



***“Are we better prepared for emerging threats”***

Dr Penny Wilson

Innovation Platform Leader, Stratified Medicine

12 November 2012

# Foresight Project

## The Detection and Identification of Infectious Diseases

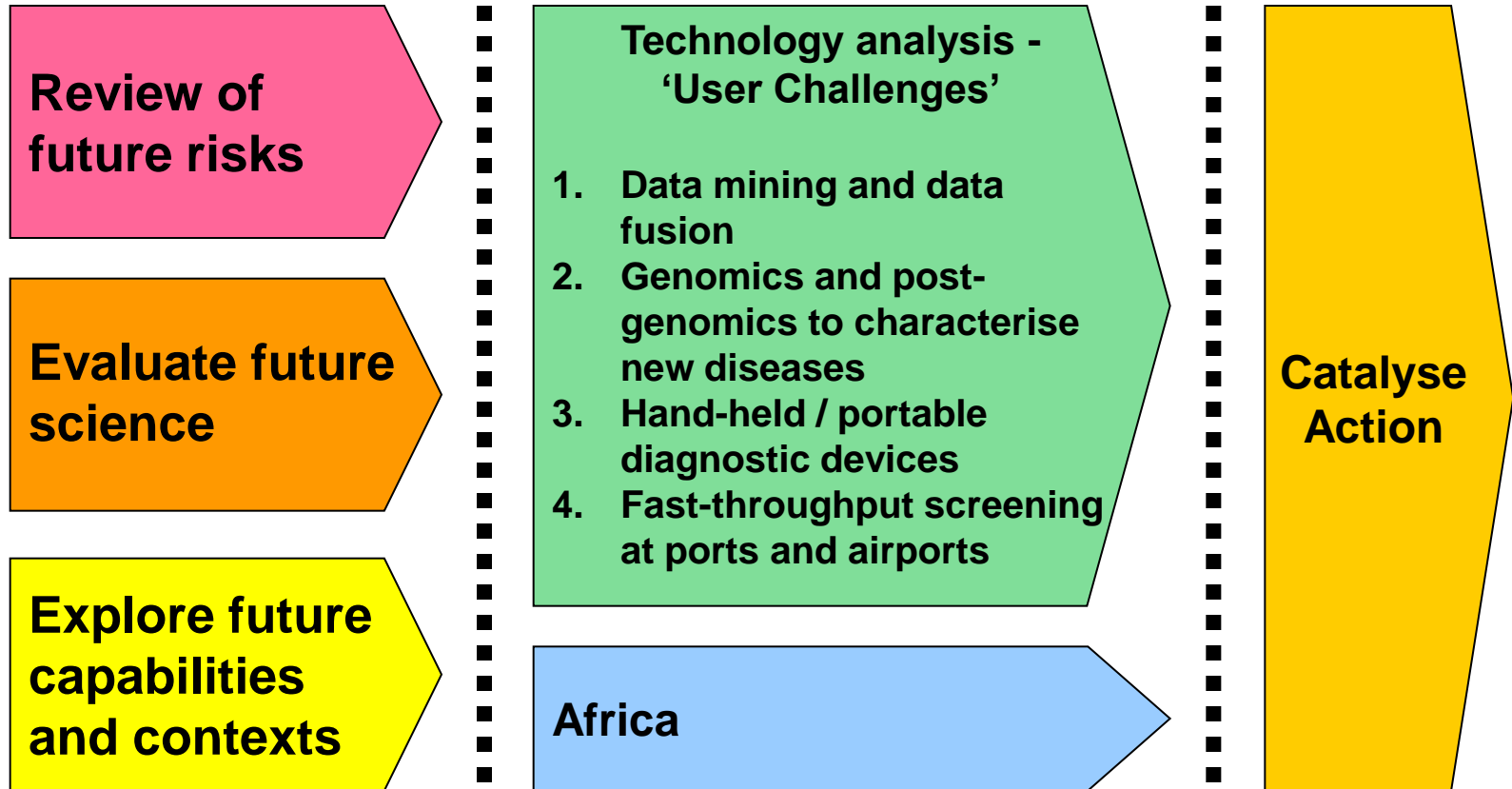
### Infectious Disease Project:

**Key Question:** How can we use science and technology to improve our capability for detecting, identifying and monitoring infectious diseases in order to improve control?

