



Dirk Helbing (ETH Zurich)
dhelbing@ethz.ch

Gefahren von Big Data und Lösungsansätze

Follow **FuturICT** on

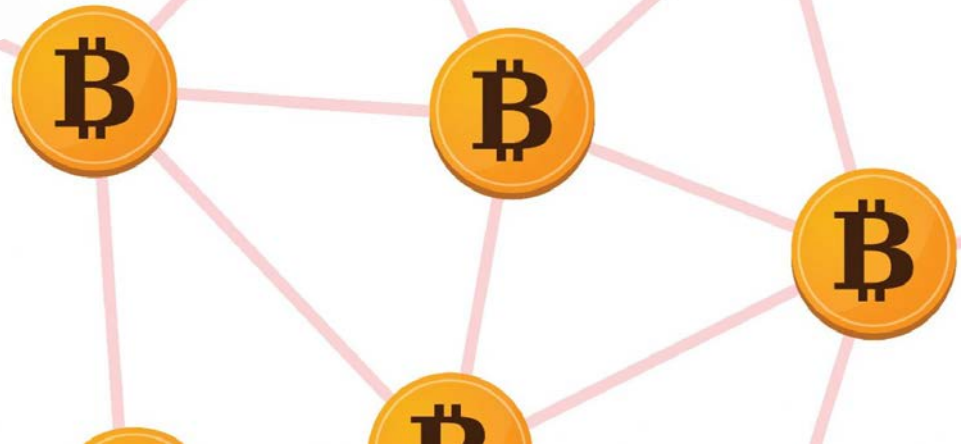
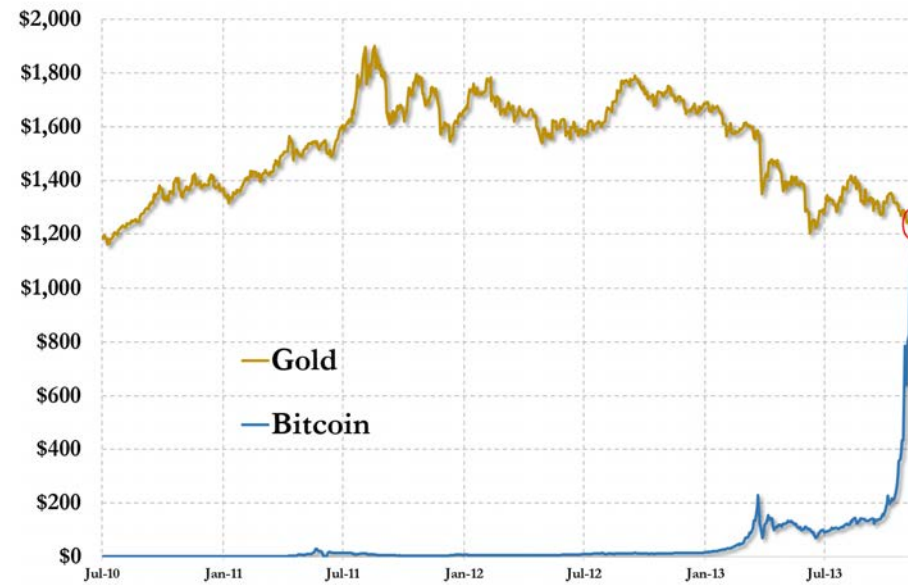


Irritating signs of a new era:
the Information Age

Peer to Peer Money Is on Its Way



Gold vs Bitcoin



From Taxi Stands to Uber



HERO

OR

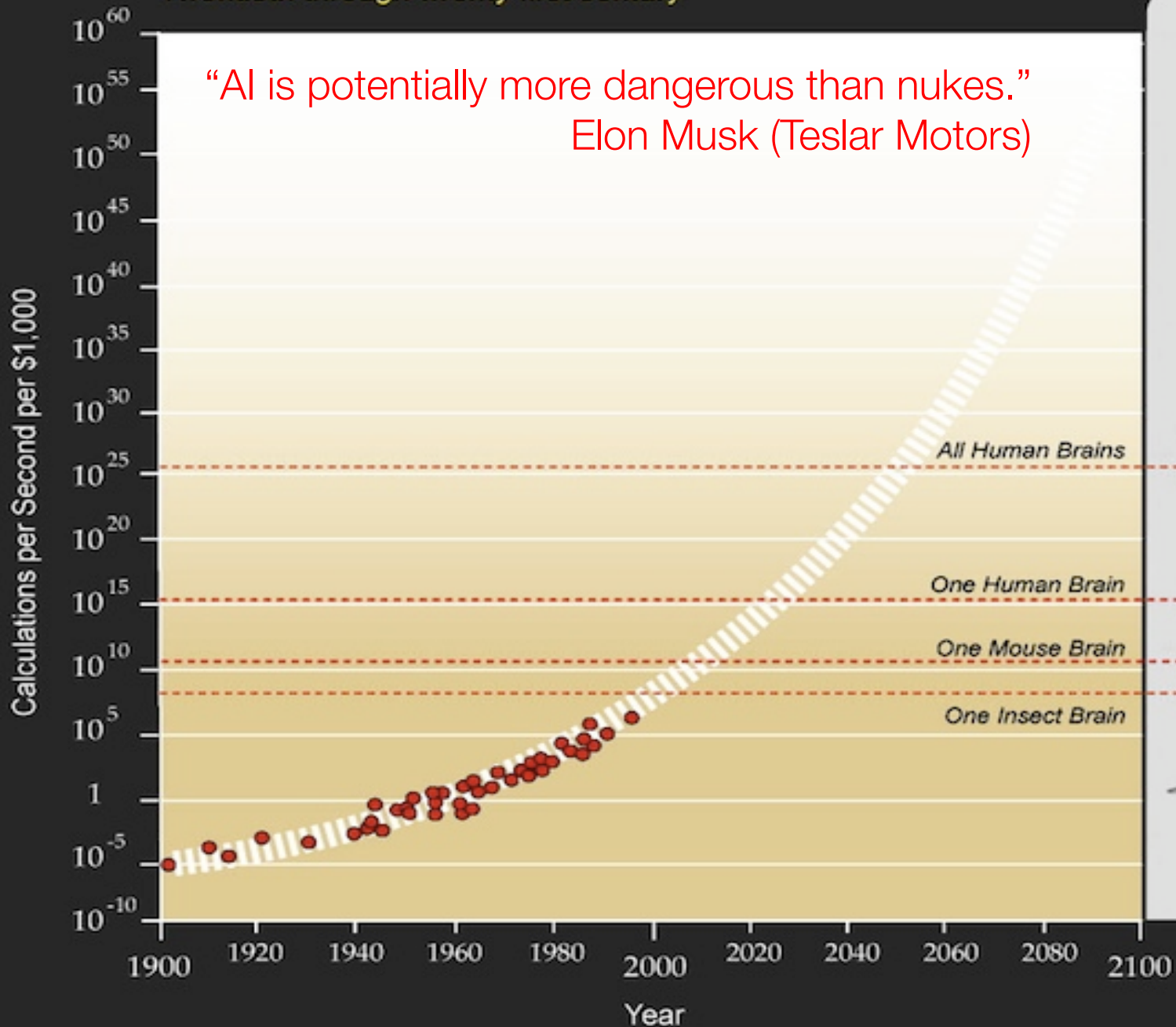
TRAITOR?



