ICR The Institute of Cancer Research

ICAT Face-to-Face Meeting

Transforming Data Storage for Life Sciences Research

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Our mission is
to make the discoveries
that defeat cancer

Presentation Outline

ICR's Lifecycle Management Requirement for Research Data

1. Institute of Cancer Research / Royal Marsden
2. ICR Research Infrastructure
3. RDS Service: solution, rationale
4. ICR Research Data Storage Programme

Is ICAT the solution?

1. Institute of Cancer Research and The Royal Marsden Hospital

Institute of Cancer Research - at a glance

Top 4 global cancer research organisation

Top-ranked UK academic institution (REF)

20 drug candidates discovered since 2005

More than 1,000 staff

£161.9m income
£110.0m expenditure

Athena SWAN Silver Award

Awarded Athena SWAN Silver

More than 900 scientific papers

Partnerships with 163 different companies

Top UK university for invention income

141 research students
143 MSc students

ICR Academic Successes

The ICR is ranked as the top academic research centre in the UK; first in the *Times Higher Education* league table of university research quality compiled from the Research Excellence Framework (REF 2014)

Joint top of the *Times Higher Education* table for Innovation – based on worldwide citation of research in patents

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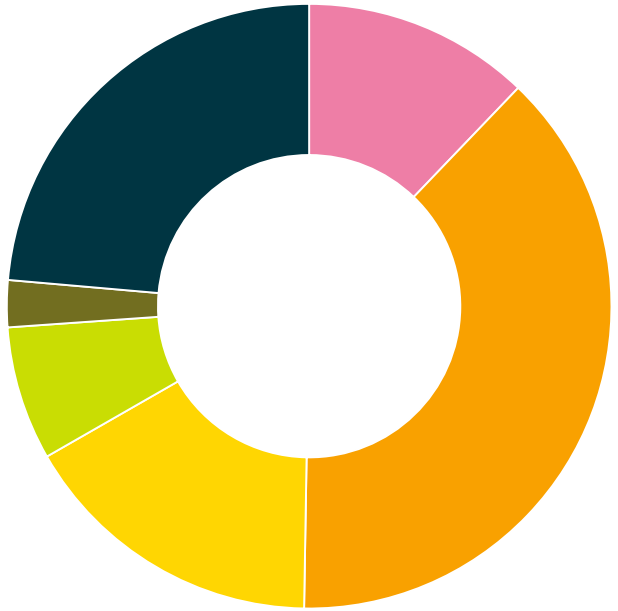
Substantial and diverse funding

2016

- Total income £162m
- HEFCE 12% based on research excellence
- Grant income 38%
- Legacies and donations 7%
- Invention income from our discoveries 16%

-> Services not centrally funded

Total incoming resources 2016



12%
Higher Education Funding Council for England

38%
Research grants

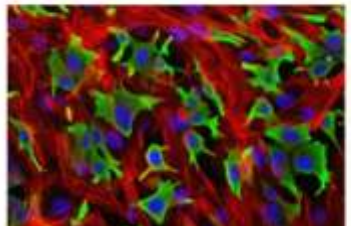
16%
Royalty income

7%
Legacies and donations

3%
Investment and tuition fees

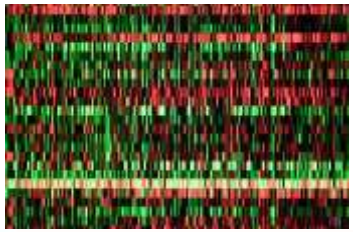
24%
Sale of part of our future royalty stream