**Ultimate goal:** To detect all known and unknown infectious diseases, of plants animals and humans, in ~ 30 years.

Report published April 2006

# Project structure



# UCs and future risk management

Categories of particular concern	Potential contribution to managing future risk			
	UC1	UC2	UC3	UC4
Evolution of new diseases	***	***	**	**
Acquiring resistance in pathogens	***	**	***	*
Zoonoses	**	**	***	***
HIV/TB/Malaria	**	**	***	*
Plant disease threats	***	*	***	***
Acute respiratory infections	***	**	***	***
STIs	**	*	***	*
Trans boundary animal diseases	***	**	***	***

KEY:  \*    \*\*    \*\*\*

  
 Increasing potential

## Detection and Identification of Infectious Agents (DIIA) Innovation Platform

- Created to reduce the mortality, morbidity and economic burden of infectious diseases in humans and animals
- In July 2012 the platform was brought into the Stratified Medicine programme
- Continues to address the challenges of adoption with key stakeholders including DH, NICE and BIVDA
- Forthcoming call 2012 (proposed)
  - Diagnosis of tuberculosis
  - Diagnosis of endemic animal diseases



# Converging technologies

- Biomarker discovery
- Biosensors
- Novel chemistries
- The omics (proteomics, genomics)
- MEMS (including microfluidics)
- Sequencing technologies
- Nanotechnology
- Advanced materials
- Bioinformatics
- Information and communication technologies
- Data mining and fusion
- High value manufacturing



# Qualitative Field Testing

Inspection of imported nursery stock

Interception of quarantine viruses in imported produce



# Control and Graphical User Interface



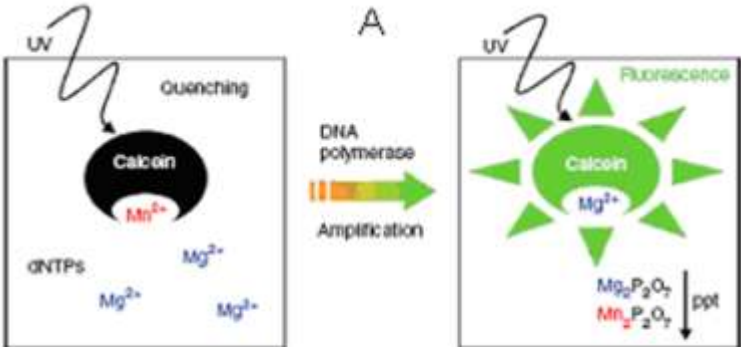


# Modified Loop Mediated Isothermal Amplification (LAMP)

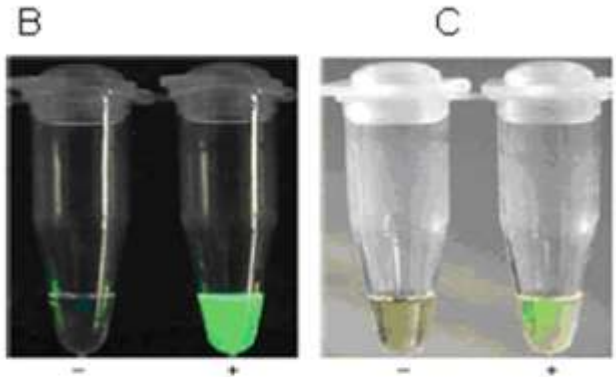
Eiken Chemical Company, Japan: *Bst* Polymerase: Isothermal polymerase 63-65 °C

Norihiro Tomita, Yasuyoshi Mori, Hidetoshi Kanda & Tsugunori Notomi Nature Protocols 3, 877 - 882 (2008)

Loop-mediated isothermal amplification (LAMP) of gene sequences and simple visual detection of products



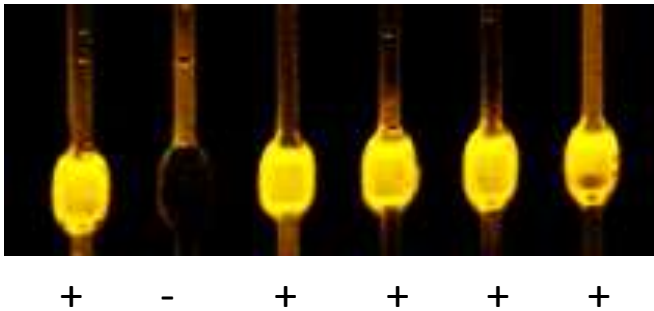
Principle of detection using a fluorescent metal indicator, calcein