We are in the middle of a
digital revolution

Exponential Growth of Computing

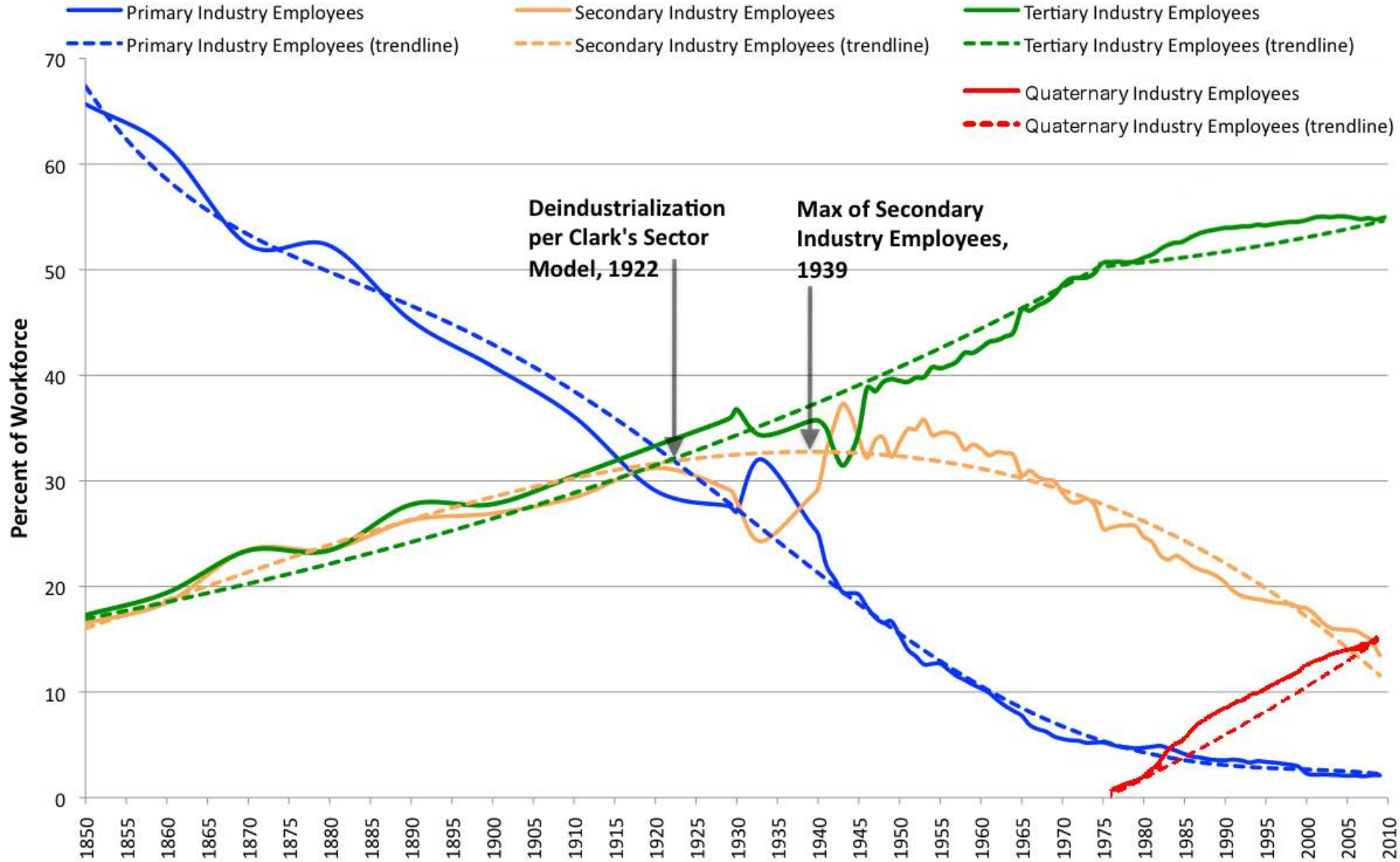
Twentieth through twenty first century



Logarithmic Plot



Clark's Sector Model, US





1
NEW
DEFINITION
IS ADDED ON
URBAN

1,600+
READS ON
Scribd.

13,000+ HOURS
MUSIC
STREAMING ON
PANDORA

12,000+
NEW ADS
POSTED ON
craigslist

370,000+ MINUTES
VOICE CALLS ON

98,000+
TWEETS

320+
NEW
twitter
ACCOUNTS

100+
NEW
Linked in
ACCOUNTS

1 associated content

NEW
ARTICLE IS
PUBLISHED

6,600+
NEW
PICTURES ARE
UPLOADED ON
flickr™

50+ WORDPRESS DOWNLOADS

695,000+
facebook.
STATUS
UPDATES

125+
PLUGIN
DOWNLOADS

510,040
COMMENTS

694,445
**SEARCH
QUERIES**

168 MILLION
EMAILS
ARE SENT

60+
NEW
BLOGS

1,500+
**BLOG
POSTS**

**70+
DOMAINS
REGISTERED**

600+
NEW
VIDEOS

100+ 40+

YAHOO! ANSWERS

13,000+
iPhone
APPLICATIONS
DOWNLOADED

20,000+
NEW
POSTS ON
tumblr.

QUESTIONS ASKED ON THE INTERNET...

**25+ HOURS
TOTAL
DURATION**

IN
60
SECONDS...

“Data is the new oil” – Clive Humby

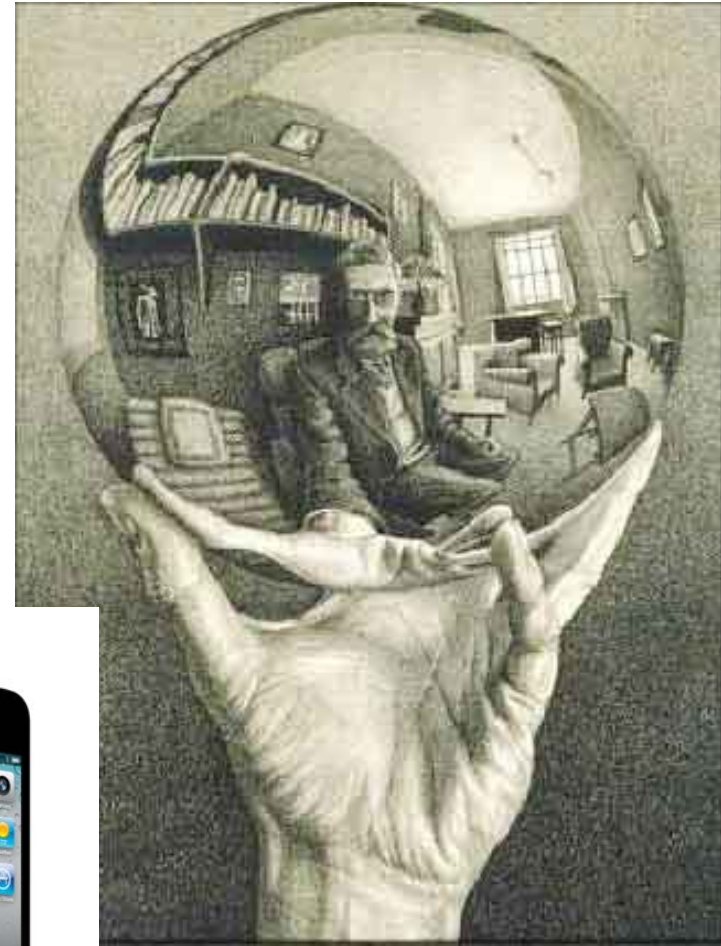




Crafting Instruments to Explore the World



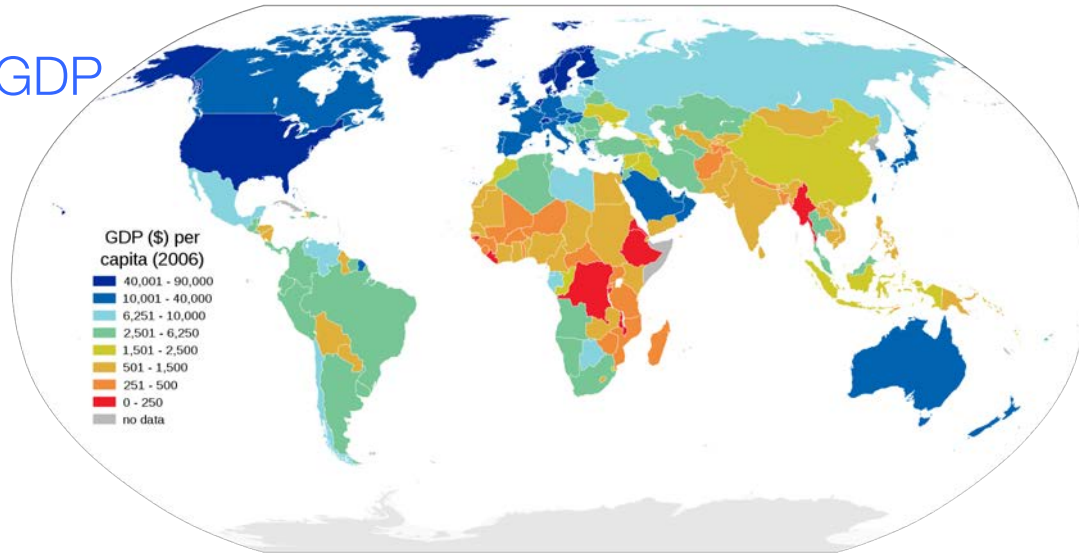
© Lawrence Manning/Corbis



Hand with Reflecting Sphere by Maurits Cornelis Escher (1935)

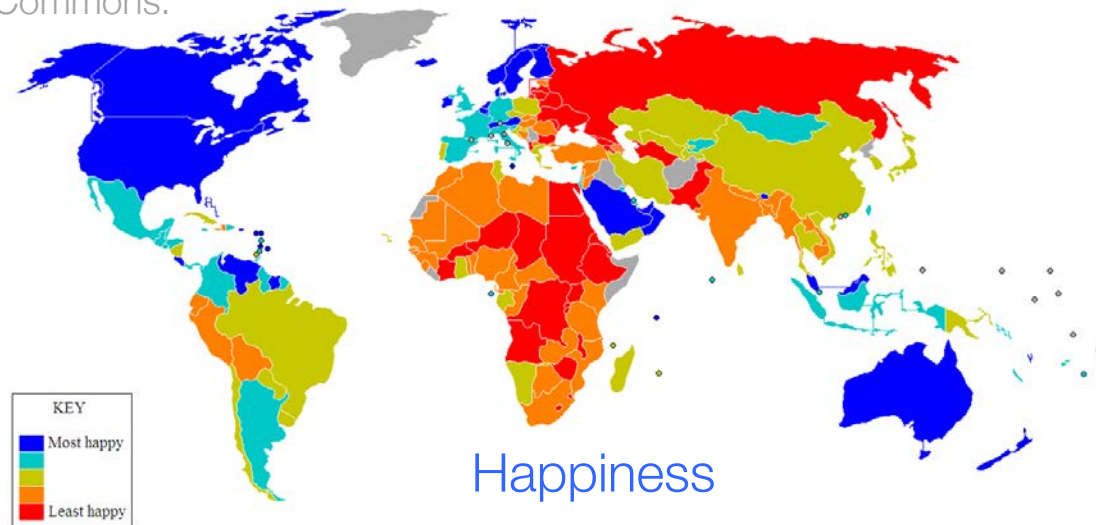
New Compasses for Decision Makers

GDP



Gross Domestic Product per capita in 2006, world map.
Bamse, CC-BY-SA 3.0. Wikimedia Commons.