ICR Research Divisions



Breast Cancer Research

Cancer Therapeutics



Genetics and Epidemiology

Radiotherapy and Imaging

Cancer Biology

Clinical Studies

Molecular Pathology

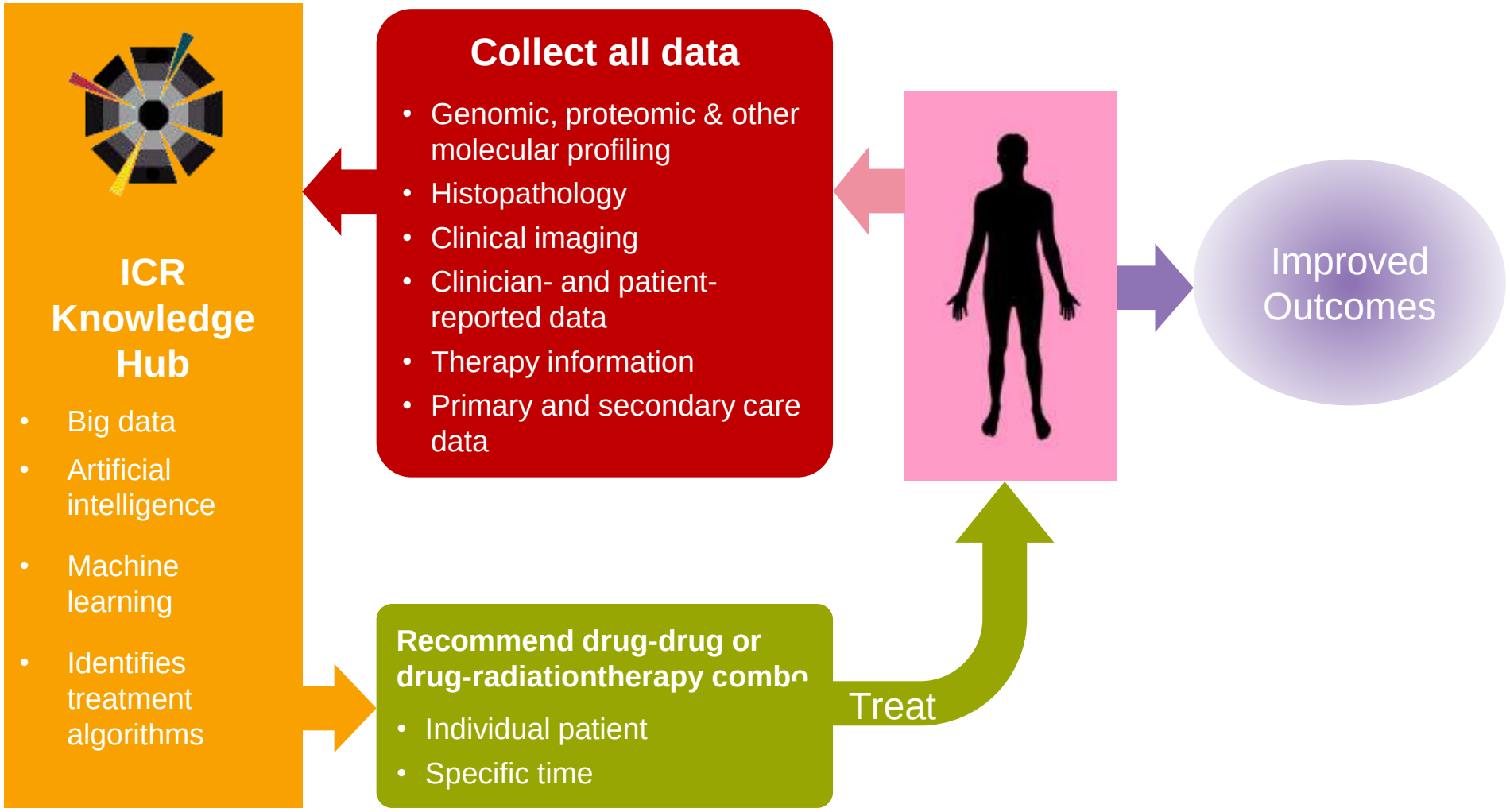
Structural Biology

The Royal Marsden Hospital

Partnership with The Royal Marsden, and “bench-to-bedside and back” approach:
-> discoveries made, and clinical impact delivered, uniquely

Outstanding record of research achievement dating back more than 100 years

Future – dynamic adaptive therapy



Plan to start novel dynamic adaptive individualized trials from 2022

- Drug-drug in advanced prostate (de Bono); lung (Swanton)
- Drug-radiotherapy in lung, prostate, breast (Harrington et al)

ICR The Institute of Cancer Research

Making the discoveries
Our strategy to defeat cancer

The ICR and The Royal Marsden delivered a joint strategy covering the next five years

Our vision
We will overcome the challenges posed by cancer's complexity, adaptability and evolution through scientific and clinical excellence, innovation and partnership

First pillar: Unravelling cancer's complexity

Comprehend the full complexity of cancer by **harnessing the power of new technologies and Big data**

The London Cancer Hub

A global centre for cancer innovation

http://www.icr.ac.uk/our-research/our-research-centres/london-cancer-hub

The London Cancer Hub aims to create a world-leading life-science campus specialising in cancer research, diagnosis, treatment, education and biotech innovation.

To deliver: an exceptional environment for cancer research that enhances the discovery of new treatments and their development for patients

To provide: state-of-the-art facilities, and be joined by a multitude of high-tech enterprises in a network of 10,000 researchers, clinical staff and support staff all operating from one site

2. ICR Research Infrastructure

HPC Infrastructure:

HPC Clusters

- c 1,800 cores,
- 12-16GB per core,
- 2PB scratch storage
- Designed for a fairly embarrassingly parallel workload

- ~70% average use (enough to keep ahead of the instruments)

Both HPC and storage have been dominated by NGS until now but new imaging systems are changing the balance

We know nothing about the incoming data other than username and some educated guesswork. No direct information about what happens to the data going through HPC either.

