caBIG dotNET and the xl-caBIG Smart Client

Browsing **caBIG** Data using Microsoft Excel

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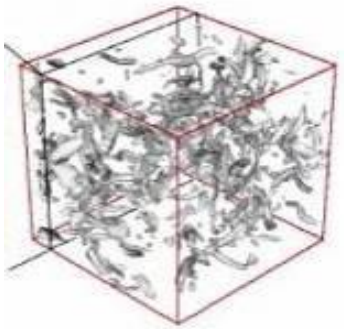
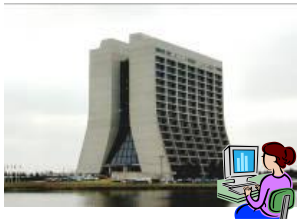
Science Paradigms by Jim Gray

- Thousand years ago:
  science was **empirical**
    describing natural phenomena
- Last few hundred years:
  theoretical branch
    using models, generalizations
- Last few decades:
  a **computational** branch
    simulating complex phenomena
- Today:
  data exploration (eScience)
  unify theory, experiment, and simulation
  using data management and statistics
  - Data captured by instruments
    Or generated by simulator
  - Processed by software
  - Scientist analyzes database / files

$$\left(\frac{\dot{a}}{a}\right)^2 = \frac{4\,G}{3} - \frac{c^2}{a^2}$$





World Wide Web and eScience

- eScience has been inspired and evolved from the World Wide Web
- e.g. ***caBIG*** (*cancer architecture Biomedical Informatics Grid*) is billed as the "*World Wide Web of Cancer Research*"
- A huge variety of data types in different presentation formats are on the World Wide Web, including:
  - PubMed
  - eBay
  - Nytimes
  - Amazon.com

  - Wikipedia
  - Maps/YellowPages
  - Banking

- All this data is accessible through a single container application: *the Web Browser* which is designed with a variety built-in/plug-in technologies (html, css, jpg/mpeg, JavaScript, Java, Flash, AJAX, XML, PDF, PPT etc.)

- For the computer novice, the Browser is the Internet!

eScience Browser

- Is there a common “eScience Browser” for this new “WWW”?
  - No; eScience projects are each developing their own set of specialized tools geared towards limited tasks
- Do we need a common eScience Browser ?
  - It would be beneficial. An eScience Browser would provide a standard interface that is easier for users to learn, and provide generic access to eScience data without additional work from eScience developers.
- The eScience Browser would complement the eScience specialized interfaces
- What would an eScience Browser be like ?

- What would an eScience Browser be like ?

  The common denominator for eScience results are tables. So a eScience Browser would, essentially, be a spreadsheet program with visualization and statistics tools.

Microsoft Excel is the future “web-browser” of eScience

… okay, that’s a nice idea. Can it be realized?

We developed a prototype, based on caBIG

for Cancer Research

- ***caBIG*** is a $60 Million (3yrs) project that will give scientists access to orders of magnitude more related data from researchers around the world.
- What tools do scientists need to browse, query, and analyze this data and make meaningful deductions?
  - Using **Microsoft Excel** and leveraging their familiarity with it's statistical analysis and visualization.
  - Using **Windows Mobile 5.0** to gain on-the-spot hypothesis testing; thus replacing the proverbial "restaurant napkin sketches"
- How could we develop such applications? Using the .NET Framework
  - Visual Studio Tools for Office
  - Compact Framework for Mobile Devices

caBIG dotNET bridges caGRID and .net Framework

- caGRID API is written in Java leveraging many Java projects: Globus Toolkit 3.2, OGSA-DAI 5.0, Tomcat, Ant
- caBIG dotNET is our project bridging the gap between caBIG and .NET
- It is a C# Client API based on the Hessian Binary Protocol that connects with a corresponding Java Servlet to provide exposition of the caBIG API
- BSD License; SourceForge Website and CVS Repository ***http://xl-cabig-client.sourceforge.net/***

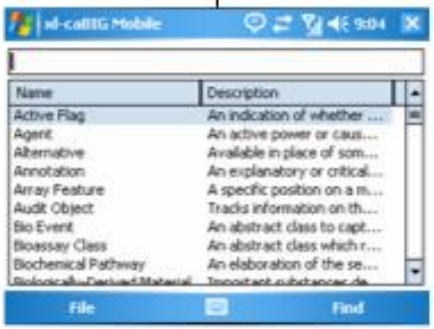
xl-caBIG Smart Client

dynamic linking

caBIG dotNET (C# Client API)

Microsoft Visual Studio 2005
- Tools for Office
- Compact Framework

dynamic linking



xl-caBIG Smart Client MOBILE

Hessian Protocol

Hessian C#

HTML View (JSP/Java)

caucho Hessian Protocol

caBIG dotNET (Java Servlet)