Measure **social capital**:
Reputation, trust,
solidarity, compliance, ...



Happiness

Satisfaction with Life Index Map - Map was published in White, A. (2007). A Global Projection of Subjective Well-being: A Challenge To Positive Psychology? Psychtalk 56, 17-20.

Mapping Change and Who Causes It

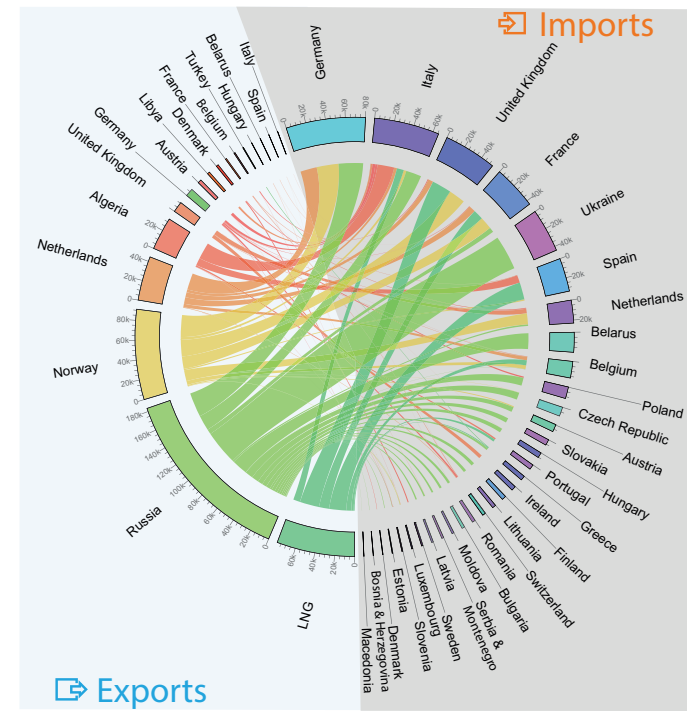
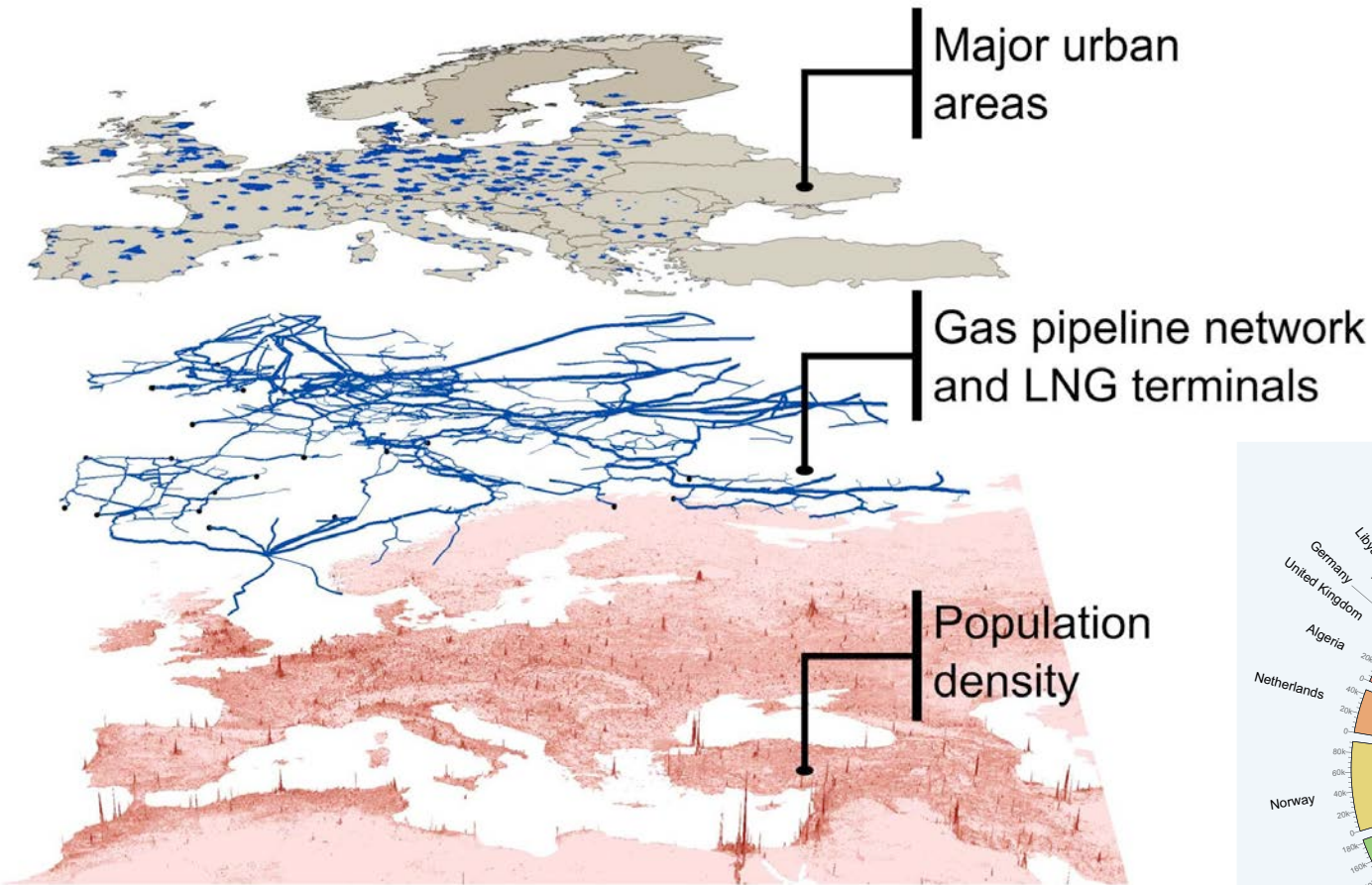