Next upgrade will include GPU nodes to support development of emerging need to support imaging, machine learning etc

Existing Research Infrastructure:

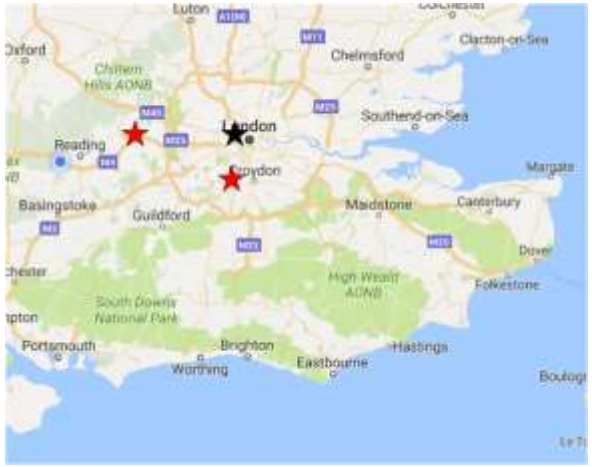
Infrastructure mainly at offsite datacentre – highly secure and resilient

Storage system geographically distributed between London and Slough

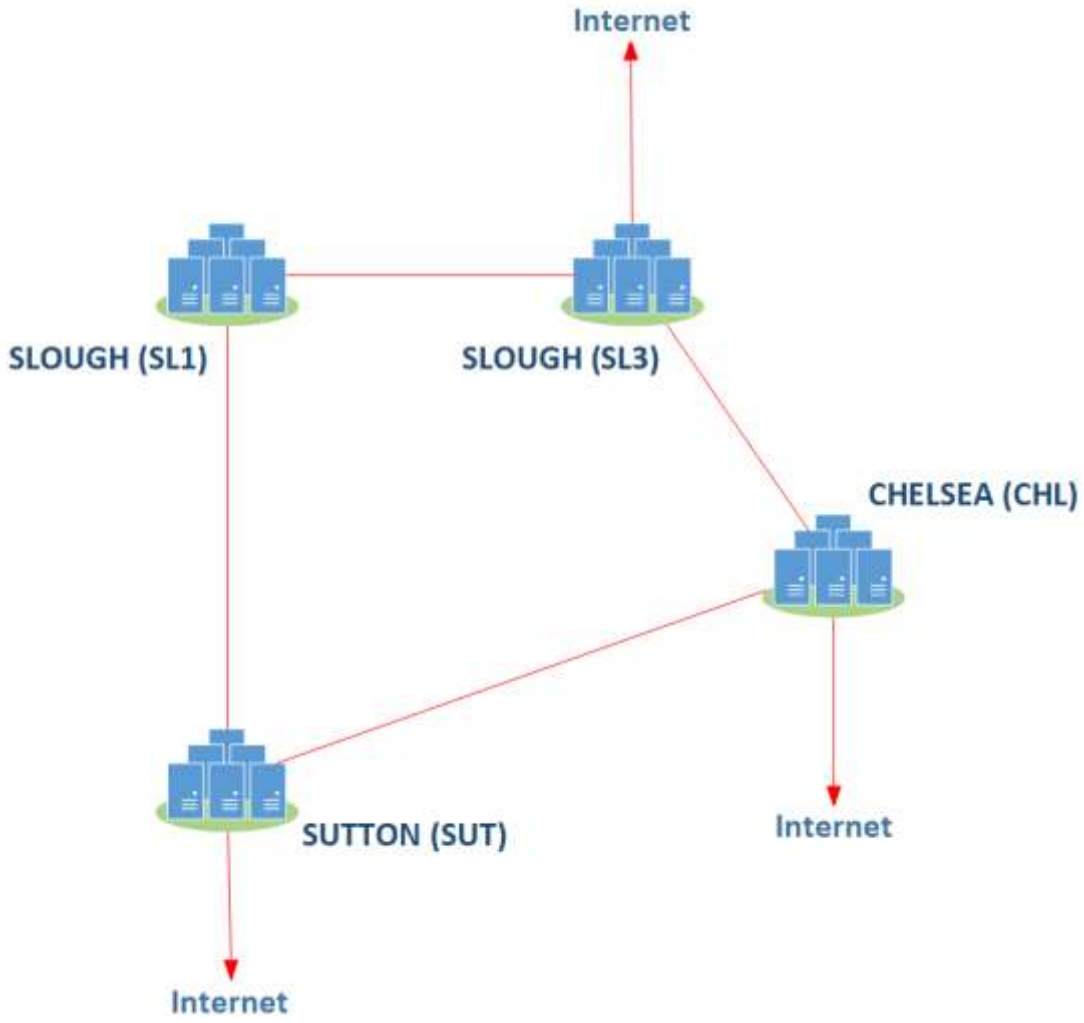
All three sites are connected by a private 10Gb network (with an option to increase b/w)

