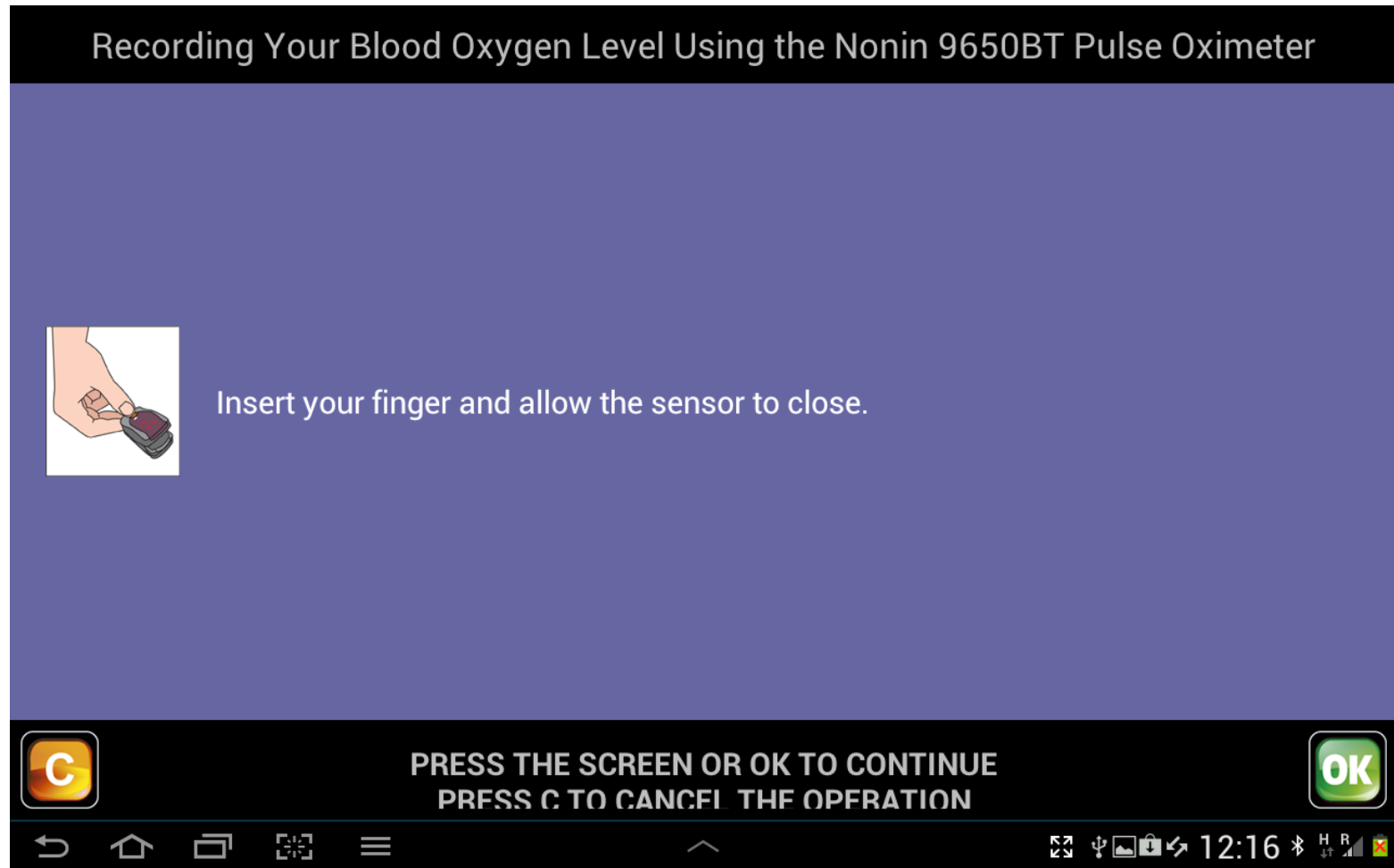
- Typical Lead I ECG recording
 - Heart Rate and Pulse Rate display
 - 20 second rhythm strip
 - 20 second heart rate variability
 - 20 second Aortic Arch Blood Flow



Home Screen



Automated Entry of Physiological Data



Manual Entry of Physiological Data

Please measure your blood pressure using the device specified by your clinician.