Servlet Container

Java

Java 1.4.2

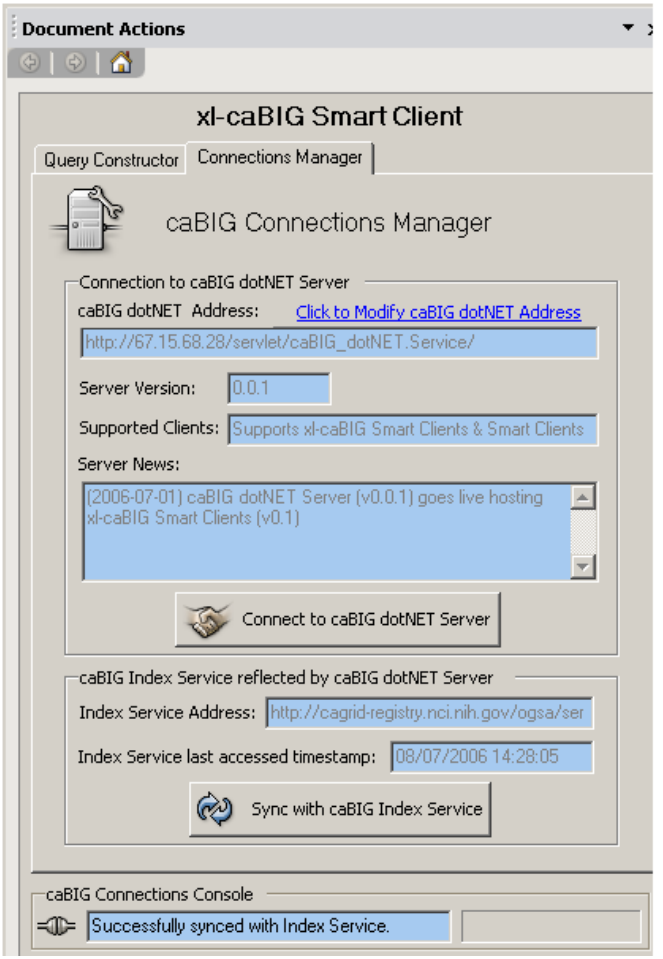
caBIG cancer Biomedical Informatics Grid

caucho Hessian Protocol

Console Manager (Java)