Traffic can reroute in the event of failure

Each site has a 10Gb internet (JANET) connection



RDS Service Network



3. RDS Service: solution, rationale

RDS **Service** - User Requirements

Collected from researcher workshops:

- 6PiB* storage, expandable to growing research need; minimum 20PiB capacity
- High level redundancy ensuring robust solution
- Cost effective and competitively priced solution (-> vendors offered two Tiers)
  - Rapid access to data held in Tiers
  - Ability for researchers to manage data transfers between Tiers
  - Single namespace
  - Direct access to data in Tier 2
- Ability to protect against accidental loss of datasets
- Staging Areas to guarantee access to storage from instruments

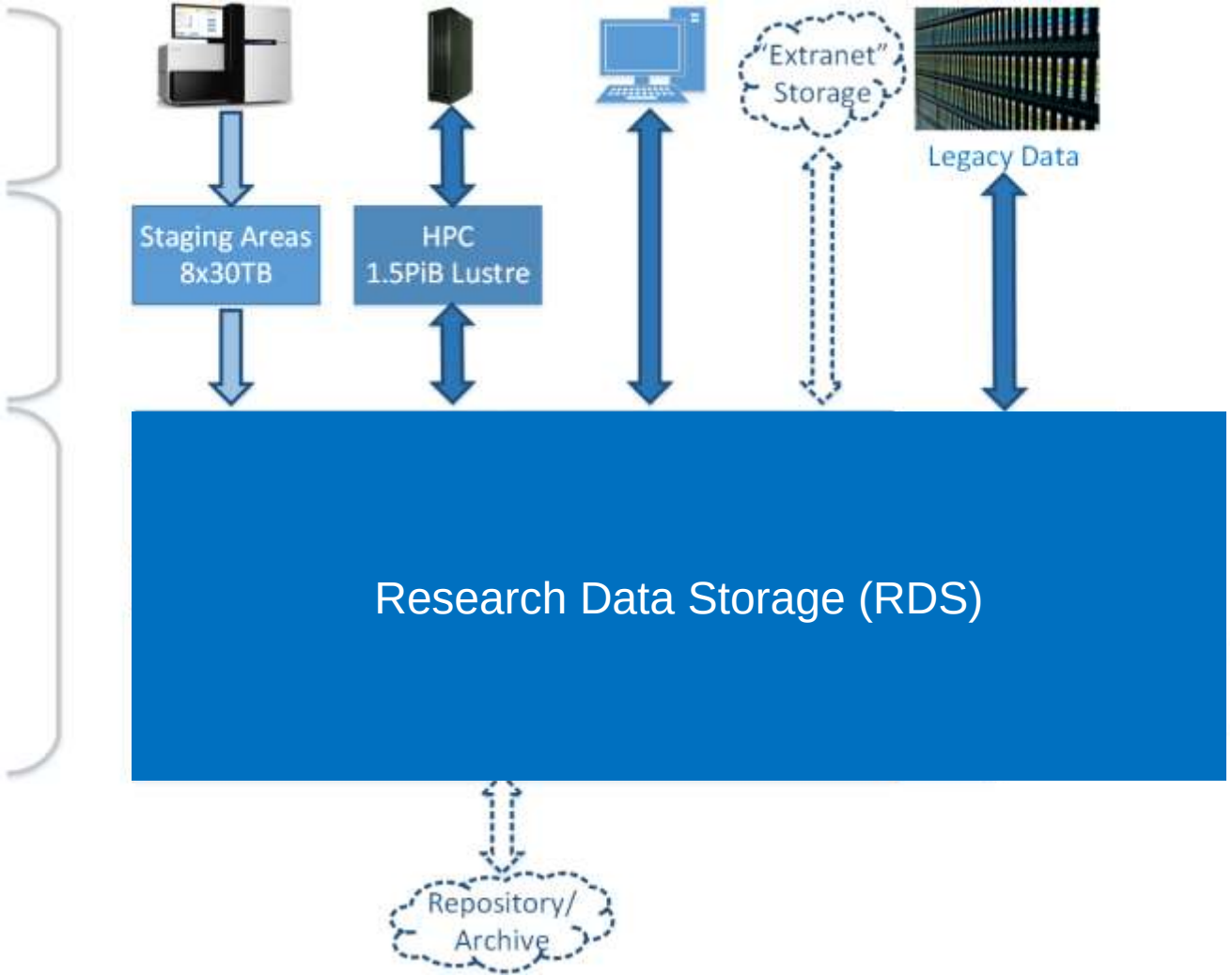
** PiB is a binary unit of storage equivalent to 1.13PB (decimal version)*