The Systolic reading is the higher number, and the Diastolic reading is the lower number.

☐ Systolic ☒ Diastolic ☐ Pulse Rate

130 mmHg 70 mmHg

30 mmHg 120 mmHg

? C ← → OK

11/10/2016

Entry of Symptomatic Data

How well did you sleep last night?

I did not sleep at all	<input type="checkbox"/>
I was mostly awake	<input type="checkbox"/>
I slept on and off	<input type="checkbox"/>
I only woke up once	<input type="checkbox"/>
I slept very well	<input type="checkbox"/>

Navigation icons: ? C ← → OK

System bar: 12:15

The Unregulated Medical Environment

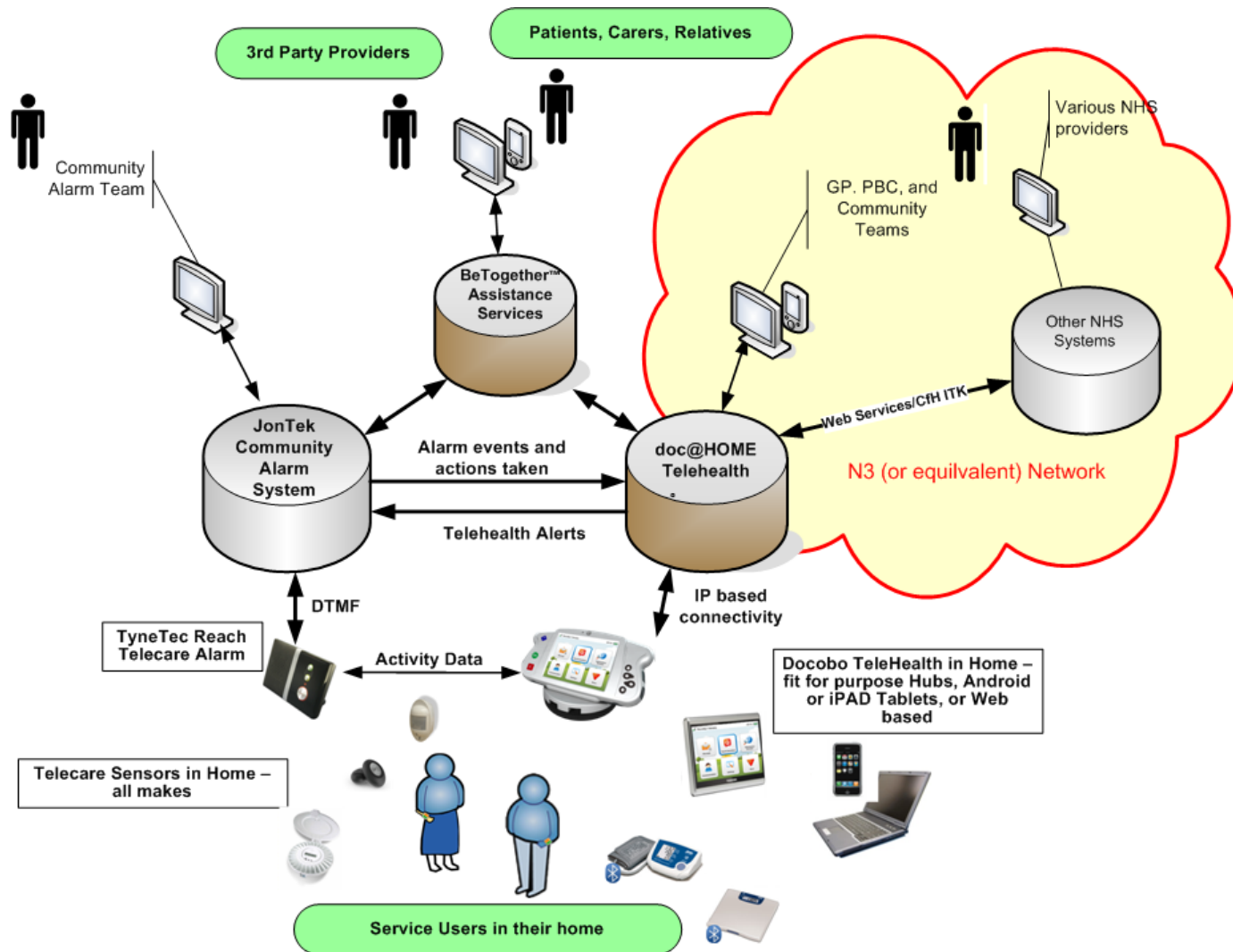
Introducing IoT for eHealth

- The **Internet of Things (IoT)** is the network of physical objects—devices, vehicles, buildings and other items embedded with electronics, software, sensors, and network connectivity that enables these objects to collect and exchange data.

What is IoT For eHealth?

- The IoT concept has now been introduced into the eHealth environment on the basis that this myriad of sensors will give indications about the health and wellbeing of a patient which will be used to support a diagnosis of the patient's condition by the clinician.
- HealthIoT – Blending regulated Health data with unregulated fitness and sensor data
- Overlaps the Social and Telecare environment
- An Enabler for the Integrated Care initiative in the UK
- A bridge between the Regulated and Unregulated environment
- **Normally treated as symptomatic data**

Interoperable Solutions for Integrated Care



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Home Platform Functions

Self Help, educational content and clinical management

Patients 4 Week Display
"Static" Information - Information Browser
"Dynamic" Information – interactive
Clinical support and management

Text and Video Messages

Maintains social interaction
Provides educational videos
Supports secure personal networks
Clinical interaction and communications

Assist projects and family/carer

Location, Where am I?
Falls prevention
Ensures contact is maintained
Friends and family interaction
Social interest groups