Mapping Resources and Who Uses Them

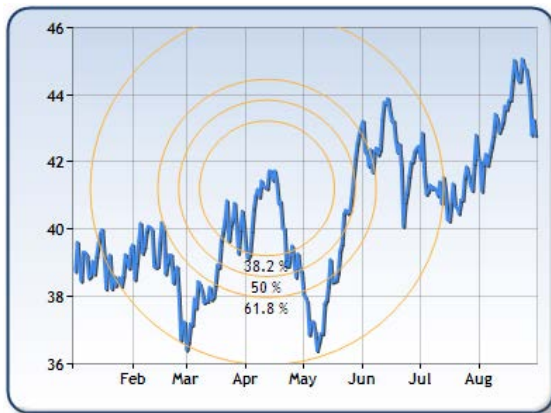


Could help to avoid shortages and recessions

Vulnerability of European Gas Supply



Real-Time Financial Risk Map

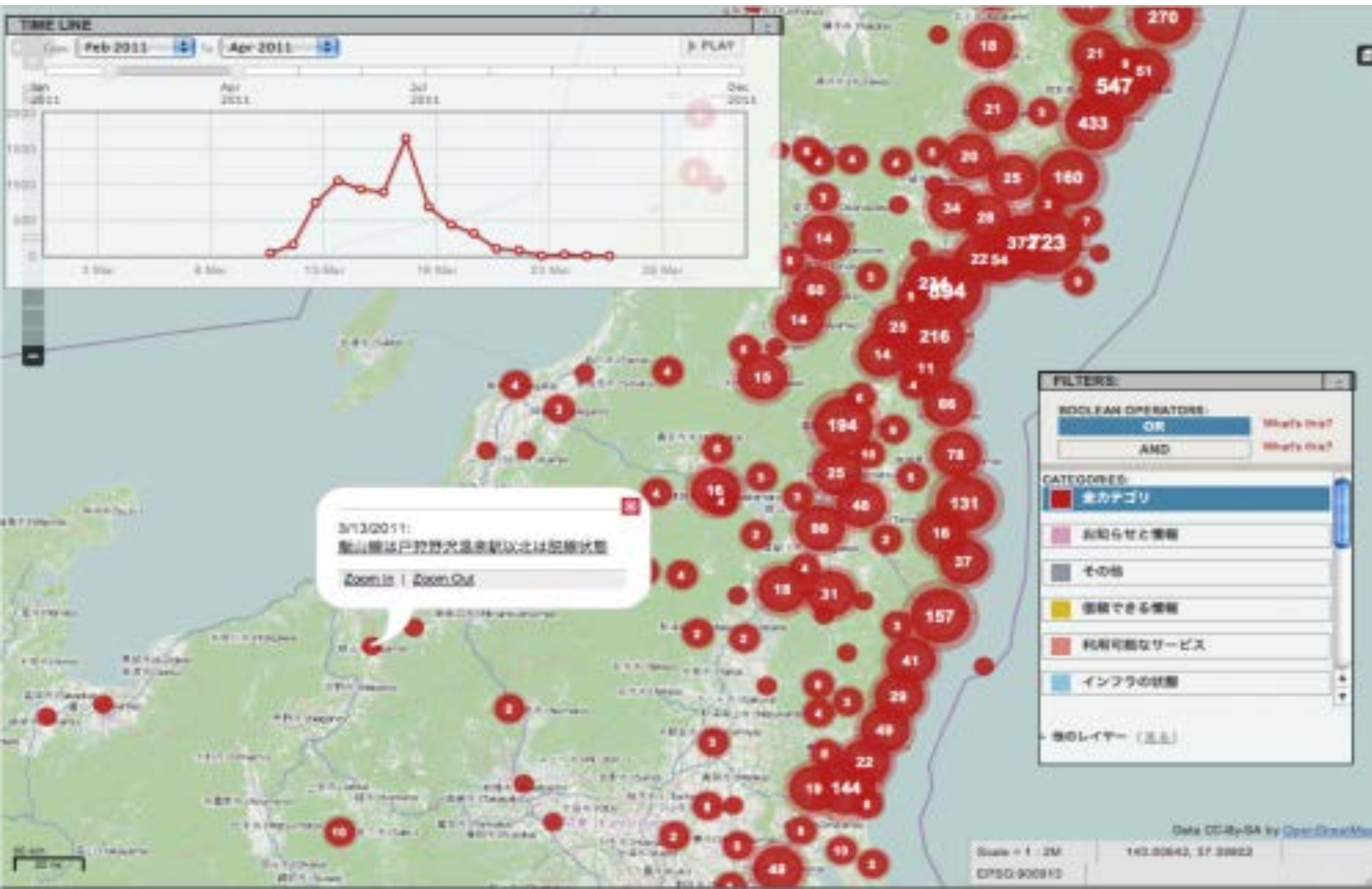


Cascading Effects During Financial Crises

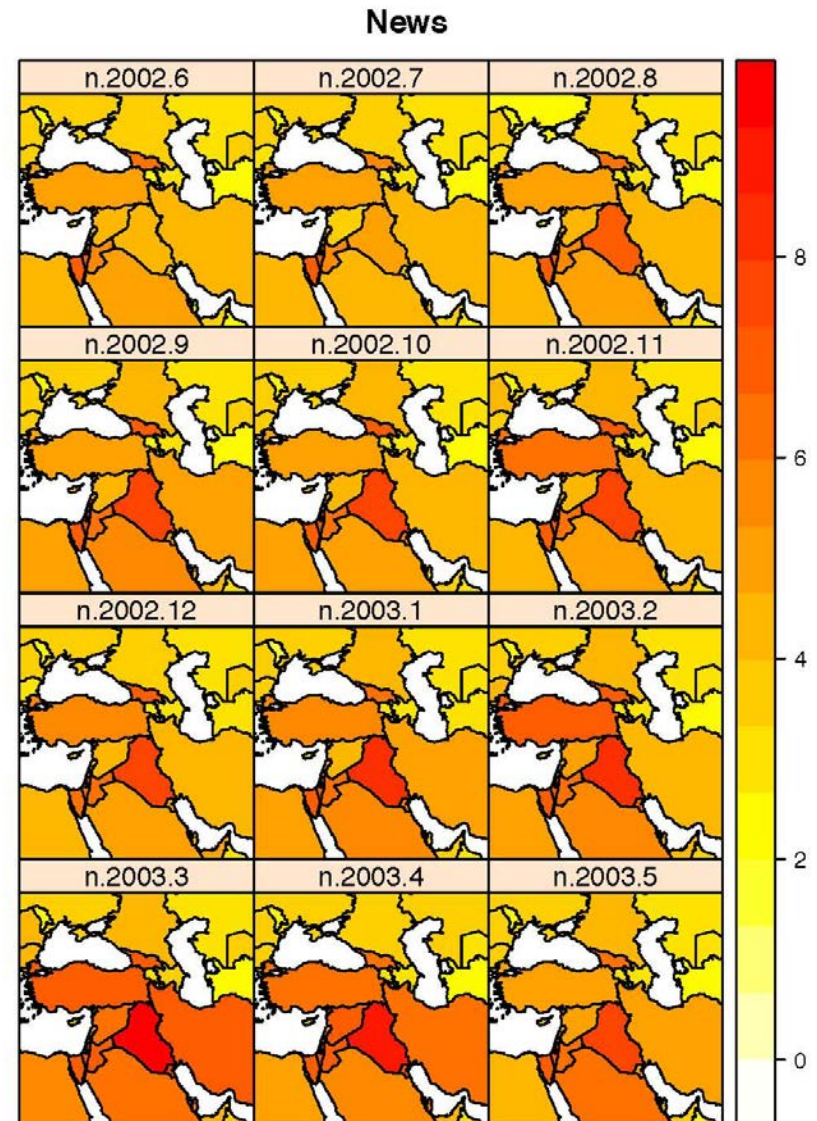
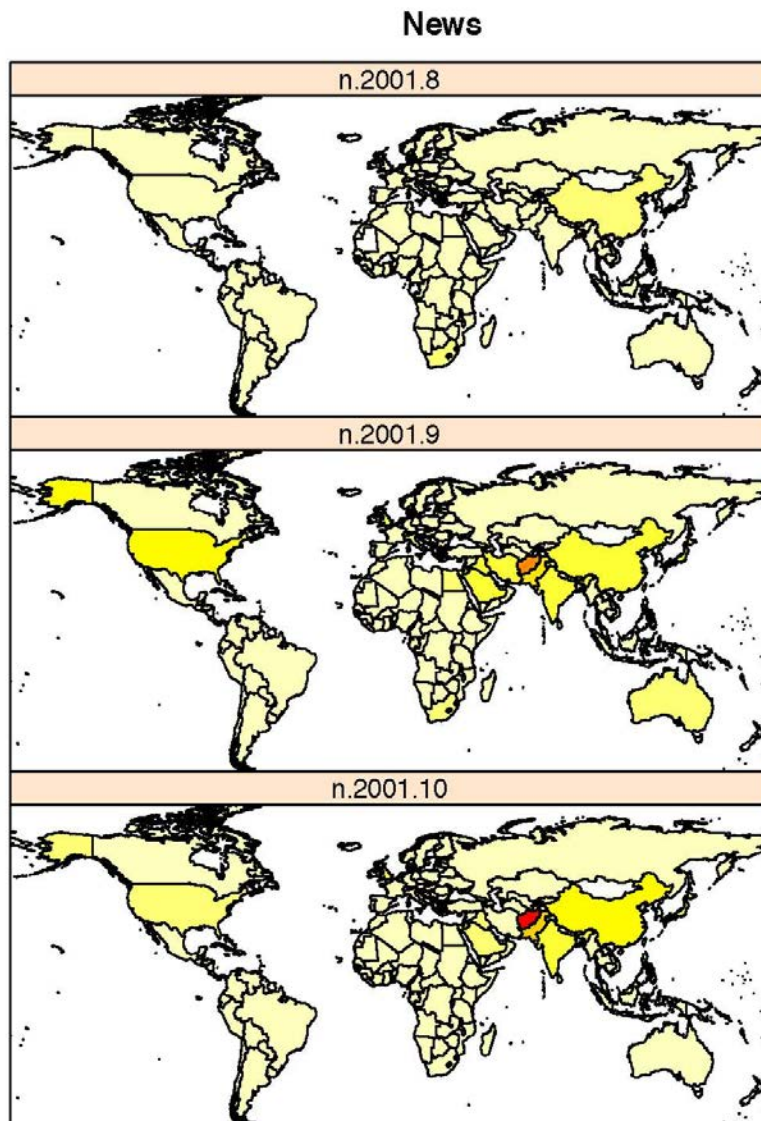


Video by Frank Schweitzer et al.

