

Reflections on *Digital Britain*

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Outline

1. The Future
2. Lessons from the Web: Federation, Reach, and Evolution
3. An Evolutionary Revolution: Totally Transparent Processing
4. Fostering the Future
5. Exciting Challenges

The Future

- If we could but predict the future, our present deliberation (e.g., Digital Britain) would be easy.
- On the one hand:
Prediction is very difficult, especially about the future, Niels Bohr (1885 - 1962)
- On the Other hand:
The future is here. It's just not widely distributed yet, William Gibson (1948 -)
Never let the future disturb you. You will meet it, if you have to, with the same weapons of reason which today arm you against the present, Marcus Aurelius (121 – 180), Meditations
- Perhaps, we can be confident of the (integrated) implications of rapid evolutionary change we are seeing.

The Web Story: Federation, Reach, & Evolution

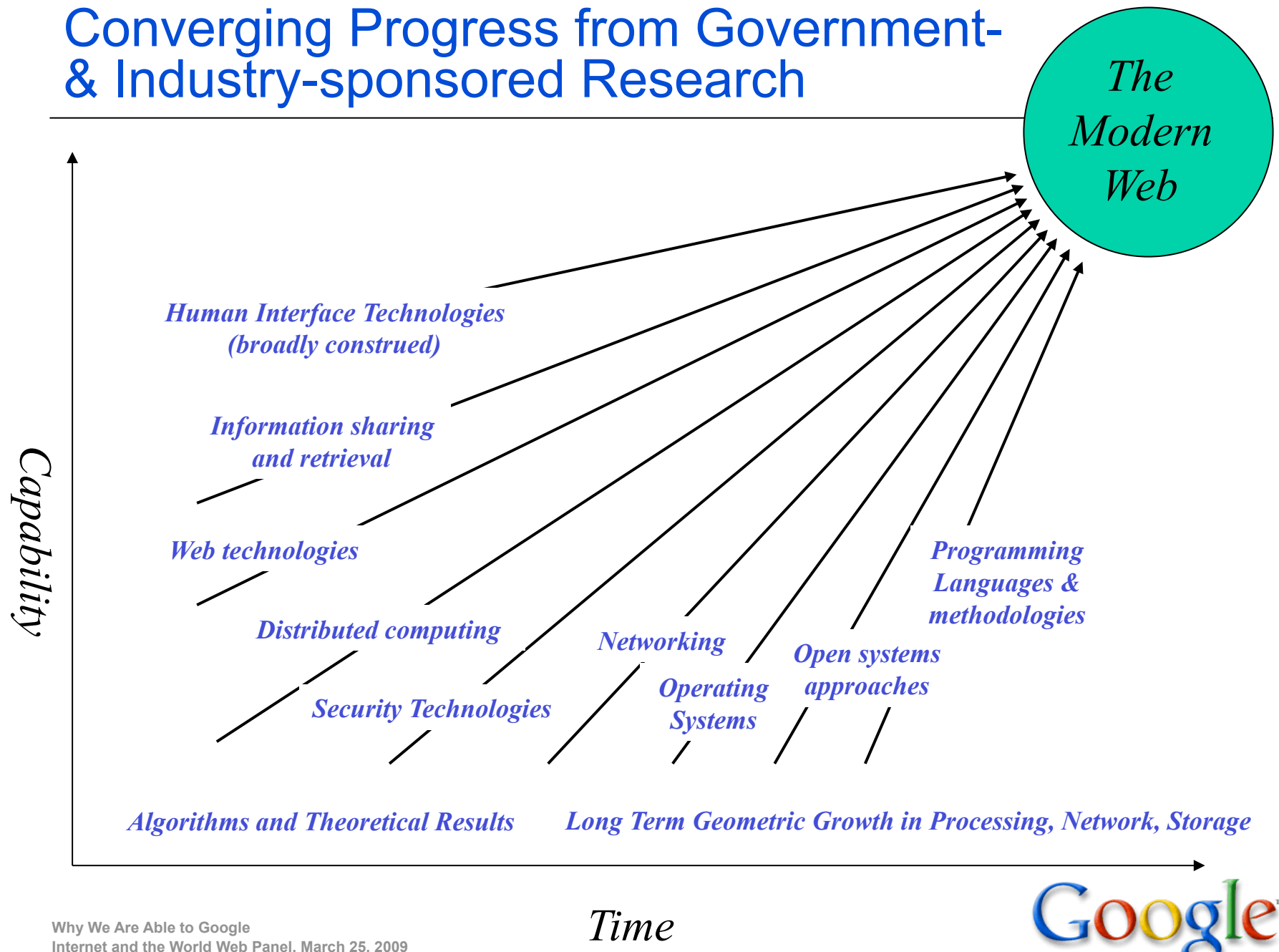
- The simplicity of the early web standards were genius
 - Federated name space
 - Access (HTTP)
 - Simple data format (HTML)
 - Extensibility!
- Not over-architected in any dimension
- Brilliant omissions (or at least, mostly so 😊)
 - Security
 - Read-write data
 - Semantics