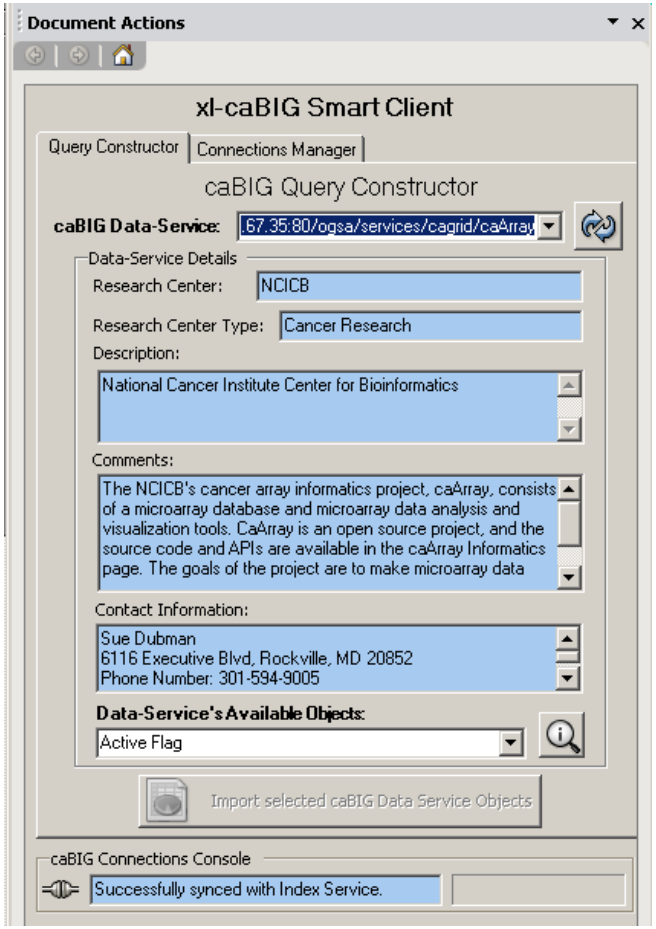
xl-caBIG Smart Client

- Live demo



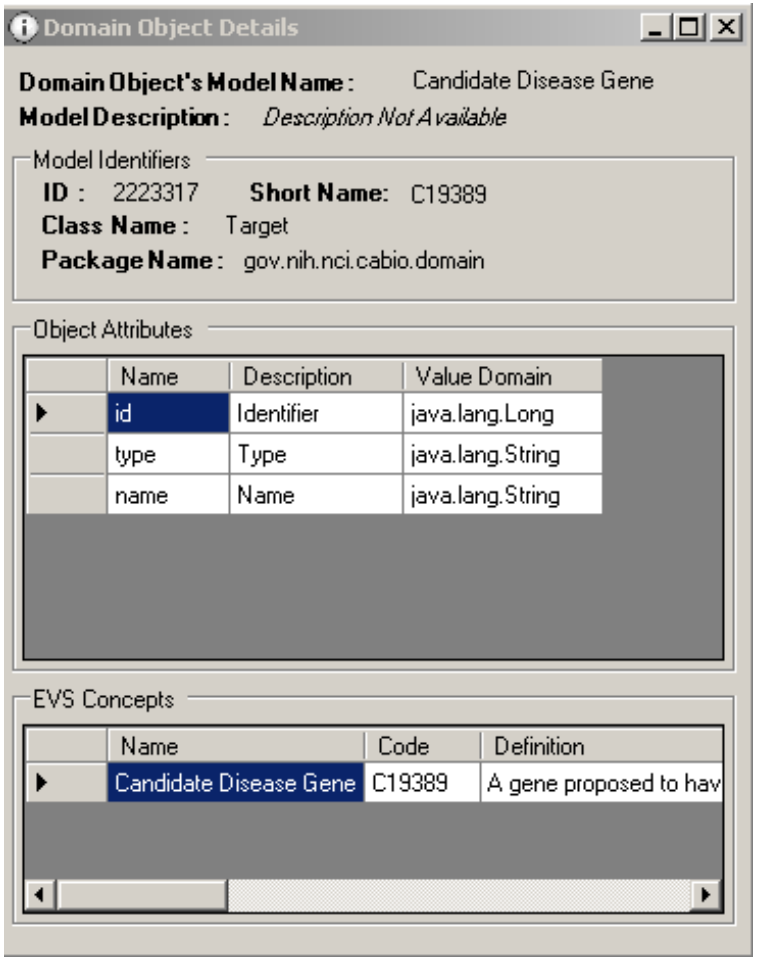
xl-caBIG Smart Client

- Live demo



xl-caBIG Smart Client

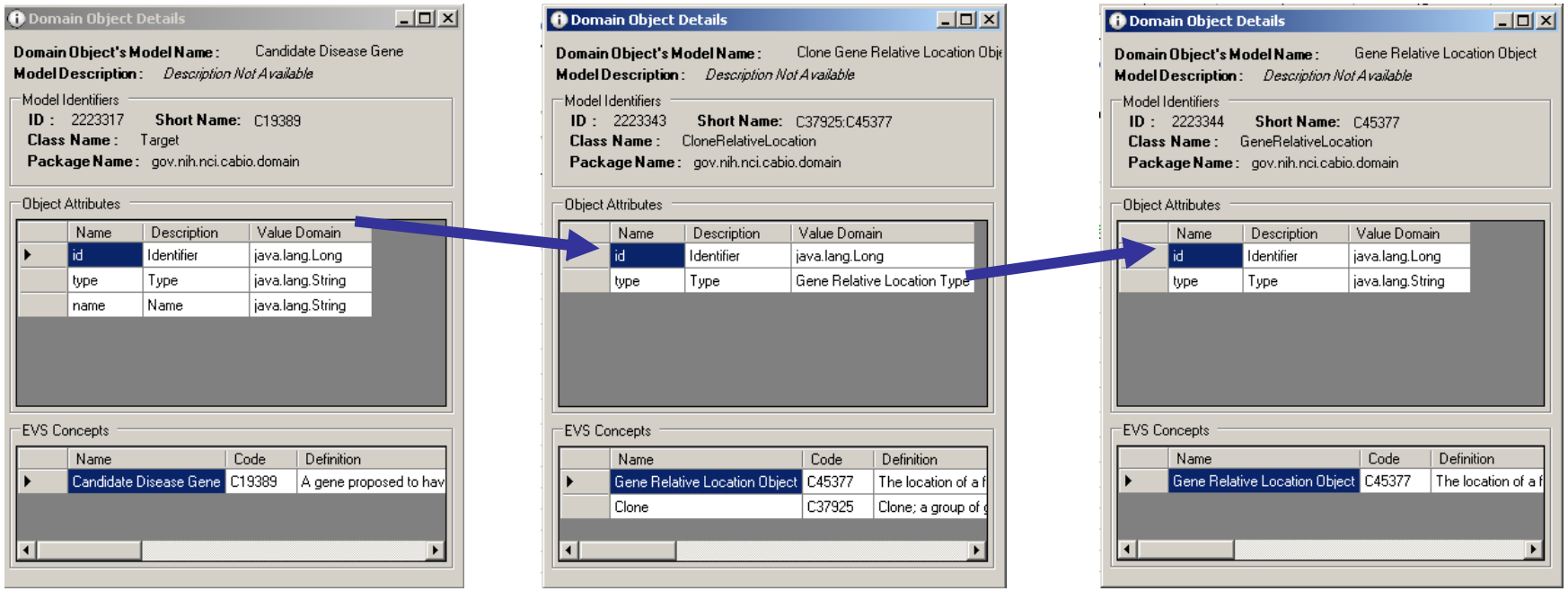
- Live demo



xl-caBIG Smart Client

Planned Features

– The Smart-Client's Document Actions Pane will allows users to graphically compose a query relating multiple Domain Objects.



xl-caBIG Smart Client

Planned Features

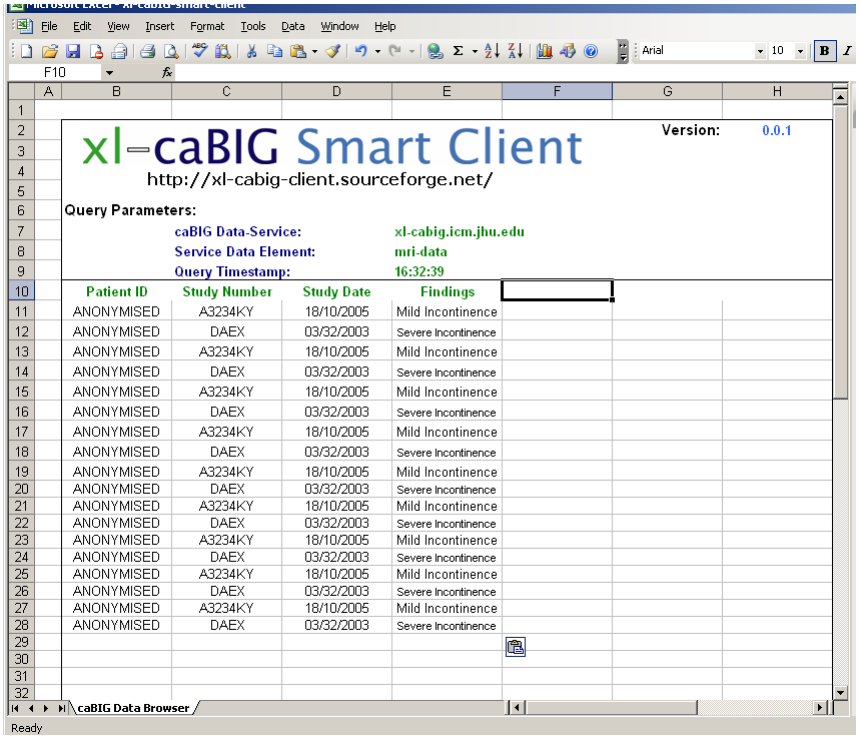
– This query will be transcribed into **caBIG** Common Query Language (XML) and executed against data-services via caBIG dotNET

```
<caGridXMLQuery name="caArrayQuery">
    <criteria name="gov.nih.nci.mageom.domain.Protocol.Protocol">
        <criterion name="identifier" condition="EQUAL_TO value="P-MEXP-1963"/>
    </criteria>
</caGridXMLQuery>
```