Risk Maps and Crisis Maps

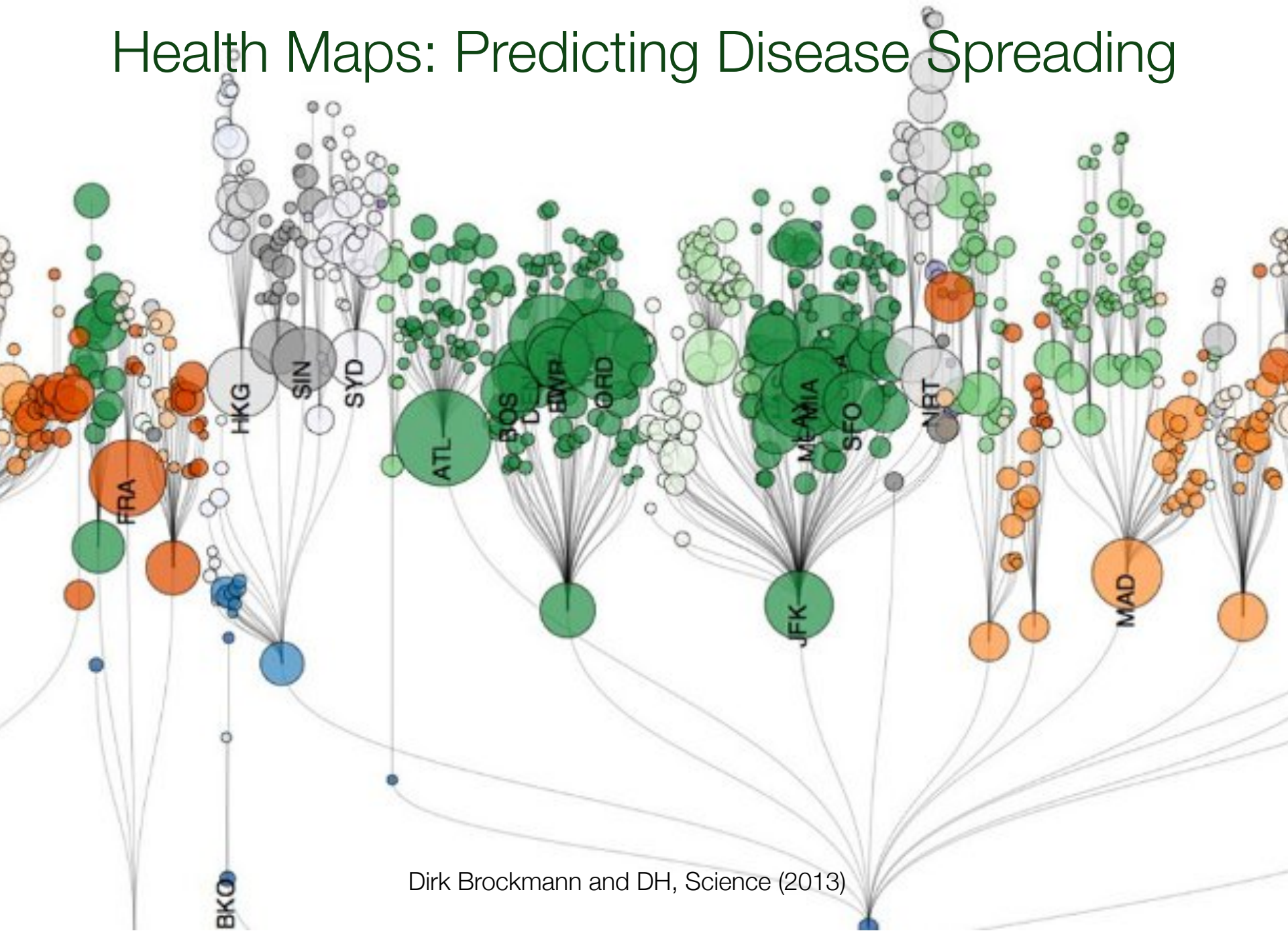


Spreading of International Tension



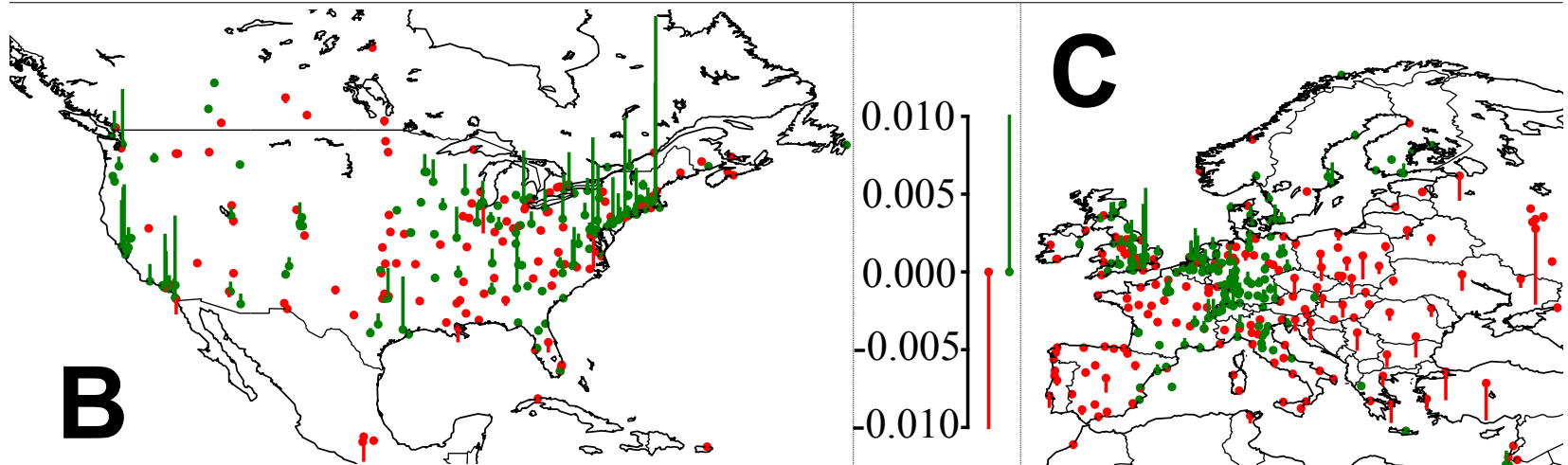
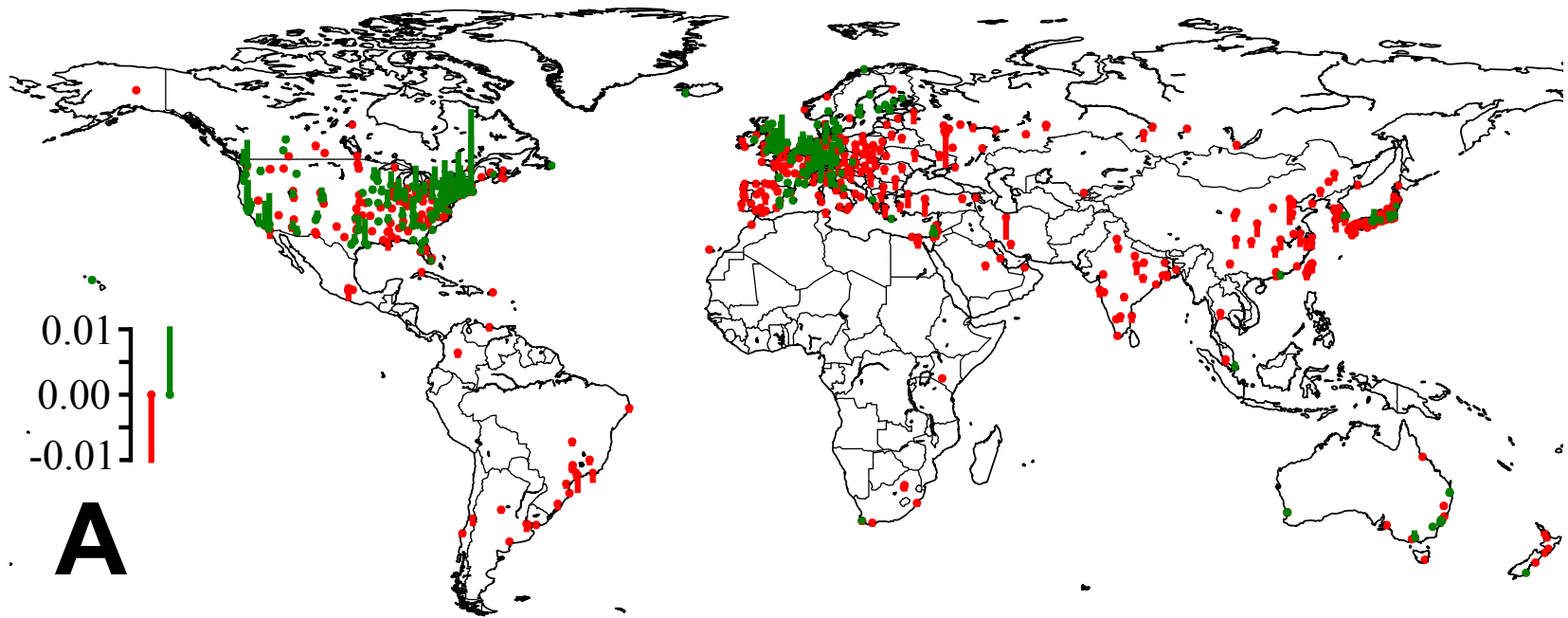
Joint work of Thomas Chadeaux and Dirk Helbing