Detection of LAMP reaction (A) UV lamp (365nm) (B) Daylight

## Modifications:

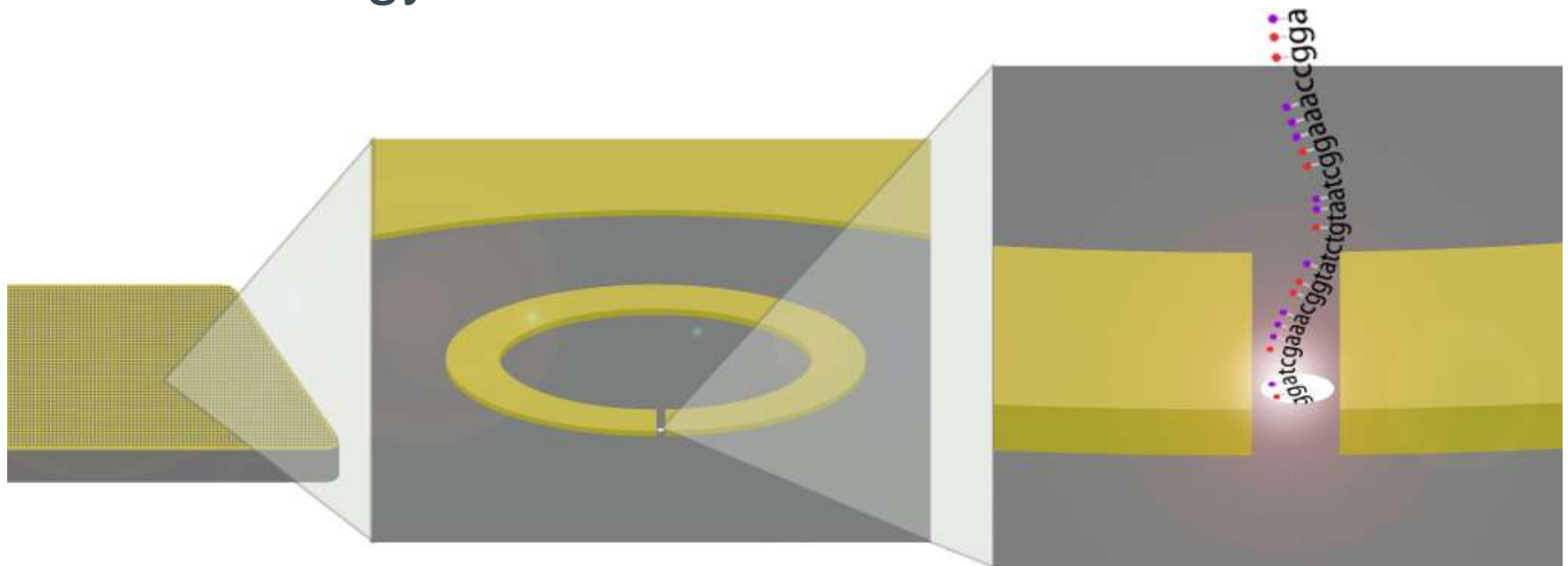
500 nl volume wells , Syto 82, 560 nm Filter



+ - + + + +



# Technology



## Silicon wafer

- Silicon wafer with 20nm thick silicon membrane and 10nm covering of gold.