xl-caBIG Smart Client

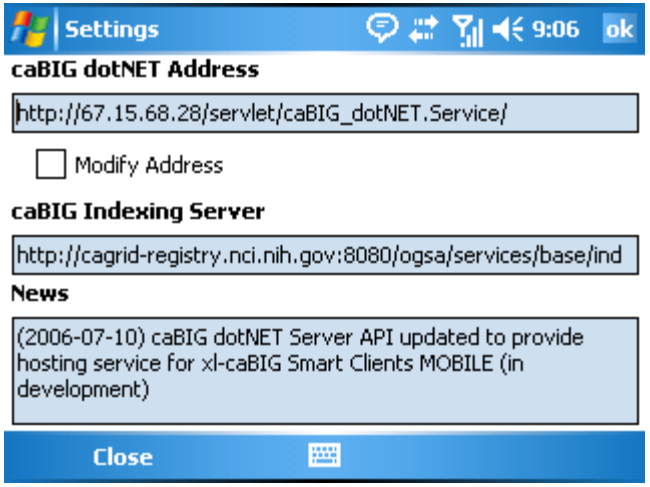
Planned Features

– Results of the query (XML) will be interpreted by the Smart Client to populate cells in the Excel Workbook.



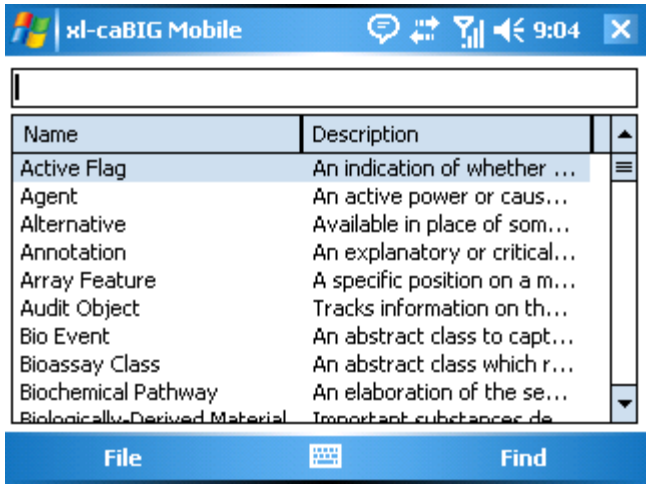
xl-caBIG Smart Client MOBILE

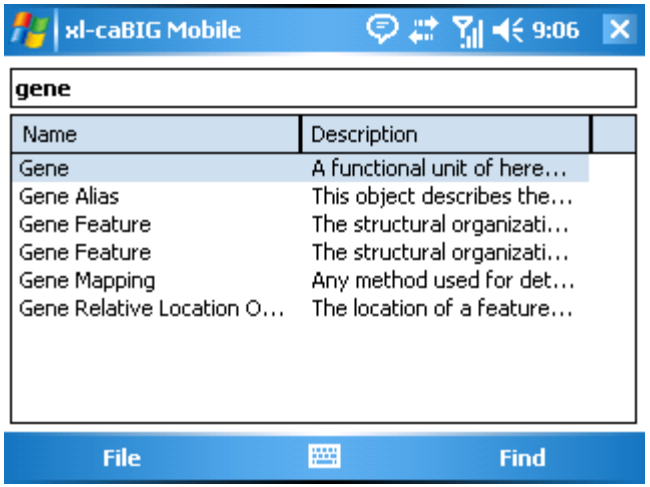
- xl-caBIG MOBILE uses the Smart Phone's GPRS to connect with the caBIG dotNET service



xl-caBIG Smart Client MOBILE

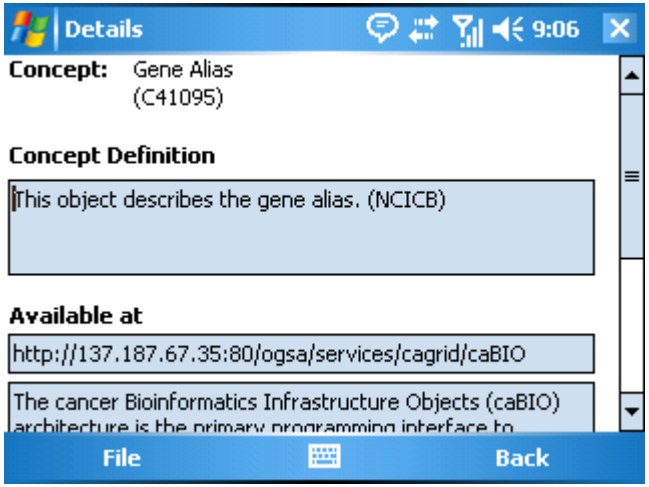
- Scientists use their **Windows 5.0** Mobile Device to browse and search for cancer concepts of interest