Health Maps: Predicting Disease Spreading

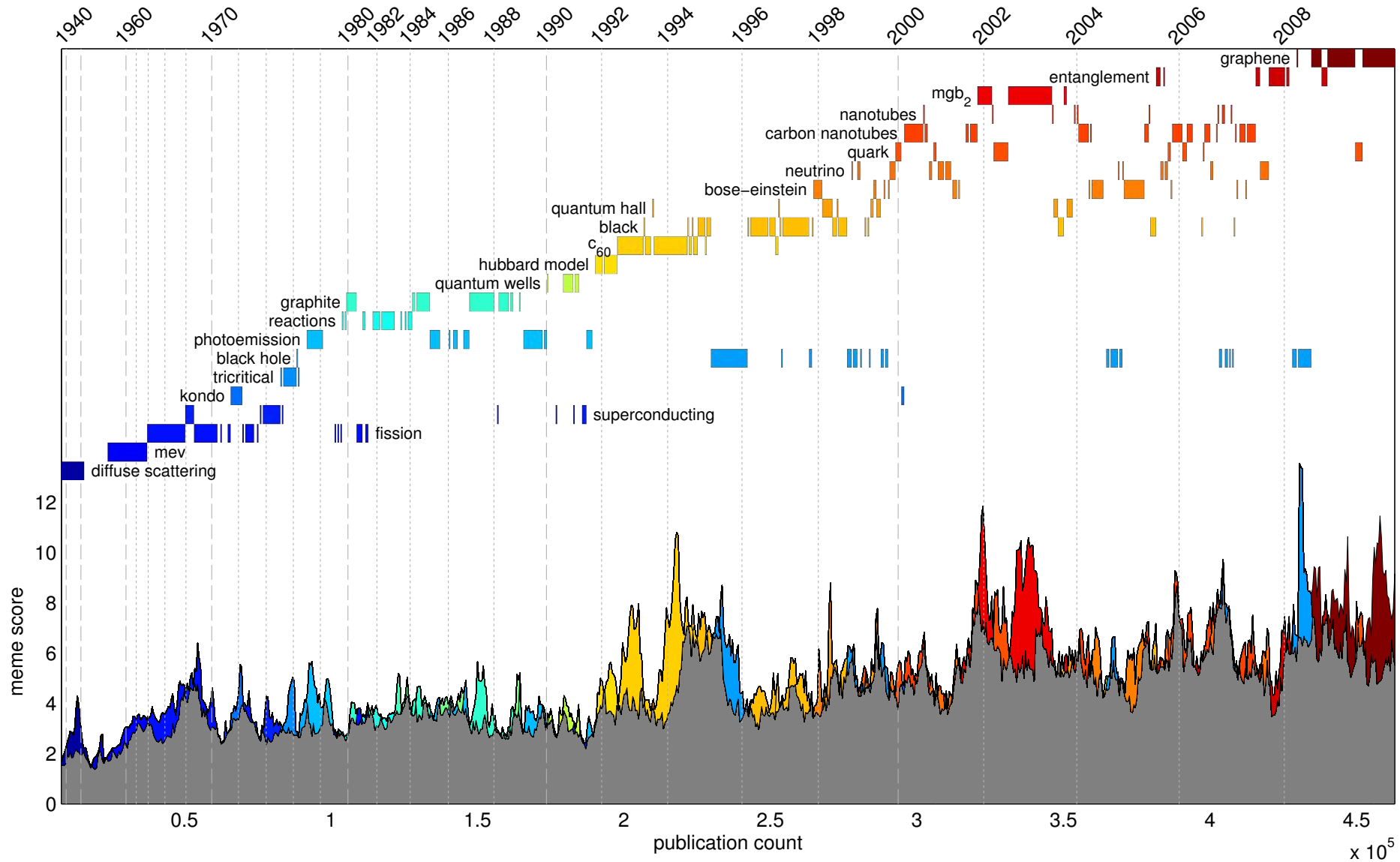


Dirk Brockmann and DH, Science (2013)

Global Knowledge Production and Consumption



Measuring “Memes” and Scientific Trends



A

B

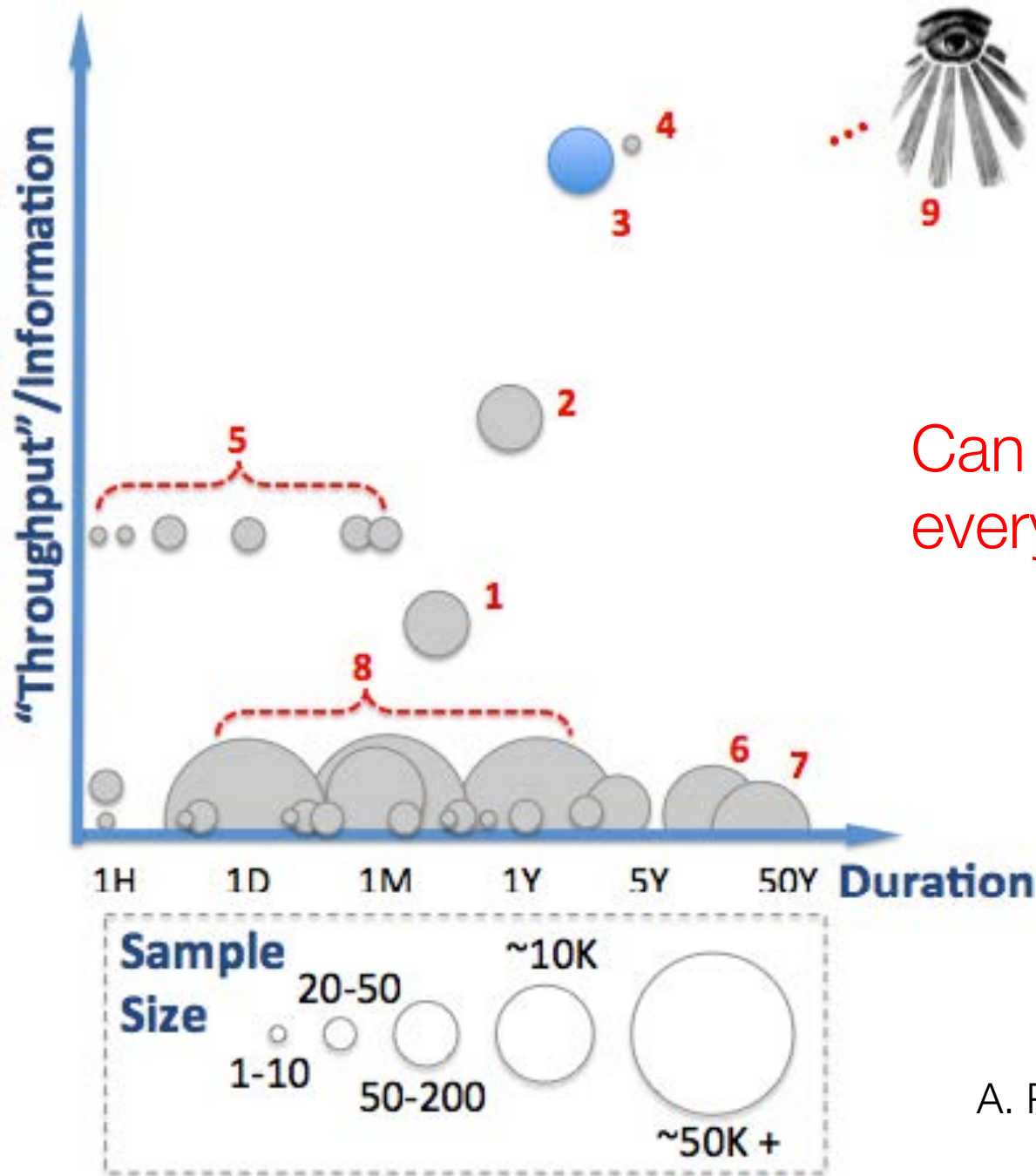
Tokio

Figure 1 displays a large network graph representing connections between cities. The nodes are colored red or blue and sized according to their degree. The edges are represented by grey lines. The graph shows a dense network of connections, with major hubs like London, New York, Paris, and Moscow. An inset in the top right corner provides a zoomed-in view of a specific cluster of nodes, highlighting the detailed structure of the network.