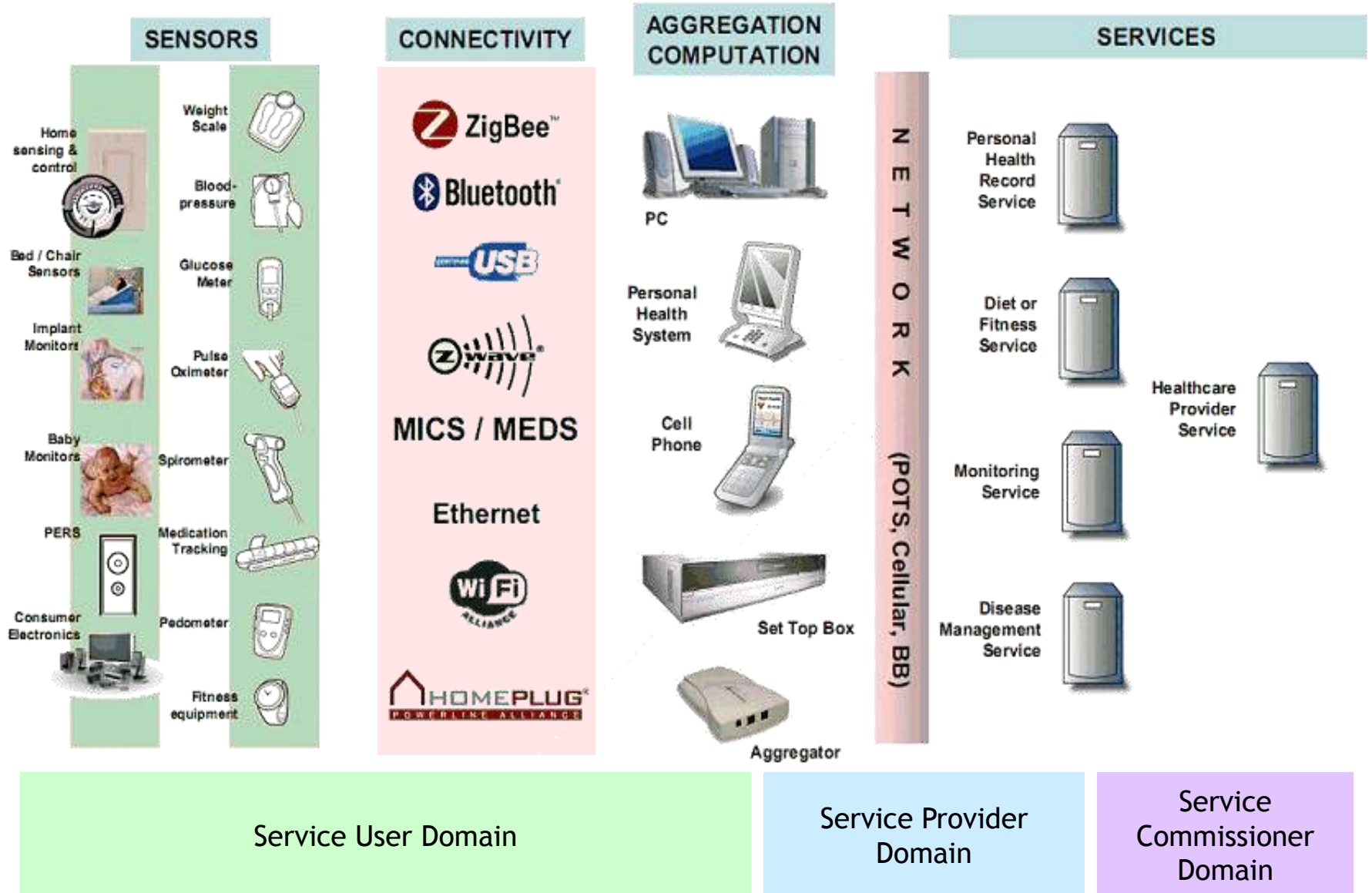
## Nanofabrication

- Gold on membrane is etched away to produce a plasmonic nanostructure
- Nanopore is etched through silicon

## Translocation and detection

- Wafer incorporated into microfluidic chamber
- Fluorescently labelled DNA induced to pass through nanopores
- Fluorescence from individually labelled nucleotides detected optically at high speed (up to 1 million bases/second)

# Continua 'ecosystem'



# Converging technologies



What's the relevance?

What's the impact?

Results must lead to a decision



# User Challenge Roadmaps – basic template

Drivers and trends

Systems

Applications

Technologies

Now

5 Near

10

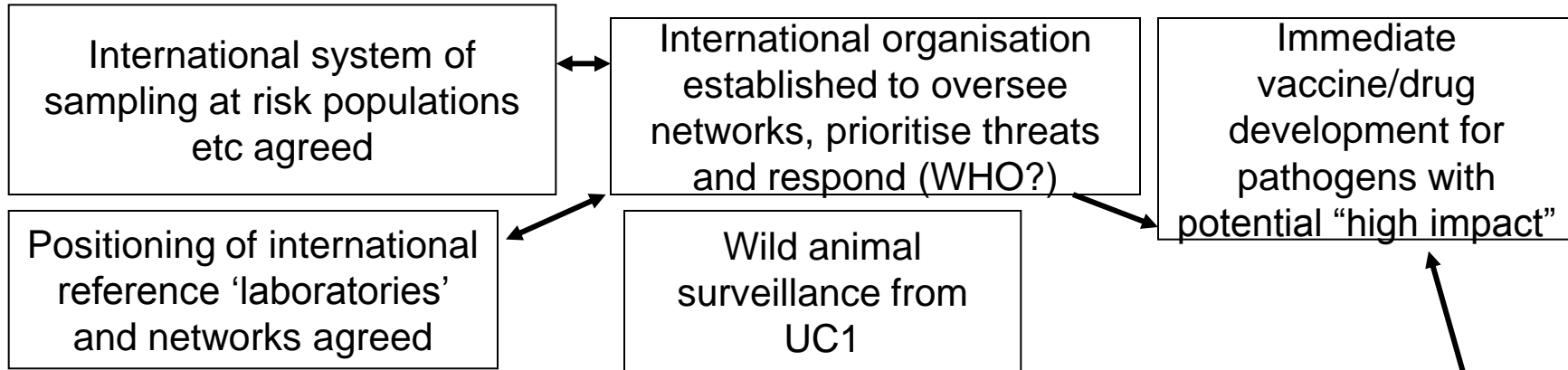
Time (Years)