Architecture

Data source

Transient Storage

Main RDS Storage



Research Data Storage *Project*

Project Overview

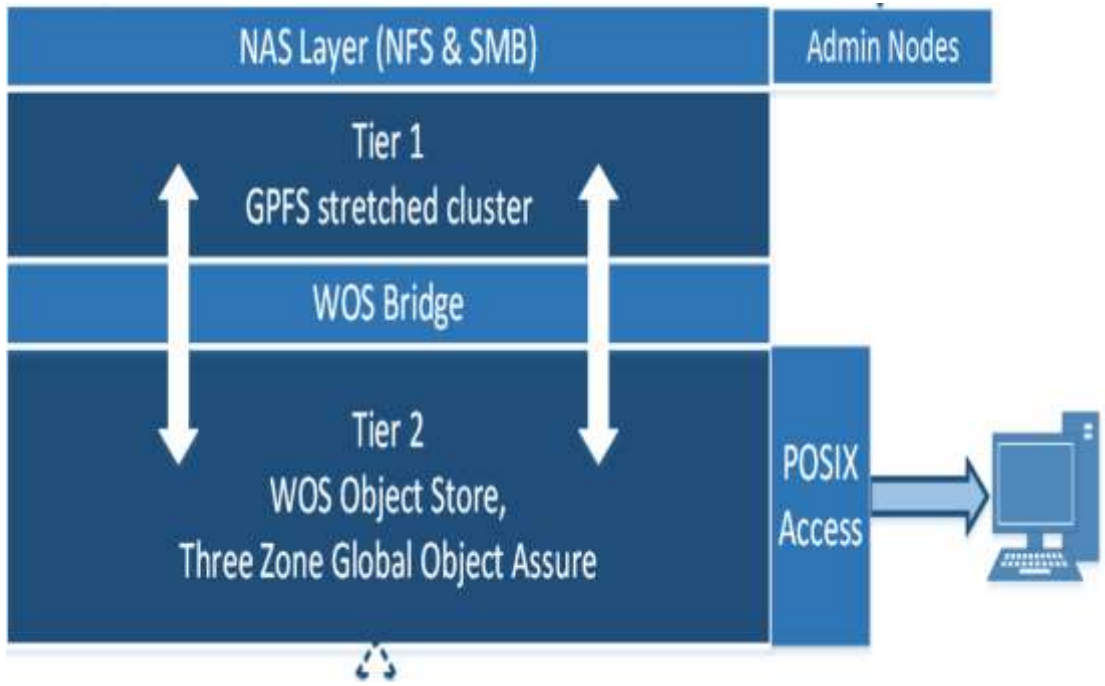
- Delivered:
  - Tier 1: December 2016
  - Tier 2: May 2017