A Semi-Random Walk to Extraordinary Achievements

- The virtuous circle
 - Initial simplicity begat data and usage
 - Usage generated more data and transactions
 - Data modalities diversified
 - User experience blossomed
- Architectural limitations were addressed as needed
- *A bottom-up architectural evolution repeatedly favoring local optimization has resulted in truly momentous results.*
 - The virtual Library of Alexandria
 - The search engine
 - The serving of the long tail
 - Vast changes in business models
 - Technologies: Cloud, Browser, & “universal” networking



Converging Progress from Government- & Industry-sponsored Research



The Evolutionary Revolution

- Application mix will continue to grow in unpredictable ways:
 - Areas with substantive impact, and flux, today:
 - *Publishing*
 - *Education*
 - *Healthcare*
 - *Government*
 - *Military*
 - *Science, itself, and more*
- Systems will evolve: ubiquitous high performance networking, distributed computing, new end-user devices, ...
- Large impact abrewing:

Totally Transparent Processing



Totally Transparent Processing

$$\forall d \in D, \forall l \in L, \forall m \in M, \forall c \in C$$

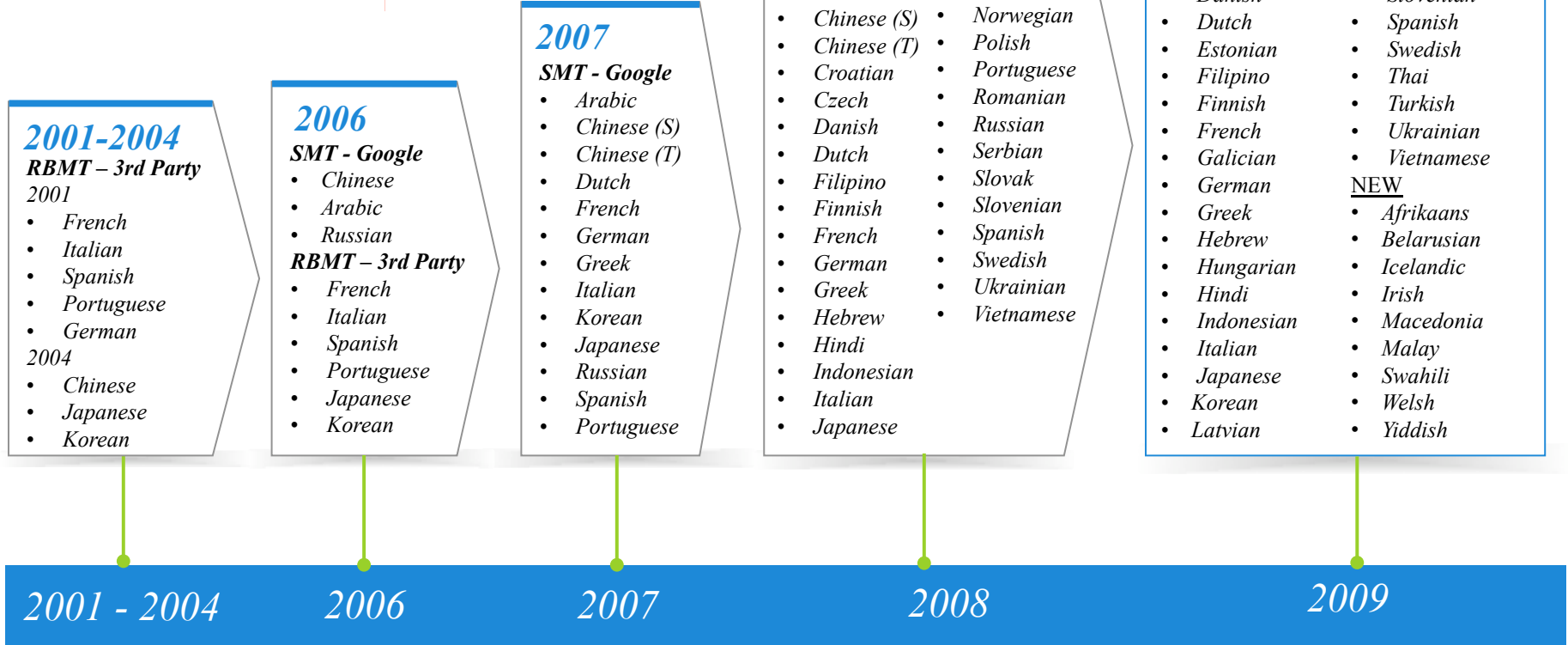
D: The set of all end-user access devices	L: The set of all human languages	M: The set of all modalities	C: The set of all corpora
Personal Computers	Current languages	Text	The normal web
Phone	Historical languages	Image	The deep web
Media Players/Readers	Other forms of human notation	Audio	Periodicals
Telematics	Possible language specialization	Video	Books
Set-top Boxes	Formal languages	Graphics	Catalogs
Appliances	...	Maps	Blogs
Health devices		3-D Models,	<u>Universal</u> Geodata
...		Other sensor-based data	Scientific datasets
		...	Health data
			...