20

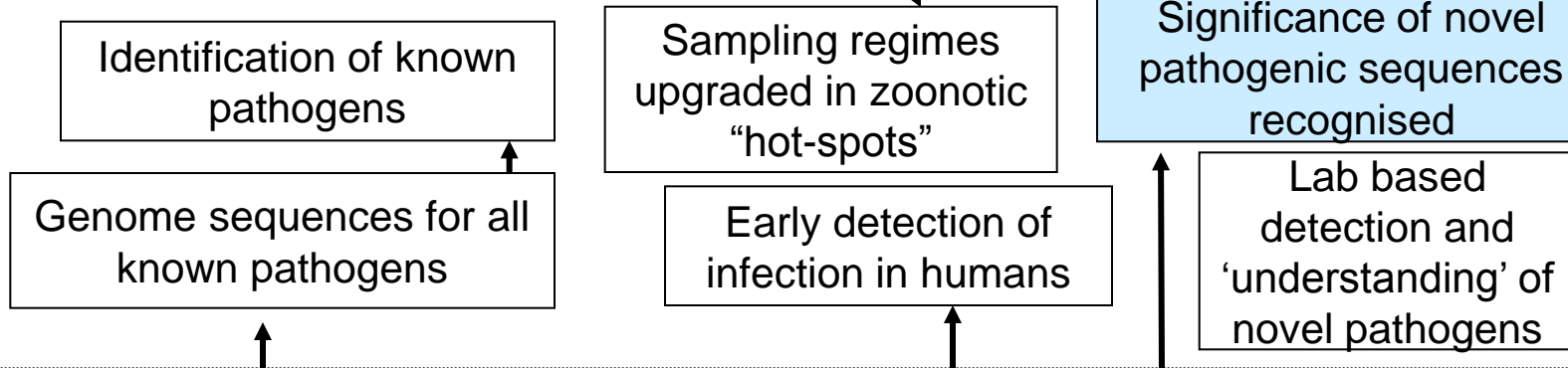
25-30

# UC2 Roadmap (sections only)

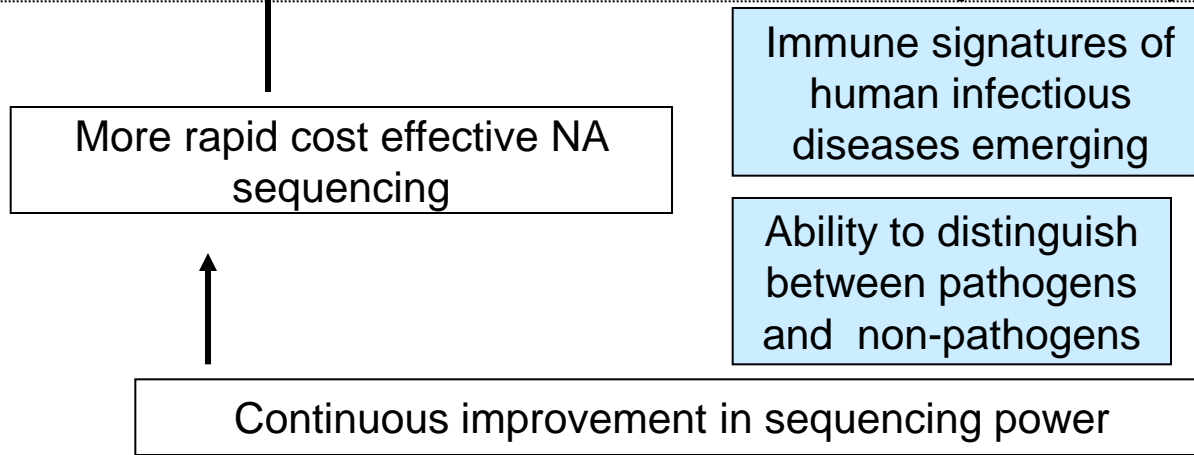