- Total user capacity > 6.5Petabyte
- Current use: c. 1 Petabyte stored

- Some data still to be transferred from previous storage service

- Completed in August 2017

RDS: two Tiers connected by a WOS Bridge

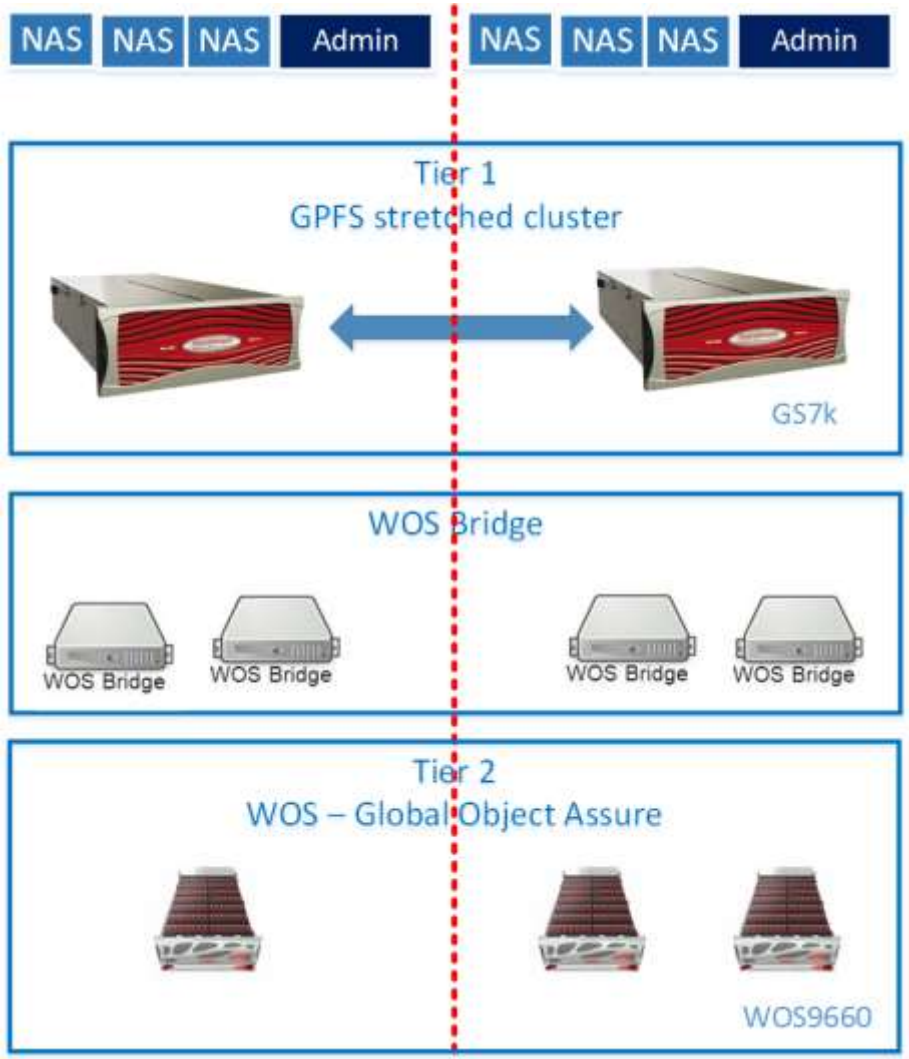


Architecture

Tier 1 is a stretched cluster with synchronous mirroring between Sutton and Slough. Total usable capacity of 2PiB

WOS Bridge Servers at both sites for migration and retrieval of data at both sites eg. an HSM implementation

Tier 2 is a WOS object store (three zone GOA configuration). Space and power means that Chelsea could not be used. 4PiB usable capacity



Management of Data

ICR has ~140 research teams; each allocated a Tier 1 fileset

The directory tree is laid out exactly as our Active Directory structure is (same applies to scratch disks on HPC):

Division > Unit > Team > Person > …

Each fileset is has a snapshot taken every day. Snapshots are retained for 90 days by default. (The snapshot also includes the OID for any files which have been stubbed and the data migrated to Tier2)

Each fileset has a quota on it; individuals may also have a quota

Management of Data

Data can be migrated from Tier 1 to Tier 2 based on Bridge Rules

The default rule is for files which have not been accessed for 90 days to be migrated

Most files migrated to WOS are managed by the Global Object Assure policy

Smaller files (<10MB) on WOS are managed by simple replication between Sutton and Slough – more efficient