Just one example: Google Translate

RBMT – Rules-based machine translation

SMT – Statistical (data-driven) machine translation



YouTube Caption Translation

YouTube Broadcast Yourself™
Worldwide | English

Home Videos Channels Community

2/28/09: Your Weekly Address



في القضاء على برامج اننا لسنا في حاجة ل

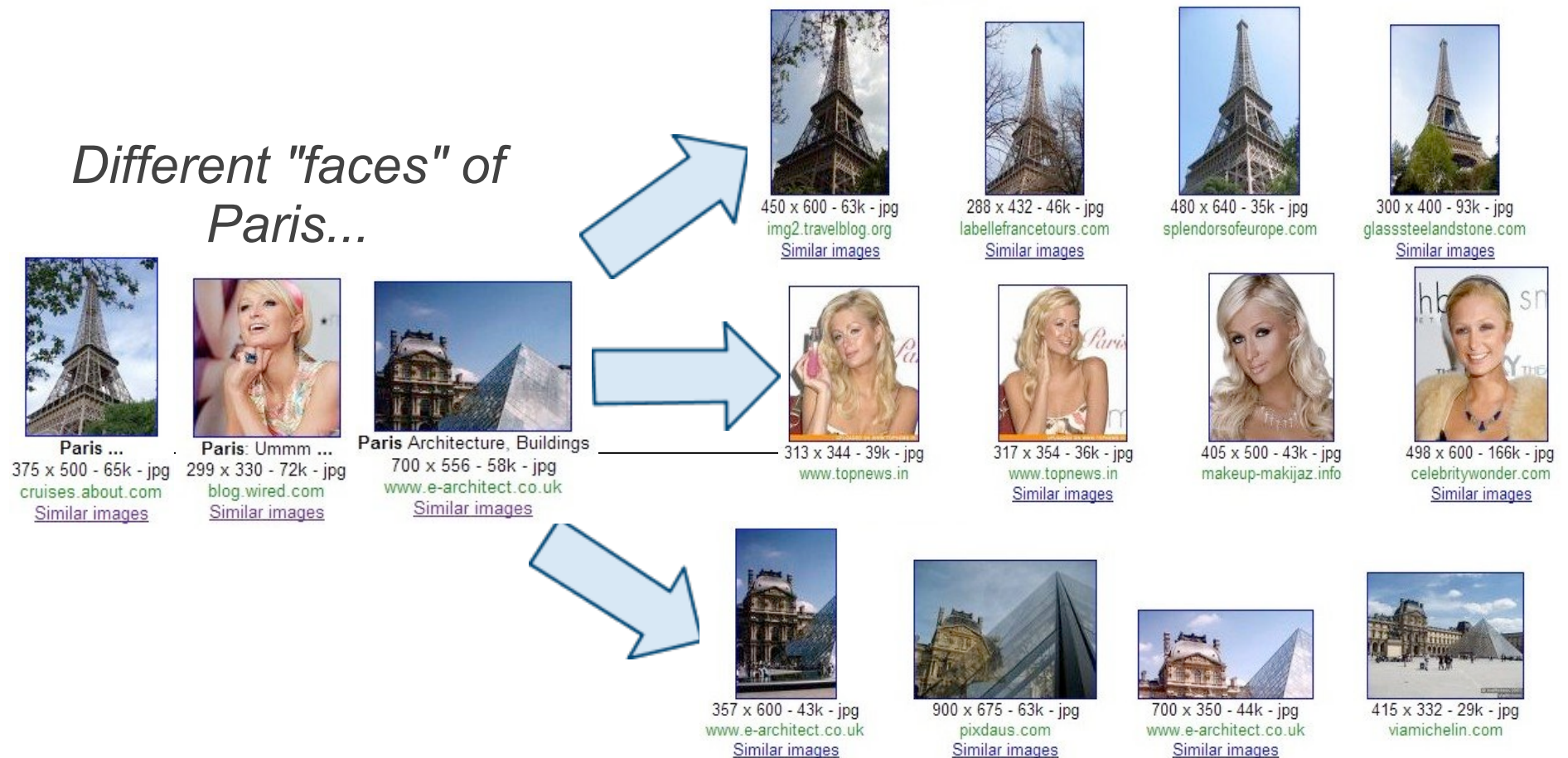
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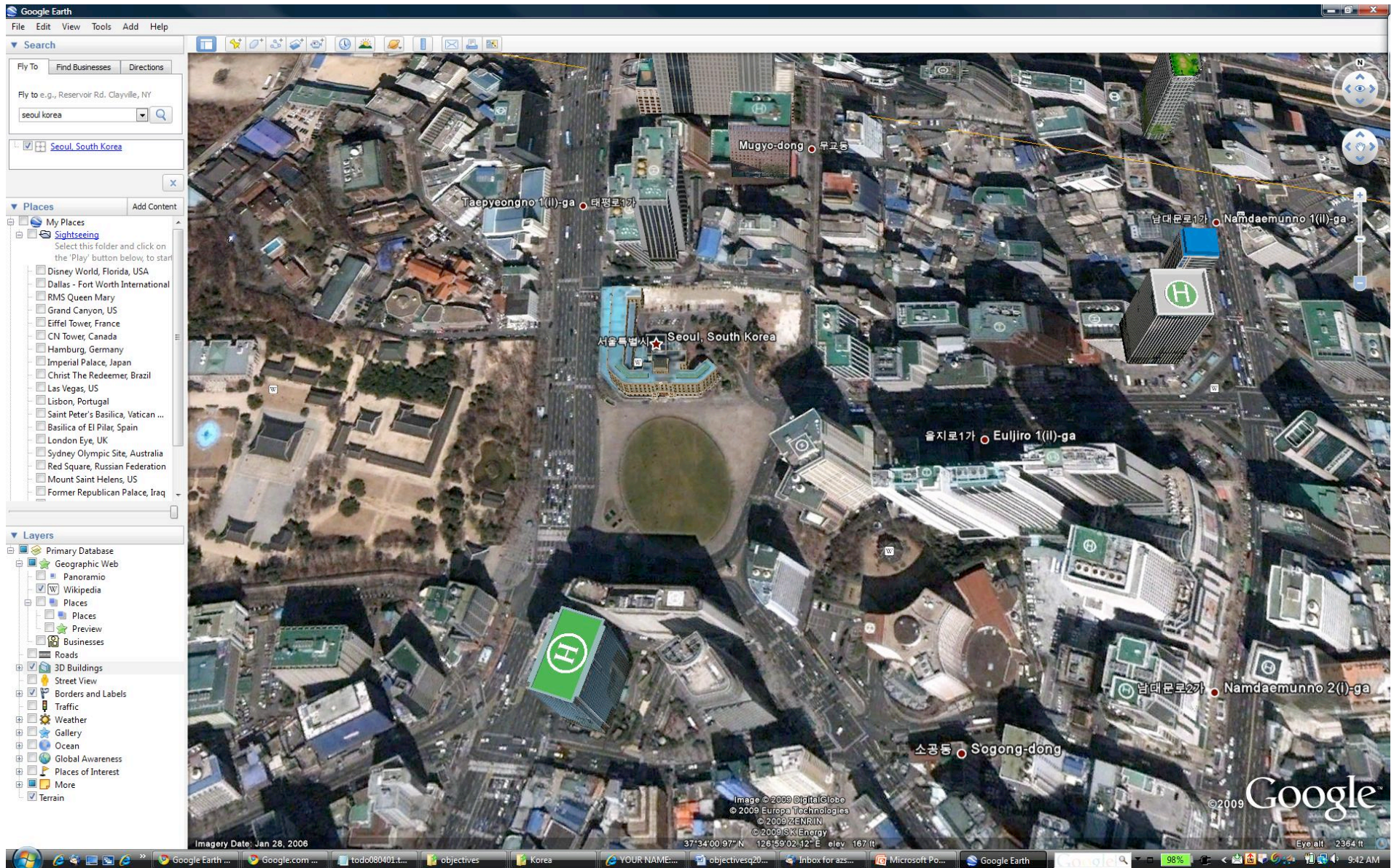


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Maps/Earth as a Modality



Fostering the Future

- While the big picture may have elements of clarity,
The *exact* pseudo-random walk forward is most unclear
 - Choice of top-down winning strategies is most difficult
 - At Google, we foster this bottom-up evolution
- Enabling innovation is key:
 - Minimal barriers to network service creation and use
 - Ubiquitous high performance communication
 - Opportunity for fast experimentation with technologies and business models – recognizing many will fail

Challenges and opportunities

- New Interfaces and applications with mass customization
- Virtually unlimited data storage and processing
- User Interface Technologies, with potentially radical changes afoot
- Ever improving system “understanding”
- Increasingly fluid partnership between people and computation
- Fundamental changes in the methods of science
- Opportunities for optimization in many more domains
- Challenges to ensure computer security

But, there are clearly no real limits – the laws of physics do not apply.

We need do only fairly simple things to foster these innovations.

Thank you!