Image: Introduction of Internet of Things.
Retrieved from <http://en.wuxi.gov.cn/>

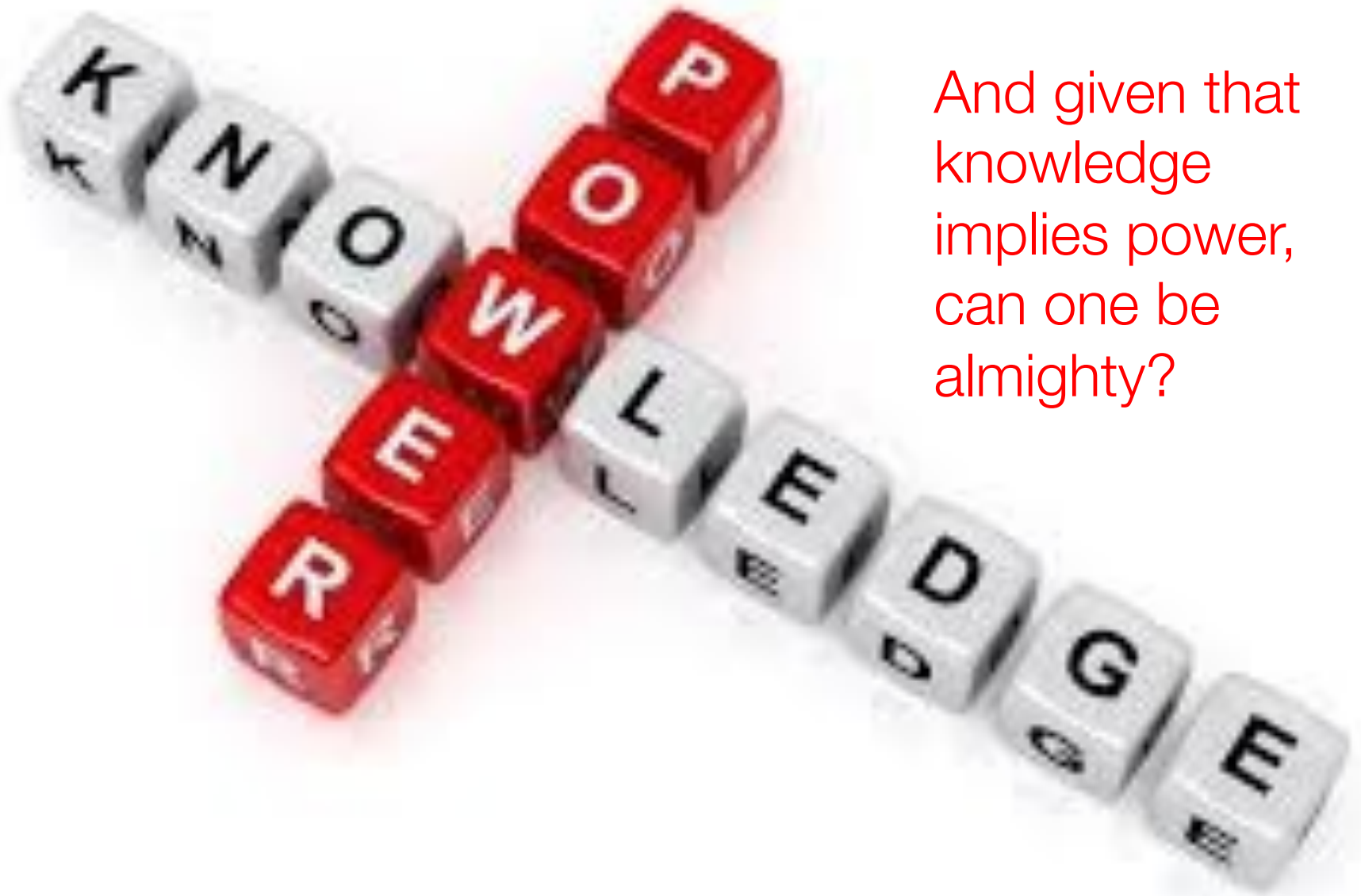
“Big Governments” – the
Future?



A. Pentland et al.

A blue-tinted image featuring a crystal ball in the foreground. Inside the crystal ball is a globe with the word "facebook" written across it in white. The background is a blurred screenshot of a web browser window, showing a Facebook logo and some text in the address bar. The text "Can we build a Crystal Ball?" is overlaid in red on the crystal ball.

Can we build a Crystal Ball?



And given that
knowledge
implies power,
can one be
almighty?

Manipulate people's choices by
personalized information and
recommendations?

Google™





Would so much
information
enable a wise
king, a
benevolent
dictatorship?

(Model of
Singapore?)

GET ALL THE
INFORMATION YOU CAN,
WE'LL THINK OF A
USE FOR IT LATER.



[Shop All Departments](#)

Search

Movies & TV



Movies & TV

[Advanced Search](#)[Browse Genres](#)[New Releases](#)[Bestsellers](#)[DVD & Blu-Ray Deals](#)

Jon and Kate Plus Ei8ht: The Complete Season 4 (6 DVD Set)

Starring: [Jonathan Gosselin](#), [Kate Gosselin](#) **Director:** [Jennifer](#)**Stocks** **Format:** List Price: ~~\$49.98~~Price: **\$29.99** & this item ships for **FREE** with Super Saver Shipping. [Details](#)You Save: **\$19.99 (40%)****In Stock.**Ships from and sold by **Amazon.com**. Gift-wrap availa

Customers Who Bought This Item Also Bought

[Hanging Ceiling Fan](#)

★★★★★ (1) \$94.99

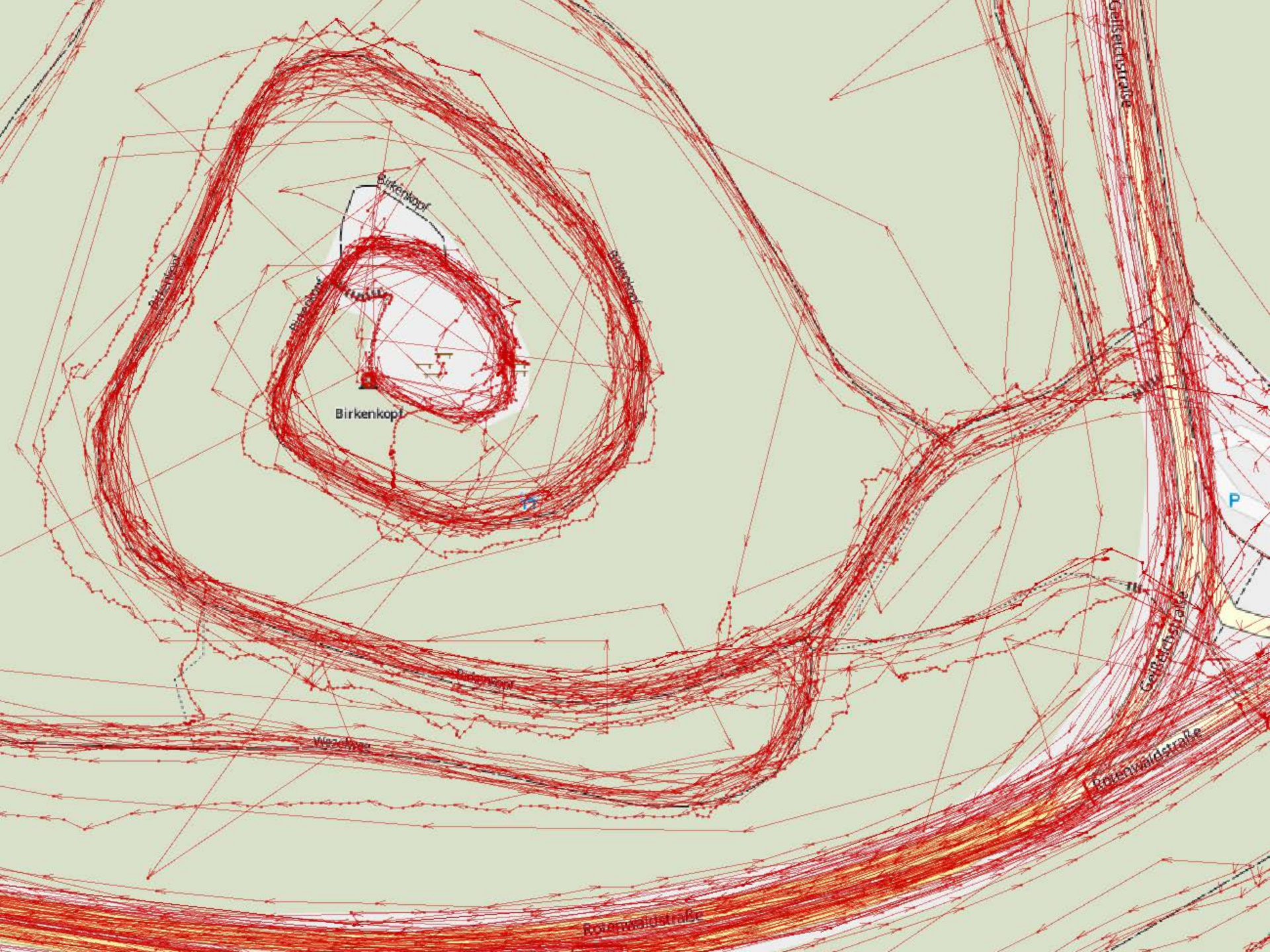
[12" Footstool](#)