Systems



Applications

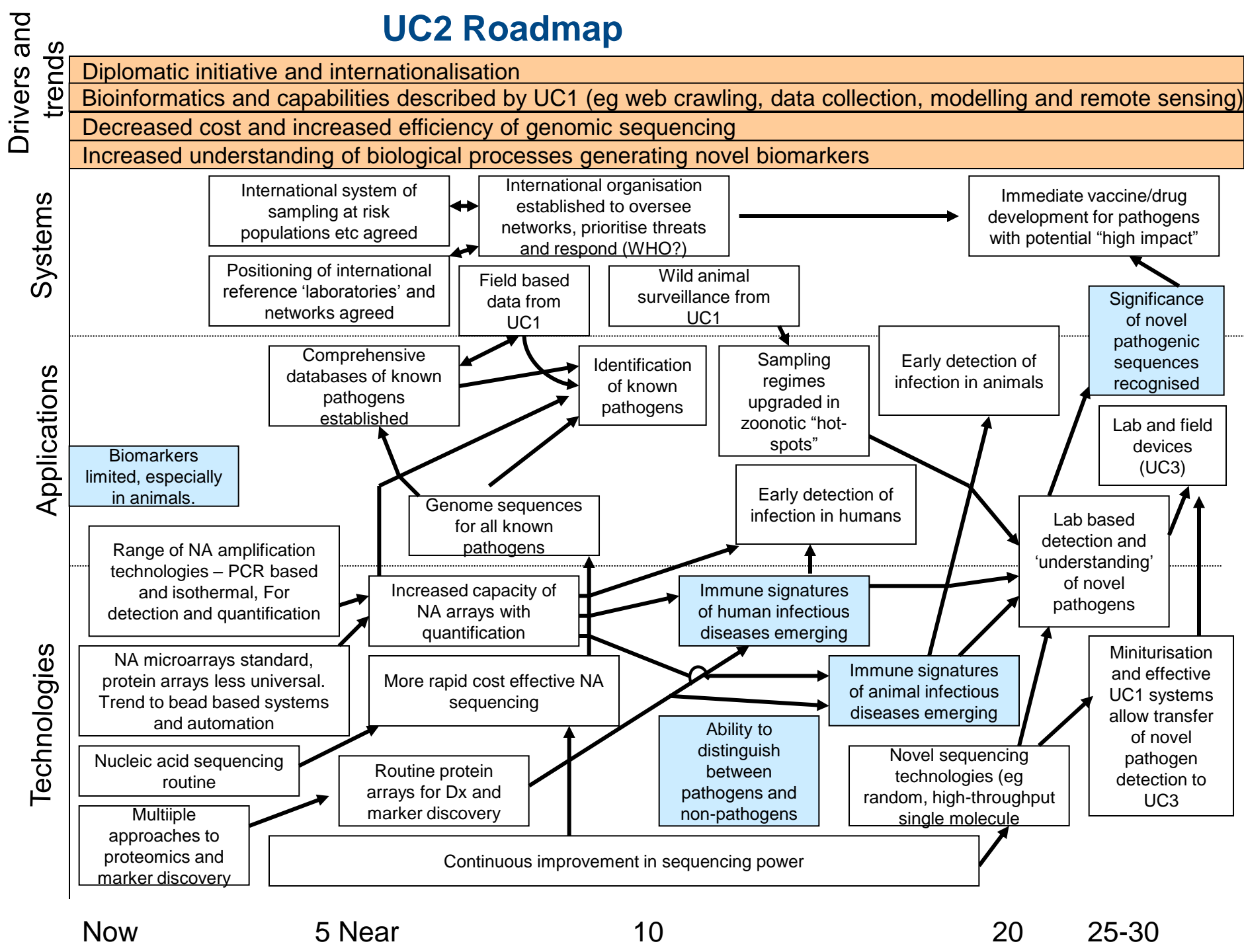


Technologies

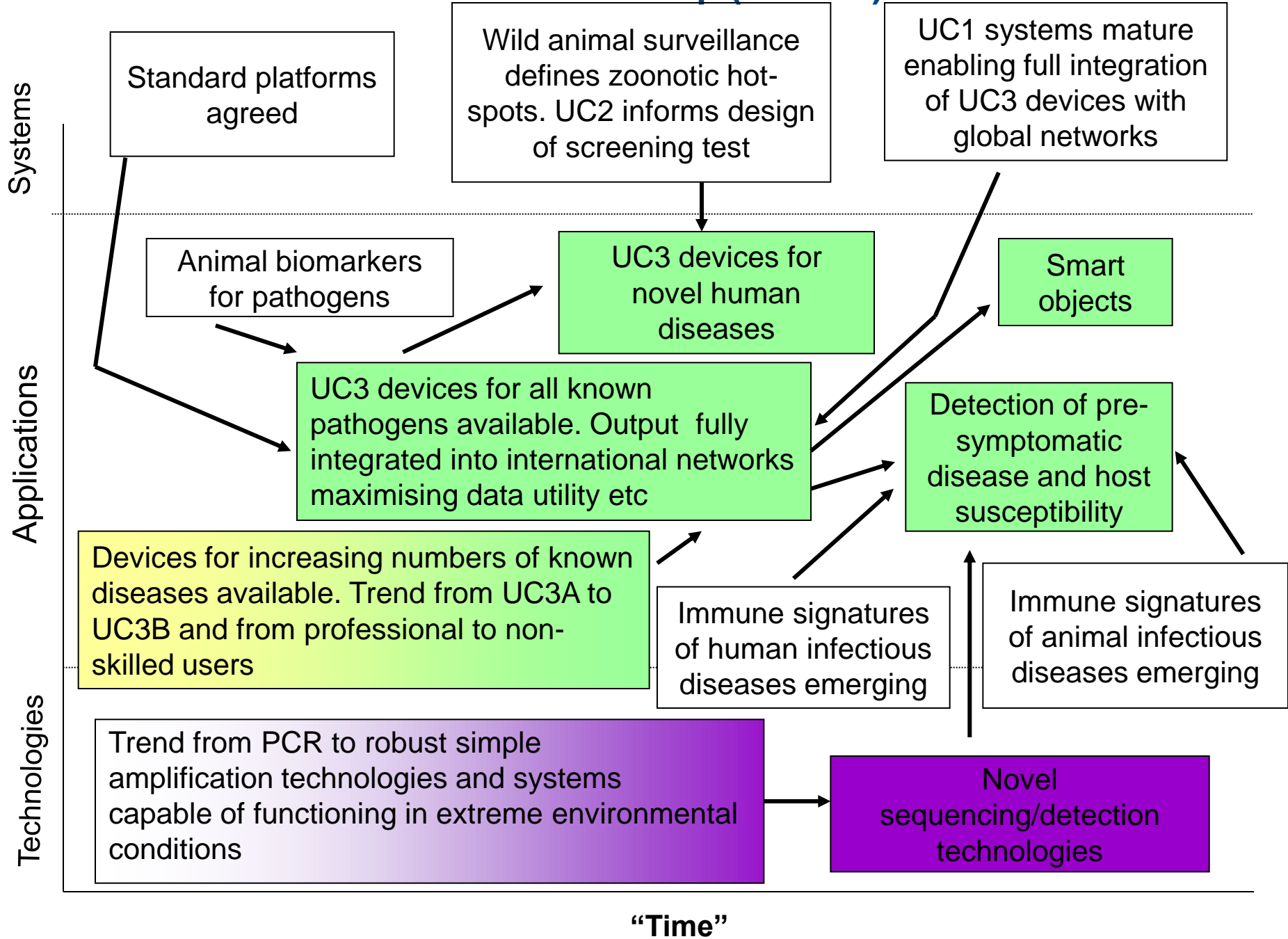