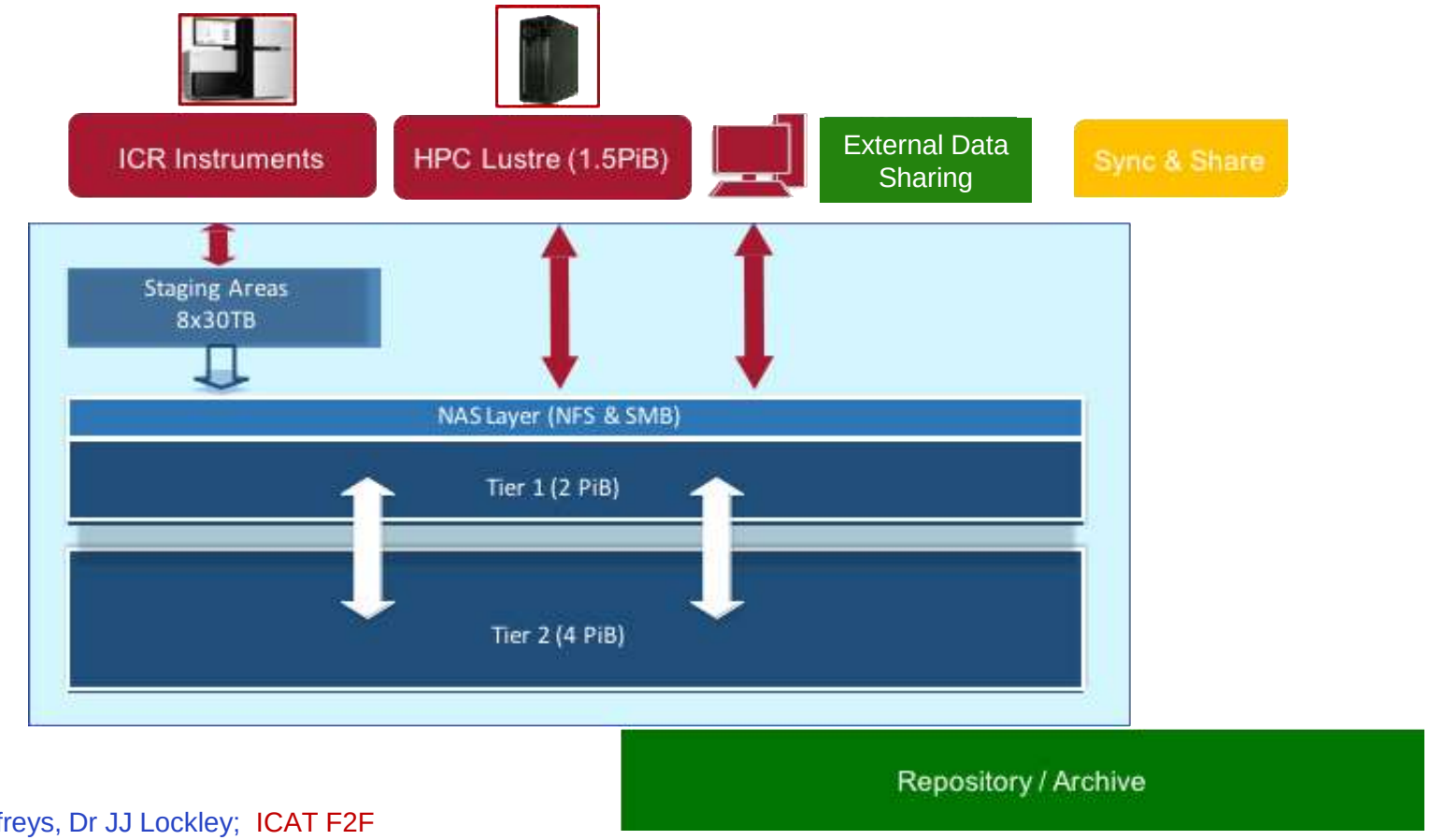
Plan to implement a user-controlled “no-migrate” option for their data using extended attributes later this year

Usage of Tier2 cannot be quota’d but can be *measured*

4. ICR Research Data Storage Programme

Research Data Storage *Programme*:

- RDS Service at core of RDS Programme
- Projects to develop two new components; also Dropbox Business service



RDS **Programme** Vision

RDS Programme

- Support world-leading research for ICR and The RM

- Life cycle management for ICR research data *(nb ICR culture)*
  - Capture information at creation -> Long term storage

- Simple and efficient to use; no appreciable overhead to researchers
- Cost-effective
- Scalable
- Highly resilient

- In future: underpin ‘big data analytics’ capability
  - ICR Data Science department established

Questions for ICAT F2F Attendees:

Does your site:

1. Have a single central live data storage service (used by majority of researchers)?
2. Plan to have a single central live data storage service?

3. Currently have a central storage service > 20Petabyte?
4. Plan to have a central storage service > 20Petabyte within 2 years?

5. Have a single name space across central storage?
6. Plan to have a single name space across central storage?

7. Have a repository for long term storage/curation of research data?
8. Plan to have a repository for long term storage/curation of research data?