ASSIST Project and Third Party Smart

Home
Environment and Home Sensors
Inside location
Smart metering

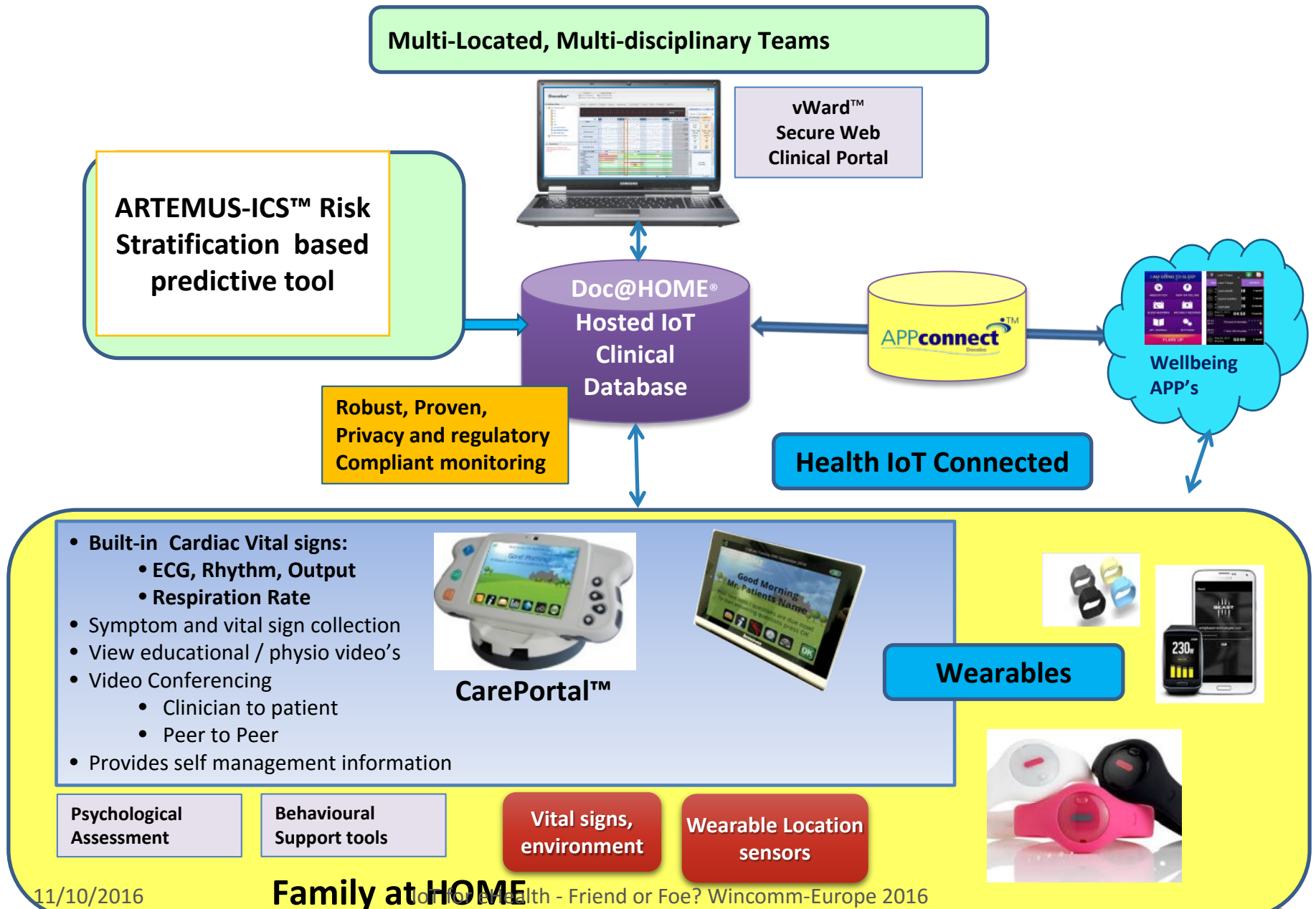


Location Services
Self-help
programmes

Home Environmental
Controls Interface



Docobo Doc@HOME Health IoT Eco-System





The Do CHANGE Project

Do CHANGE



Do Cardiac Health Advanced New Generation Ecosystem

The primary goal of the Do CHANGE project is to develop a health ecosystem for integrated disease management for hypertensive and cardiac patients based upon behaviour change.

This ground breaking system – which will be adaptable for other health and social issues – will give people access to a set of personalised health services that directly respond to a range of measurements and situations.

TIHM for dementia

Using technology to improve the quality of life for people with dementia



The Health Challenge: Dementia

- ▶ 850,000 in UK have dementia at a cost of £26bn p/a in health and social care costs. Expected to jump to 1 million by 2025
- ▶ In Surrey and NE Hants 18,800 are estimated to have dementia
- ▶ 55% of those on the dementia register across Surrey and NE Hants are admitted to hospital each year
- ▶ 20% are frequent users of acute hospital services



TIHM for dementia principles

- ▶ Improving lives of people with dementia and their carers
- ▶ Reducing hospital stays and care home admissions
- ▶ Collaborating to create solutions
- ▶ Targeting resources to areas of need
- ▶ User led design and innovation
- ▶ Driving change in workforce practice
- ▶ Creating scalable solutions



How will the trial work?