"TIME"

# UC2 Roadmap



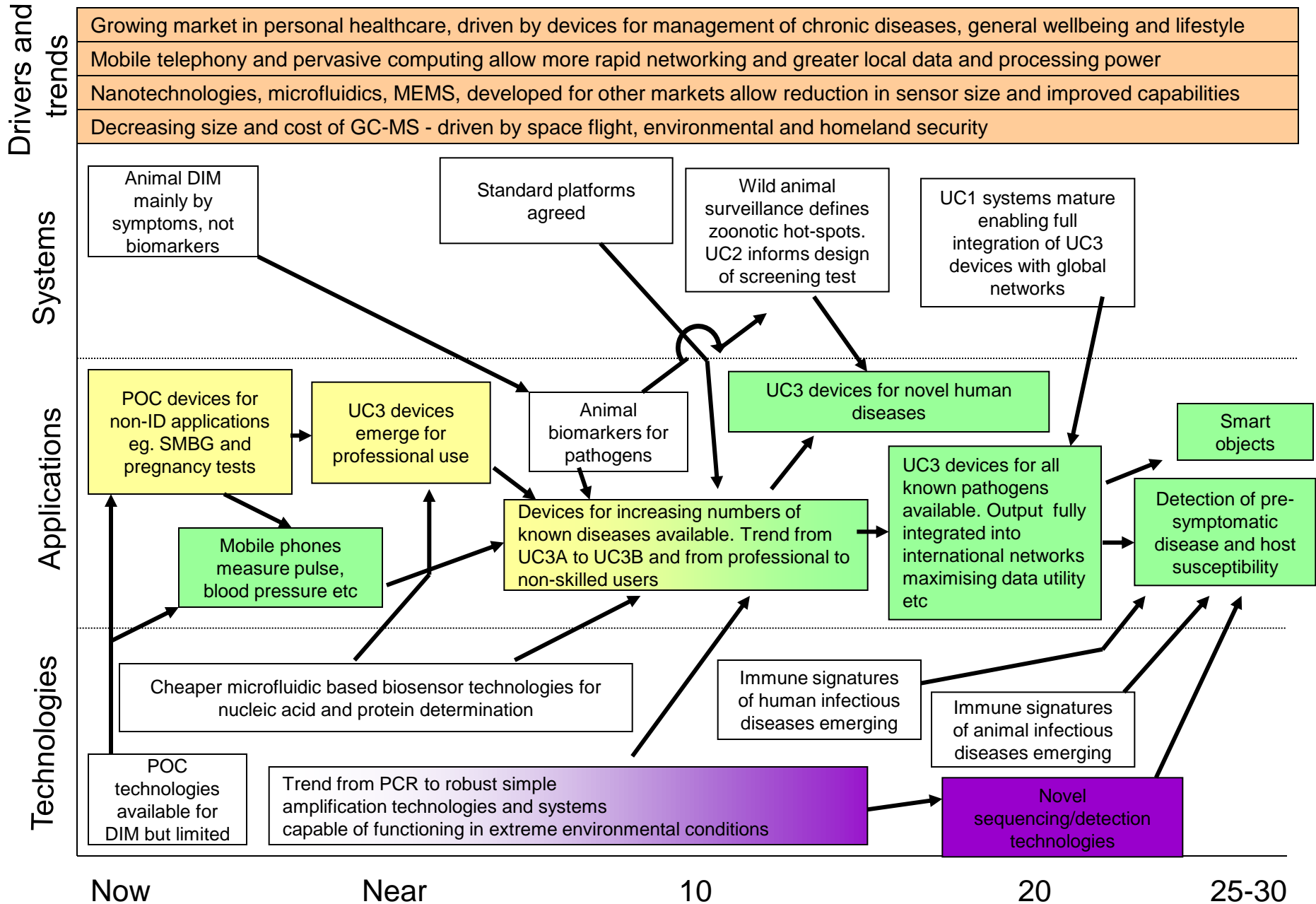
# UC3 Roadmap (section)