9. Do you deliver Research Data Management (RDM), making data held searchable?

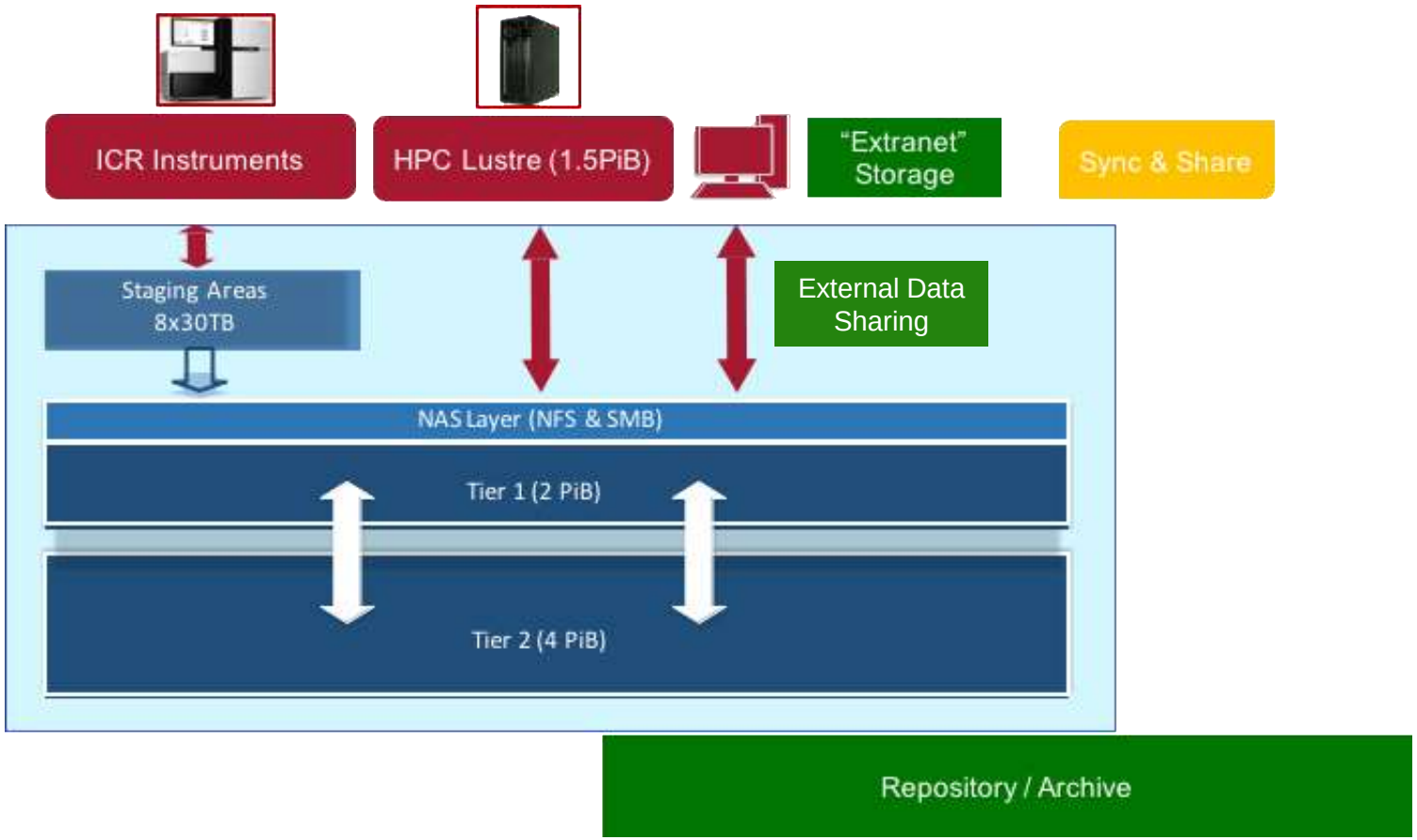
10. If you have deployed ICAT, how much resource required?

Scientific Computing Research Data *Strategy*

Research Data Strategy Outline:

- Address managing lifecycle of research data:
  - From: STiMS, Staging Areas, RDS Service, External Data Sharing, ICR Business Dropbox Service, Repository
- Lifecycle coordination:
  - Cover data movement as it passes across and between services provided by SC
- Address Information Governance across this data lifecycle
- Consider how plan might serve to underpin a broader set of activities with research data (machine learning, big data analytics…)

Example workflow:



Likely minimum Meta Data required for each dataset:

- Individual owner, team owner, when created (and by whom), instrumentation setup, how long needed
- Description (textual description)
- Data classification (public, local, restricted)
  - Patient data; anonymised, consented, ….
- State of data (live, no longer active, publishable, embargoed…)
- Provenance
  - Which services where held and when
  - Which applications used
- Hierarchy (parent, child)
- Workflow details eg:
  - When data arrives on staging area - do this
  - Processing pipeline information, applications version

What have we missed; given that very difficult to collect data?

Comment on ICAT

May have not been looking in right places, but seems like:

- Shortage of examples
- Shortage of information on which to decide whether ICAT is a viable solution for ICR
- Shortage of ICR time/resource to figure it all out from scratch; so looking for wisdom today!

Is ICAT the solution?

We think we have relatively simple requirements – to add metadata and generate workflows: ***is this naïve?***

Can we deliver a solution that is easy for scientists to use?

Adopt Core Scientific Metadata Model? – Does concept of 'studies' work for ICR?

Would ICAT be a good solution?

If so, how should we proceed - download and try?

Total effort required to deliver PoC?

Questions

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