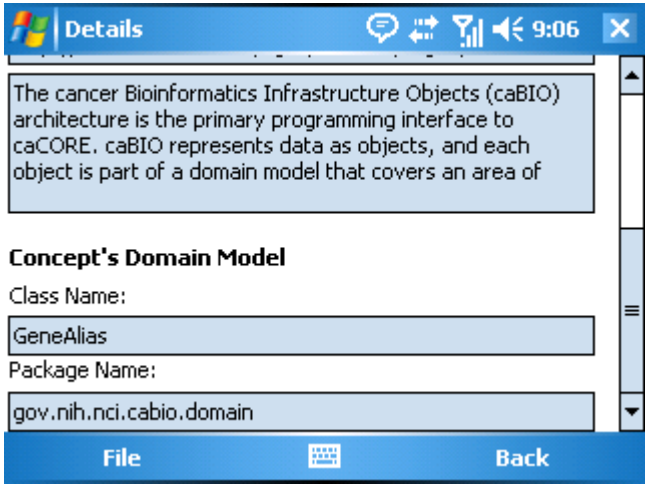




xl-caBIG Smart Client MOBILE

- Once users have found a cancer concept they're interested in, xl-caBIG MOBILE gives further information about the concept and where on ***caBIG*** this concept type is available





xl-caBIG Smart Client MOBILE

- xl-caBIG MOBILE running on Cingular 8125 Smart Phone

Microsoft eScience Workshop
2006

xl-caBIG Smart Client MOBILE

- xl-caBIG MOBILE is easy to use and very portable

In conclusion what have we accomplished ?

- It all began with a, crazy, contrarian idea …
  - Microsoft Excel should be the eScience Browser
- We developed a prototype as a reference implementation to demonstrate feasibility

xl-caBIG Smart Client

- Are capturing mind-share that our idea is the future!

the crazy idea …

xl-caBIG vs 20+ other caBIG Tools

20+ caBIG Tools

- Free
- Open Sourced (Java)
- Developed by Academia (via ≈20% going to Booz Allen Hamilton)
- Funded by Government
- Domain specific, approach specific – (typically has Cancer/Bio in their names, descriptions)

Microsoft Excel

- $499
- Closed Source (C#/C)
- Developed by Software Engineers
- Funded by for-profit Corporation, paid by customers
- Horizontal App, used by millions in dozens of fields.

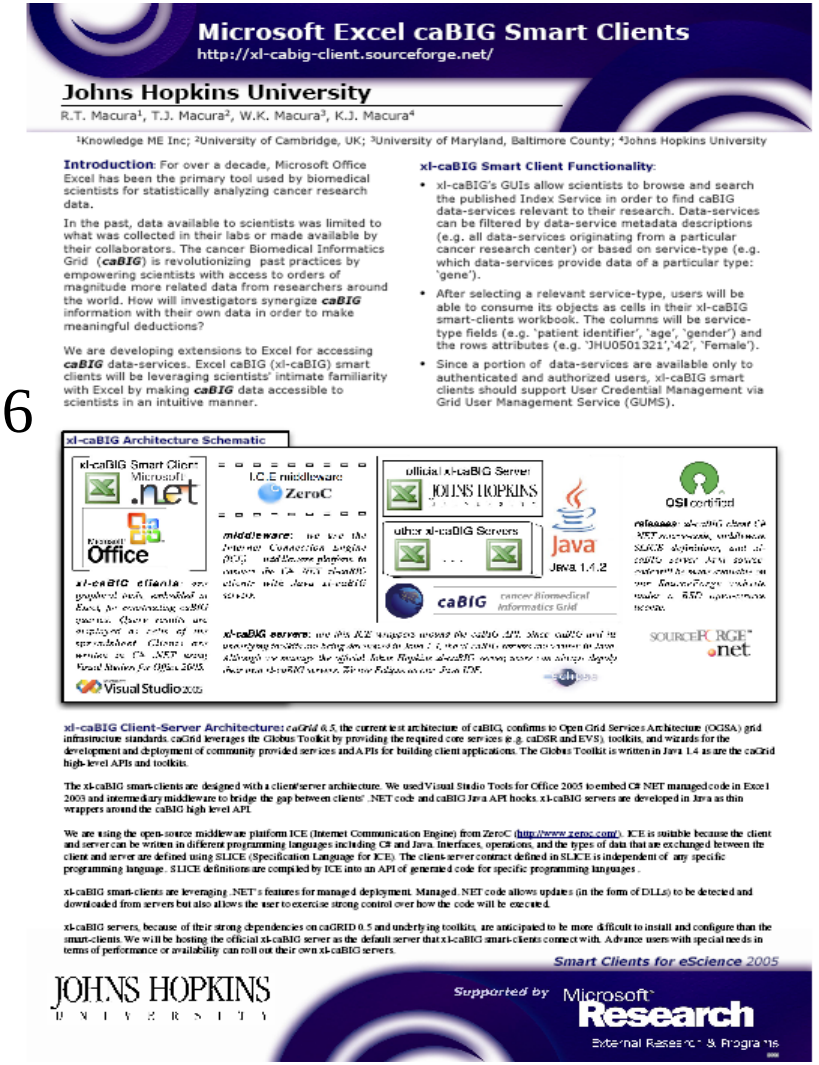
Results of our Prototype

- Limited to the constraints of a beta version of caGRID, we weren't able to achieve our complete vision. Still,

- caBIG dotNET serves as an example of how to bridge the gap between a **JAVA**, Open-Sourced, Government project with a **.NET**, Closed-Source, For-Profit Product
- xl-caBIG Smart Client shows how the resulting application is easy-to-install, responsive, has a simple interface, and is useful to a wide-range of domains and approaches.