- ▶ Technological devices such as sensors, apps and trackers installed in people's homes
- ▶ Testing remote monitoring of health and wellbeing using data combinations gathered via Internet of Things
- ▶ Evaluation of results and share health technology learning to support other long term conditions



IoT – Friend or Foe

Benefits and Pitfalls of HealthIoT

IoT Friend or Foe? (1)

- The IoT concept has perceived benefits for general lifestyle applications. Where Big Data Techniques may bring additional learning.
- However implementing such a concept in the context of eHealth where we are looking at personalised medicine - the Small Data approach - whilst there are a number of perceived benefits there are also a number of pitfalls to be considered

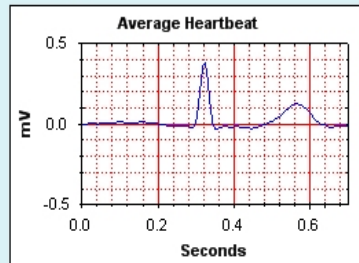
IoT Friend or Foe?(2)

- HealthIoT potentially allows a plethora of DATA to be collected
- But how much INFORMATION can be distilled and visualised in such a way to avoid information overload?
- Time waits for no man especially clinicians !
- The clinician inevitably only has a short time to assess all the information including both physiological and symptomatic inputs to provide enhanced care for an individual patient.
- A small data approach instead of the big data analytics normally associated with the IoT concept.
- **Visualisation is key**

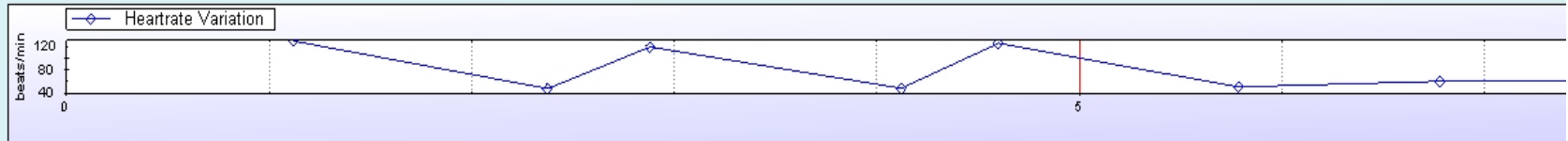
Web based Clinical Interface

HVI and Rhythm Analysis

Recording time: 15.07.2007 21:10



PR	=	0.15 seconds	(3.8 mm)	P	=	15 μ V
QRS	=	0.06 seconds	(1.5 mm)	Q	=	-17 μ V
QT	=	0.26 seconds	(6.5 mm)	R	=	376 μ V
HR	=	61 beats/minute		S	=	-34 μ V
				T	=	125 μ V



Raw ECG

Baseline Corrected ECG

Baseline Corrected ECG x 2.5



Trust and Information Governance

- Any Patient Data collected whether physiological data such as Blood Pressure from a Medical Device Blood Pressure Machine, symptomatic personal Data collected from non-medical devices such as Fitbit etc or IoT sensor data used to support an intervention forms part of the patient record.
- Must be managed in accordance with the Local Information Governance requirements.
- How much Trust a Clinician has in using such symptomatic and IoT data in making a diagnosis depends upon the provenance of the sensor.
- There are many many “Apps” out there.
- A Pulse Oximeter App can be downloaded for free. An approved Medical Device Pulse Oximeter costs around 200 + Euros
- The App if used in a consistent way may however show trends rather than absolute values

Monitored for 4 Months

- **No out of hours calls**
- **No NHS direct calls**
- **No hospital admissions**
- **Approximately £100K saved**

Deployment Issues

- IoT proponents talk about the Cloud as some mystical place where data sits awaiting their use
- One Persons Cloud is somebody else's computer!
- In Health you need to know where the data is stored
- A related consideration is that for any such IoT system that may deliver data supporting eHealth , a clinician will want to access the system via the system they already use for their work,
- In the UK is likely to be such systems such as Rio, SystmONE, EMIS, etc
- Single secure sign-on required
- One needs to address interfacing and integration of IoT Networks to those mainstream medical systems
- System of System approach bringing DATA from different Systems to provide INFORMATION