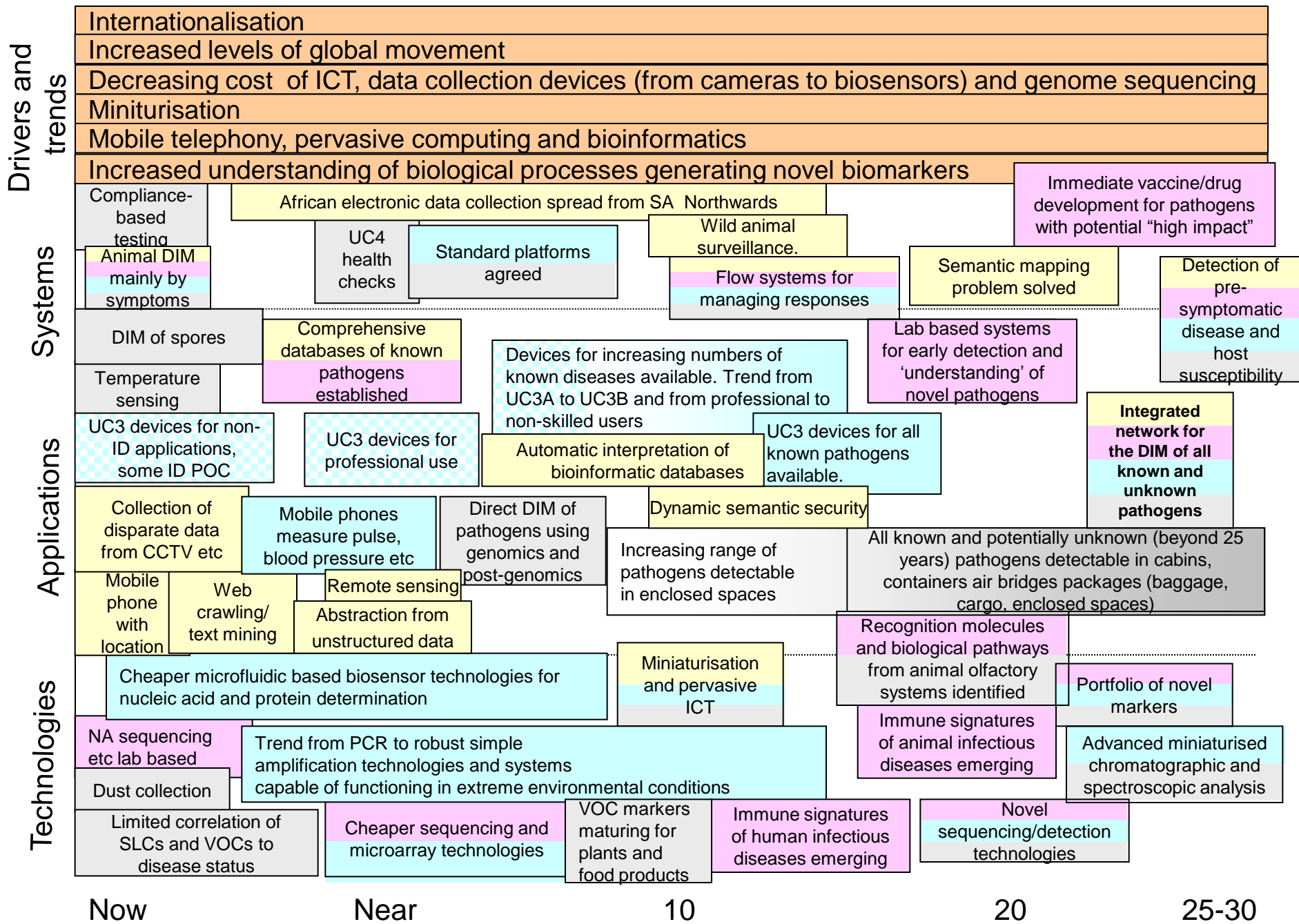


# UC3 Roadmap

KEY	Stand-alone devices – UC3A
	Devices linked to networks – UC3B



# UC Synthesis Roadmap



Culture and governance issues		SSA	China	UK
Governance	International	+	+	+++
	Regional/supra-national groupings	++	+	++
	National	++	++	+++
	Local/provisional	++	+++	+++
	Ability to implement measures through legal or coercive measures	++	+++	+
	DIM interaction with control mechanisms	+	++	+++
	Investment in science and technology	+	++	+++
	Data-sharing culture	++	+	+++
Social aspects	Religious and societal beliefs/concerns	+++	+++	+++

+ limited influence  
+++ prominent influence

**Greater importance  
In 10 – 25 yrs**

# THE LANCET

## New hope for sepsis

... This new injection of money and innovative enterprise into combating this devastating and lethal disease will hopefully lead to doctors being able to diagnose with confidence and initiate life-saving therapy early, and ultimately to fewer people dying needlessly worldwide....

*Thank you*