Capturing Mind Space

- We've presented at Conferences:
  - Microsoft Faculty Summit 2006 (*Presentation*)
  - caBIG Annual Meeting 2006 (*Poster*)
  - Microsoft eScience Workshop 2006 (*Presentation*)



Microsoft Excel caBIG Smart Clients
http://xl-cabig-client.sourceforge.net/

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[1]Knowledge ME Inc; [2]University of Cambridge, UK; [3]University of Maryland, Baltimore County; [4]Johns Hopkins University

Introduction: For over a decade, Microsoft Office Excel has been the primary tool used by biomedical scientists for statistically analyzing cancer research data.

In the past, data available to scientists was limited to what was collected in their labs or made available by their collaborators. The cancer Biomedical Informatics Grid (***caBIG***) is revolutionizing past practices by empowering scientists with access to orders of magnitude more related data from researchers around the world. How will investigators synergize ***caBIG*** information with their own data in order to make meaningful deductions?

We are developing extensions to Excel for accessing ***caBIG*** data-services. Excel caBIG (xl-caBIG) smart clients will be leveraging scientists' intimate familiarity with Excel by making ***caBIG*** data accessible to scientists in an intuitive manner.

xl-caBIG Smart Client Functionality:

- xl-caBIG's GUIs allow scientists to browse and search the published Index Service in order to find caBIG data-services relevant to their research. Data-services can be filtered by data-service metadata descriptions (e.g. all data-services originating from a particular cancer research center) or based on service-type (e.g. which data-services provide data of a particular type: 'gene').
- After selecting a relevant service-type, users will be able to consume its objects as cells in their xl-caBIG smart-clients workbook. The columns will be service-type fields (e.g. 'patient identifier', 'age', 'gender') and the rows attributes (e.g. 'JHU0501321','42', 'Female').
- Since a portion of data-services are available only to authenticated and authorized users, xl-caBIG smart clients should support User Credential Management via Grid User Management Service (GUMS).

xl-caBIG Architecture Schematic

xl-caBIG Client-Server Architecture: *caGrid 0.5*, the current test architecture of caBIG, conforms to Open Grid Services Architecture (OGSA) grid infrastructure standards. caGrid leverages the Globus Toolkit by providing the required core services (e.g. caDSR and EVS), toolkits, and wizards for the development and deployment of community provided services and APIs for building client applications. The Globus Toolkit is written in Java 1.4 as are the caGrid high-level APIs and toolkits.

The xl-caBIG smart-clients are designed with a client/server architecture. We used Visual Studio Tools for Office 2005 to embed C# .NET managed code in Excel 2003 and intermediary middleware to bridge the gap between clients' .NET code and caBIG Java API hooks. xl-caBIG servers are developed in Java as thin wrappers around the caBIG high level API.

We are using the open-source middleware platform ICE (Internet Communication Engine) from ZeroC (http://www.zeroc.com/). ICE is suitable because the client and server can be written in different programming languages including C# and Java. Interfaces, operations, and the types of data that are exchanged between the client and server are defined using SLICE (Specification Language for ICE). The client-server contract defined in SLICE is independent of any specific programming language. SLICE definitions are compiled by ICE into an API of generated code for specific programming languages.

xl-caBIG smart-clients are leveraging .NET's features for managed deployment. Managed .NET code allows updates (in the form of DLLs) to be detected and downloaded from servers but also allows the user to exercise strong control over how the code will be executed.

xl-caBIG servers, because of their strong dependencies on caGRID 0.5 and underlying toolkits, are anticipated to be more difficult to install and configure than the smart-clients. We will be hosting the official xl-caBIG server as the default server that xl-caBIG smart-clients connect with. Advance users with special needs in terms of performance or availability can roll out their own xl-caBIG servers.