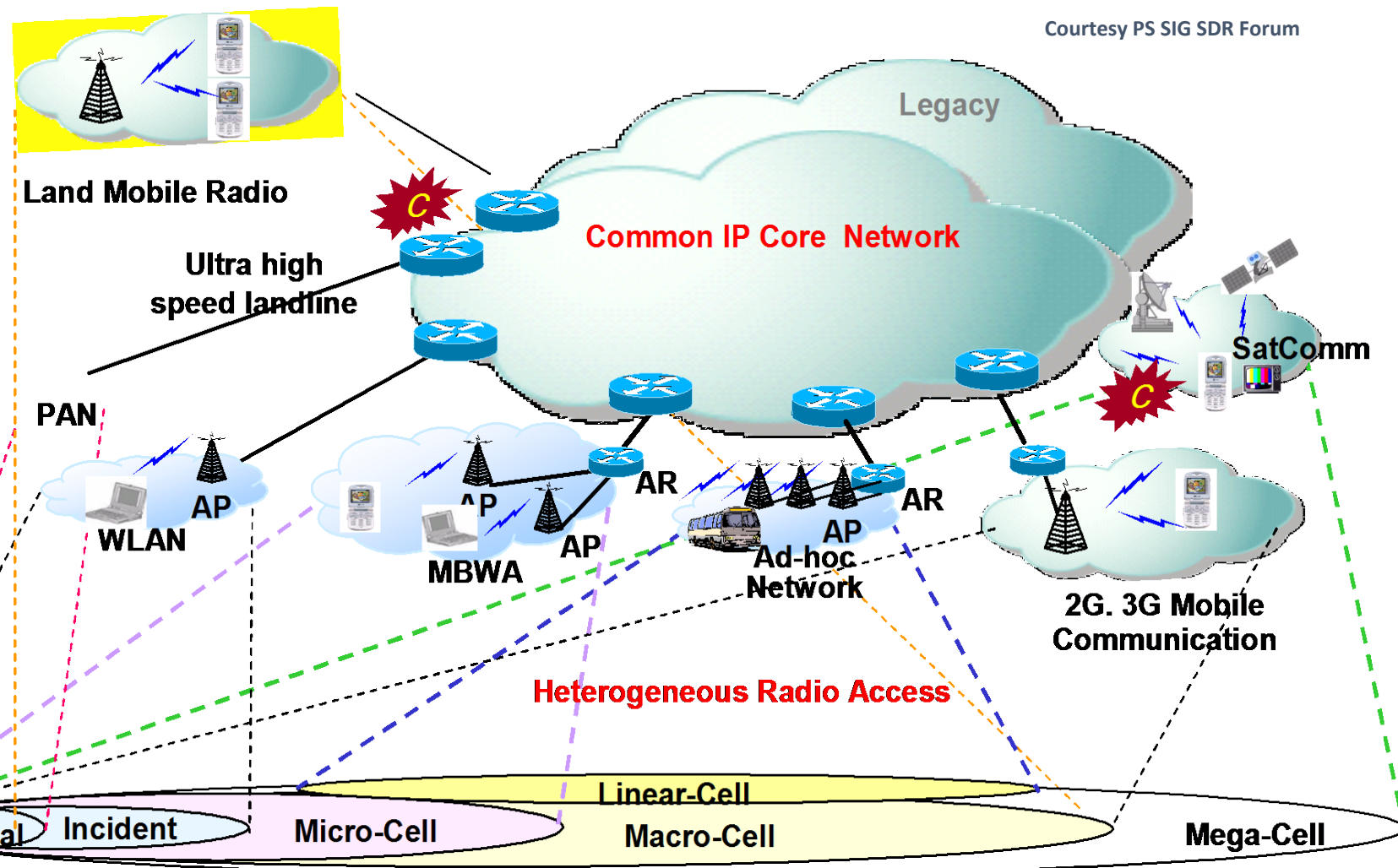
Connectivity

IoT and 5G

Connectivity – IoT and 5G

- Misconception in some areas that 5G and IoT are one and the same
- 5G will provide very high bandwidths – University of Surrey 5GIC managed 1Tb
- Bands 6GHz and above - FCC proposes rules for 4 bands above 24GHz - Experiments above 60GHz being Carried out
- SHORT RANGE
- Docobo uses 2G or any available network including satellite and POTS – Not all patients have mobile phones, broadband or cellular coverage and live in the city.
- Other competing IoT and M2M low bandwidth standards NB-IoT LoRa SigFox Weightless LTE-M
- **But where do we buy the modems!**
- Telehealth may include remote video consultations
- Connectivity to suit the application is required
- **Wireless Technologies an important part of eHealth**