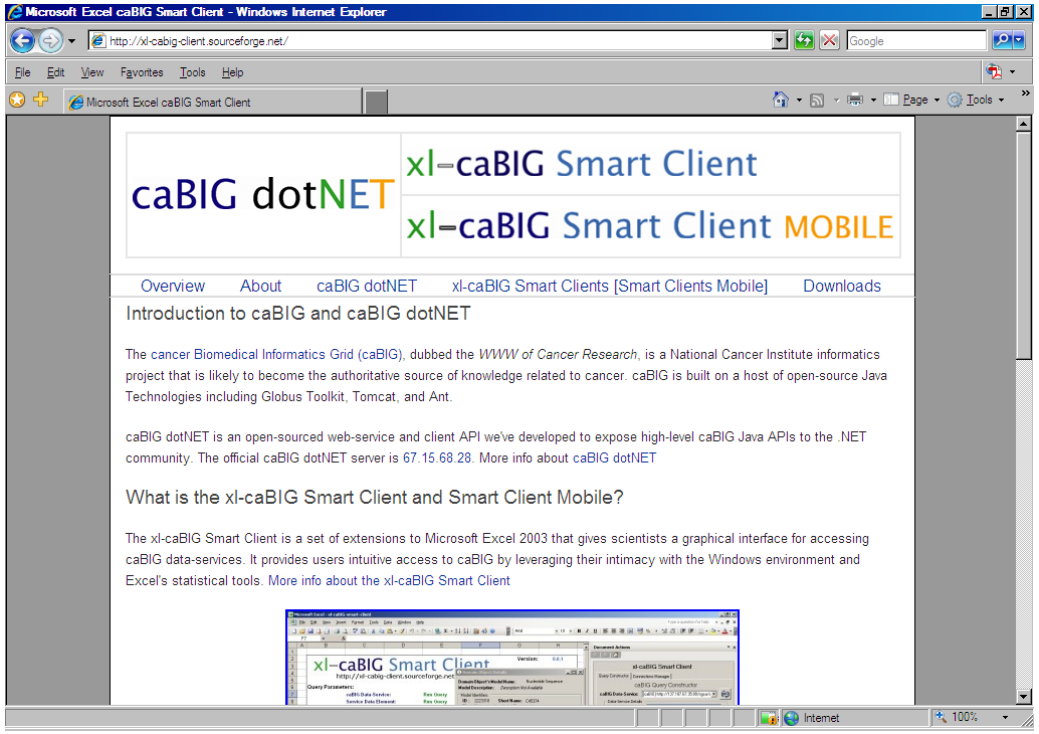
Smart Clients for eScience 2005

JOHNS HOPKINS UNIVERSITY

Supported by Microsoft Research External Research & Programs

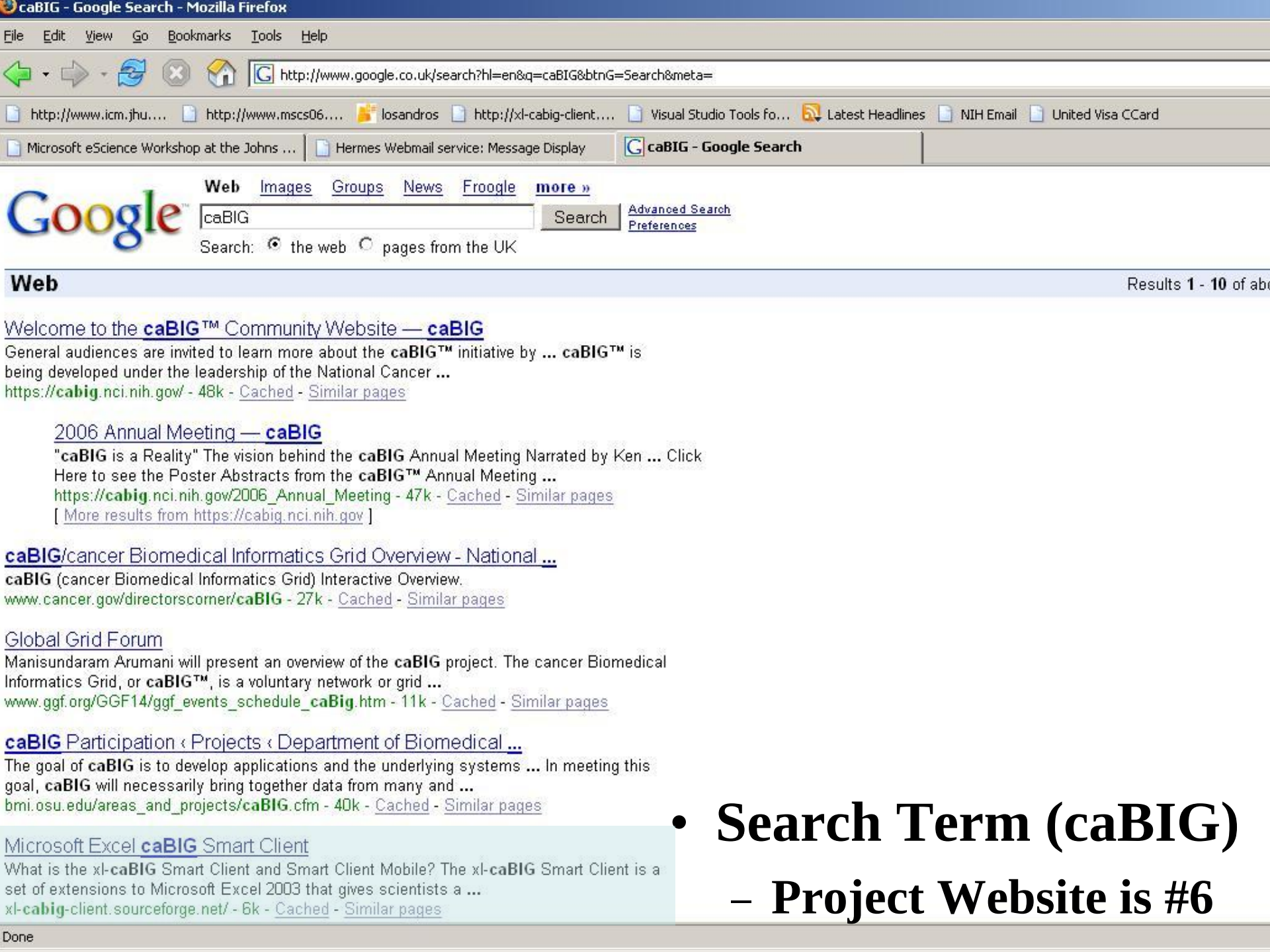
Capturing Mind Space (cont'd)