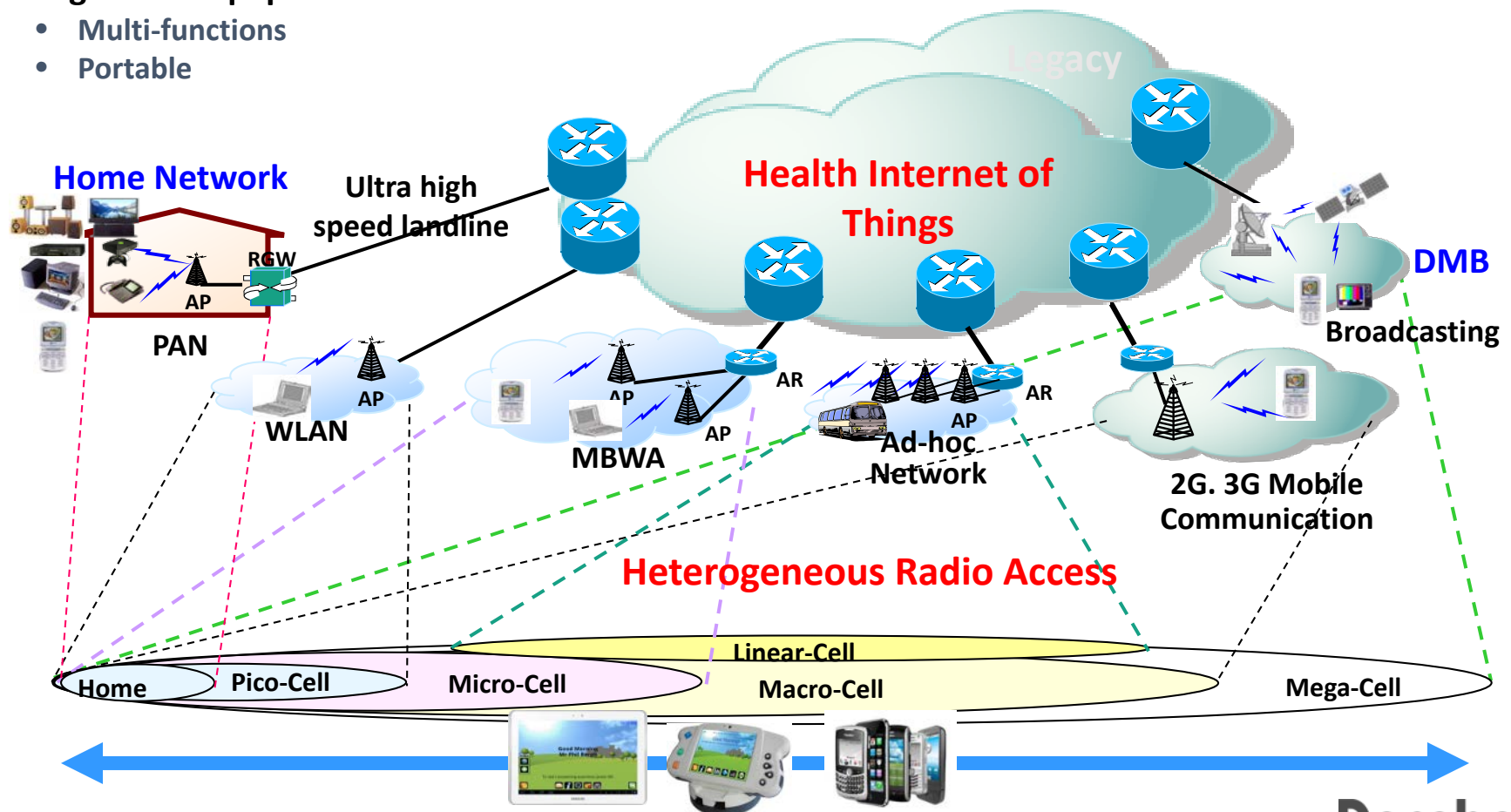
Public Safety System of Systems Approach



HealthIoT System of Systems Service Creation Environment

Health and Informal Care services delivered through a framework of invisible communication

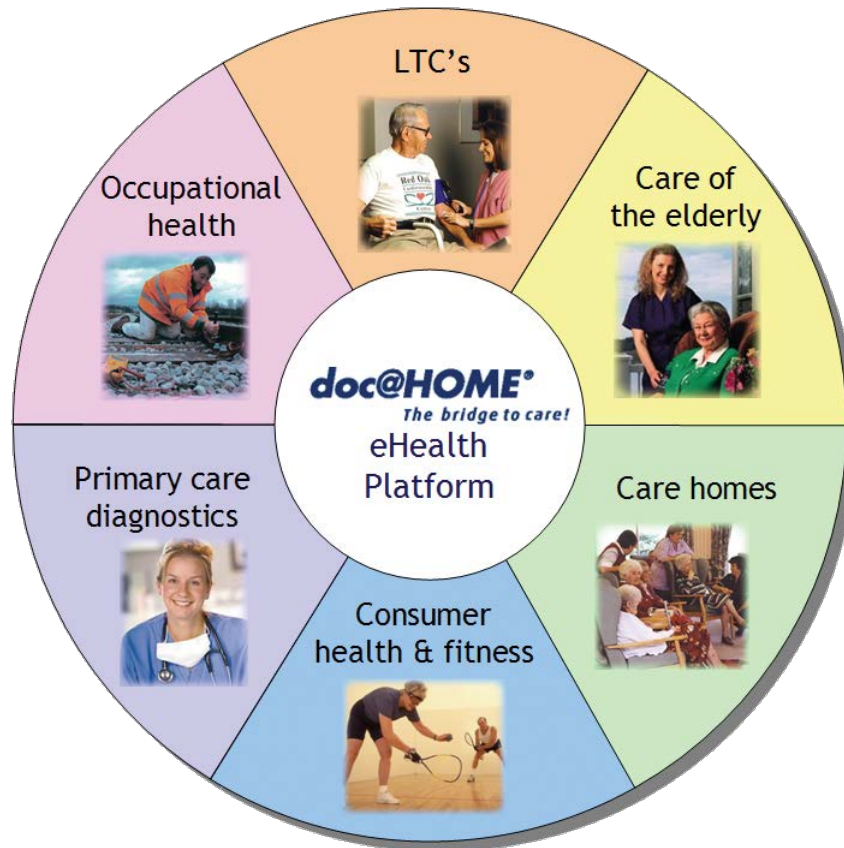
- **Convergence over IP**
 - Wireless and Wired
 - Mobile & Broadcasting
- **A single user equipment**
 - Multi-functions
 - Portable
- **Heterogeneous Inter-working**
 - User convenient network
 - User service continuity



Conclusion

- The Internet of Things concept when applied to the eHealth domain – HealthIoT - has the potential to bring a rich source of DATA from a myriad of sensors to support the clinician in the management of their patients.
- However acceptance by Clinicians will depend upon the ability of the system to realise the data as INFORMATION to enable rapid evaluation
- Integration of a range of different Health and non-Health SYSTEMS to form an eHealth SYSTEM of SYSTEMS to share INFORMATION will enable the creation of a non-proprietary Health IoT Ecosystem and increase take up across both Health and Social Care.
- IoT is not 5G but Wireless Technologies are a key enabler.
- Friend or Foe?
- Potentially **Friend** but rapidly **Foe** if adoption by Health and Social Care Authorities increases the workload of Clinicians rather than supporting their endeavours.

Thank You



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