- We've got a website and host official caBIG dotNET server: ***http://xl-cabig-client.sourceforge.net/***
  - HTML pages describing the project
  - PDF copies of all our presentations/proposals
  - CVS repository/FTP server distributing the Smart Clients

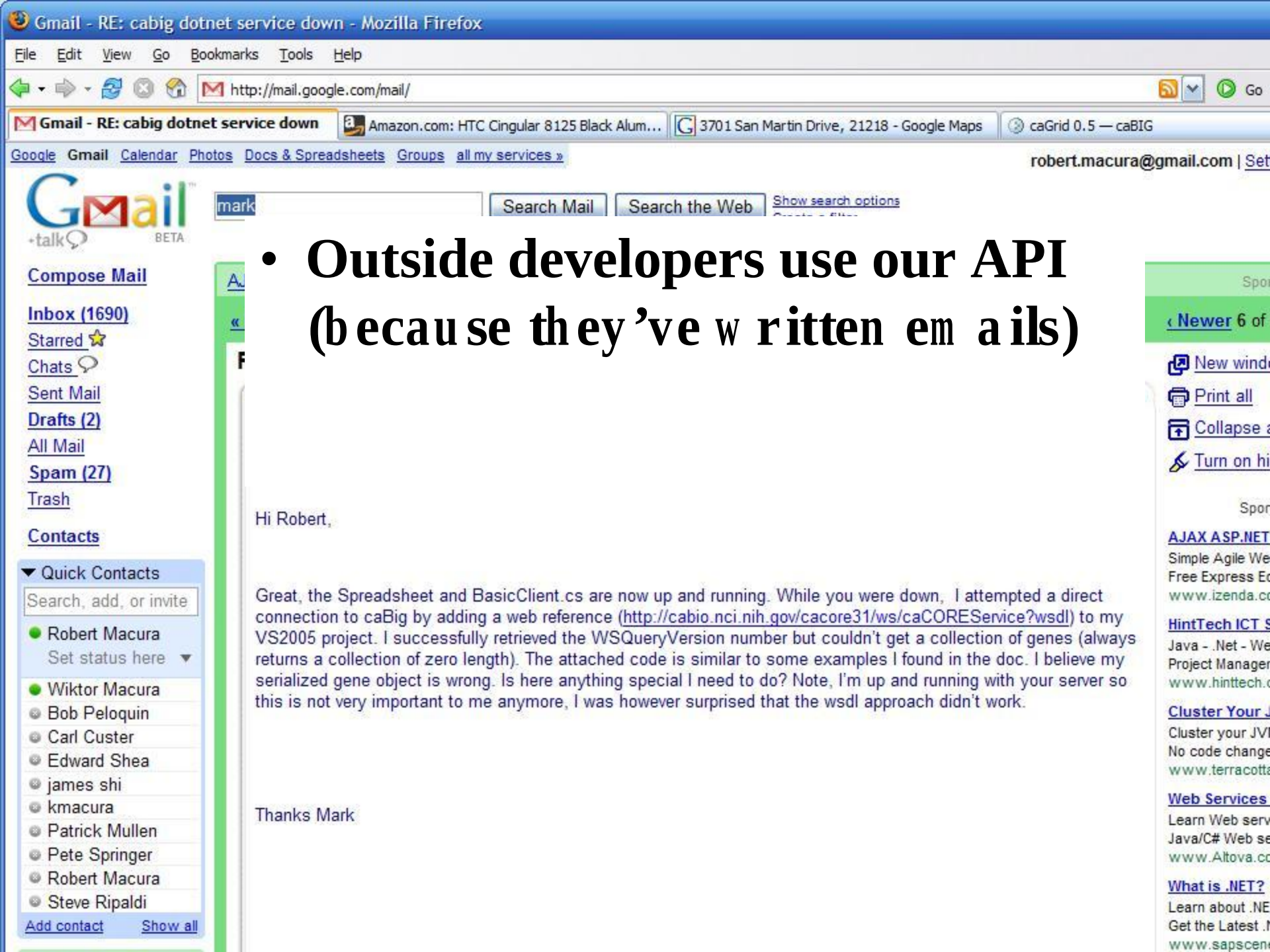


Capturing Mind Space (cont'd)

- Our Website is Influential (according to Microsoft Live and Google)
  - Search Term (xl-caBIG/caBIG dotNET)
    - #1
  - Search Term (Excel caBIG)
    - #1
  - Search Term (Microsoft caBIG)
    - #1
  - Search Term (caBIG client)
    - #1
  - Search Term (caBIG)



- **Search Term (caBIG)**
  - **Project Website is #6**



- **Outside developers use our API (because they've written emails)**

The Future

- First of all, thank you to Microsoft Research, Dan Fay, and Simon Mercer who made this all possible by giving us the initial funding.
- Our immediate goal is to publish a paper, describing the xl-caBIG Project and motivating our view-point that Microsoft Excel is the eScience Browser
- Funding dependent, we want to continue developing our prototype, integrating with caGRID 1.0 and Office 2007 technologies.

xl-caBIG Project Team

CO-PIs ***Katarzyna Macura MD PhD*** and
Robert Macura MD PhD

Lead Programmer: ***Tom Macura BS BS***
(caBIG dotNET, Smart Client)

Programmer: ***Wiktor Macura***
(Smart Client MOBILE)

Sponsored by: ***Microsoft Research Smart Clients for eScience 2005***

Project website: ***http://xl-cabig-client.sourceforge.net/***

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