★★★★☆ (10) \$36.99

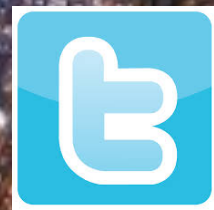
★★★



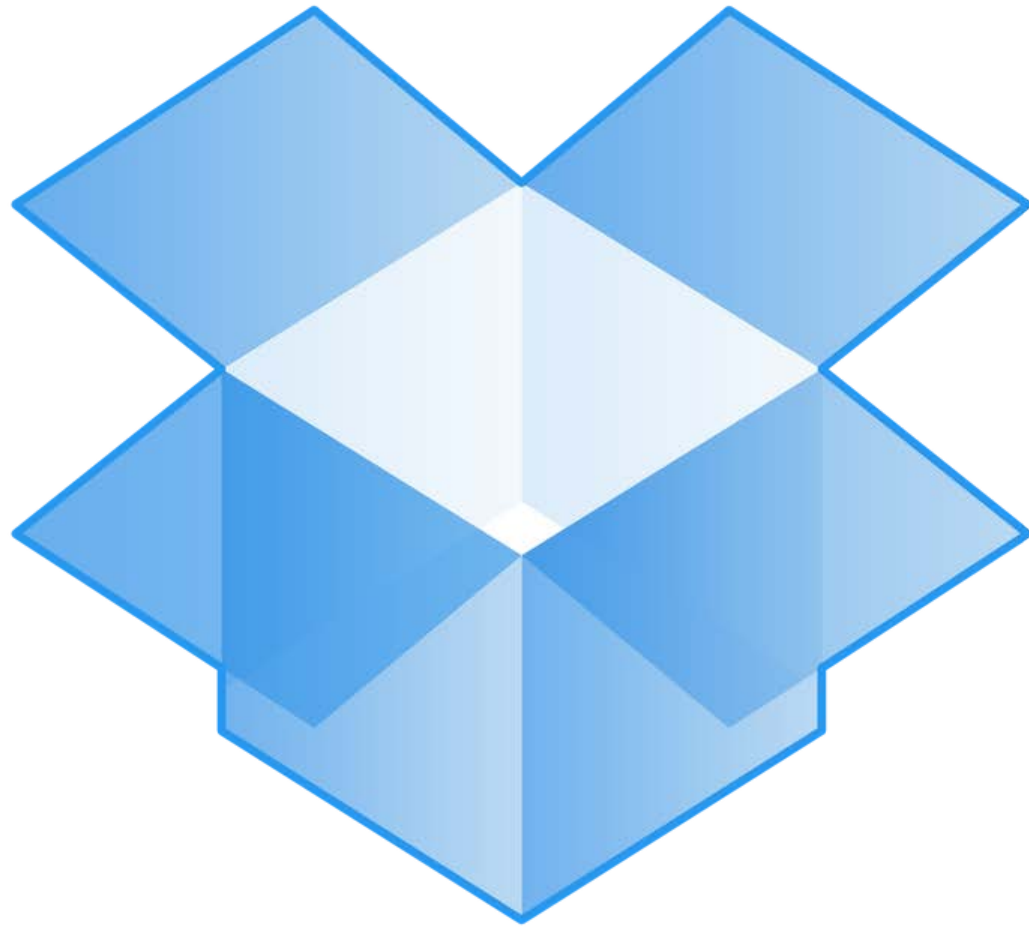








© Lion TV/422 South PBS 2012.



Dropbox





Middle Fork Lands Protected

In the last line of the Middle Fork Snoqualmie River Valley, another 14 acres have been protected by King County. "This is an important acquisition. Twenty years ago we didn't know what would become of the Middle Fork. Most of the lower valley was in private ownership and starting to be carved up into cabin sites. Shooting, dumping, and craviness was the scene," says Doug Schneider, Deputy Director of the Gateway Trust. "Today, through the hard work of many, most of the 130,000-acre valley is in public ownership and the area is cleaned up and safe for families. This property is one of the last in-biddings we have been helping to acquire for 15 years."



Photo: Washington State Department of Natural Resources
This view looks north over Clifford Lakes toward Russian State in the Middle Fork Snoqualmie River Valley. Lands in this area next to the Alpine Lakes Wilderness have been acquired over the past 20 years by the Washington State Department of Natural Resources.

Middle Fork News:

- The Washington State Department of Natural Resources received a grant to design a trailhead and trails in the area of this acquisition.
- The Federal Highway Administration is working to acquire lands to pass about 9 miles of the Middle Fork Road. The project aims to improve public access and safety, replace many hole-blocking stream culverts, and significantly cut gravel and sediment runoff during storms.
- The State Board of Natural Resources just approved adding several thousand acres of State Forest land in the valley into the Mount Si National Resource Conservation Area.

(2 of 4)

amazonkindle

Google



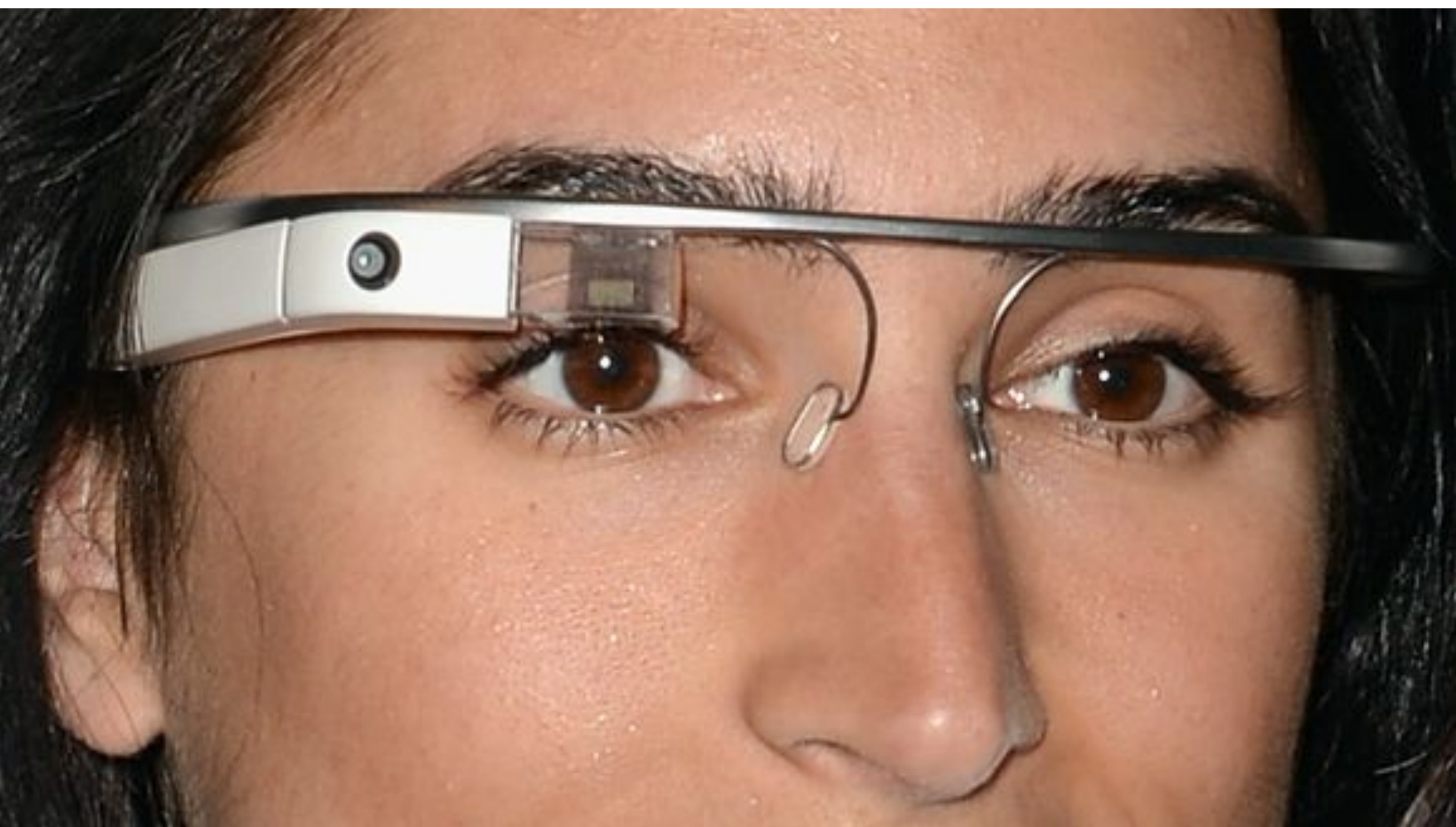
Google Search

I'm Feeling Puzzled



You





I'M WATCHING YOU









facebook

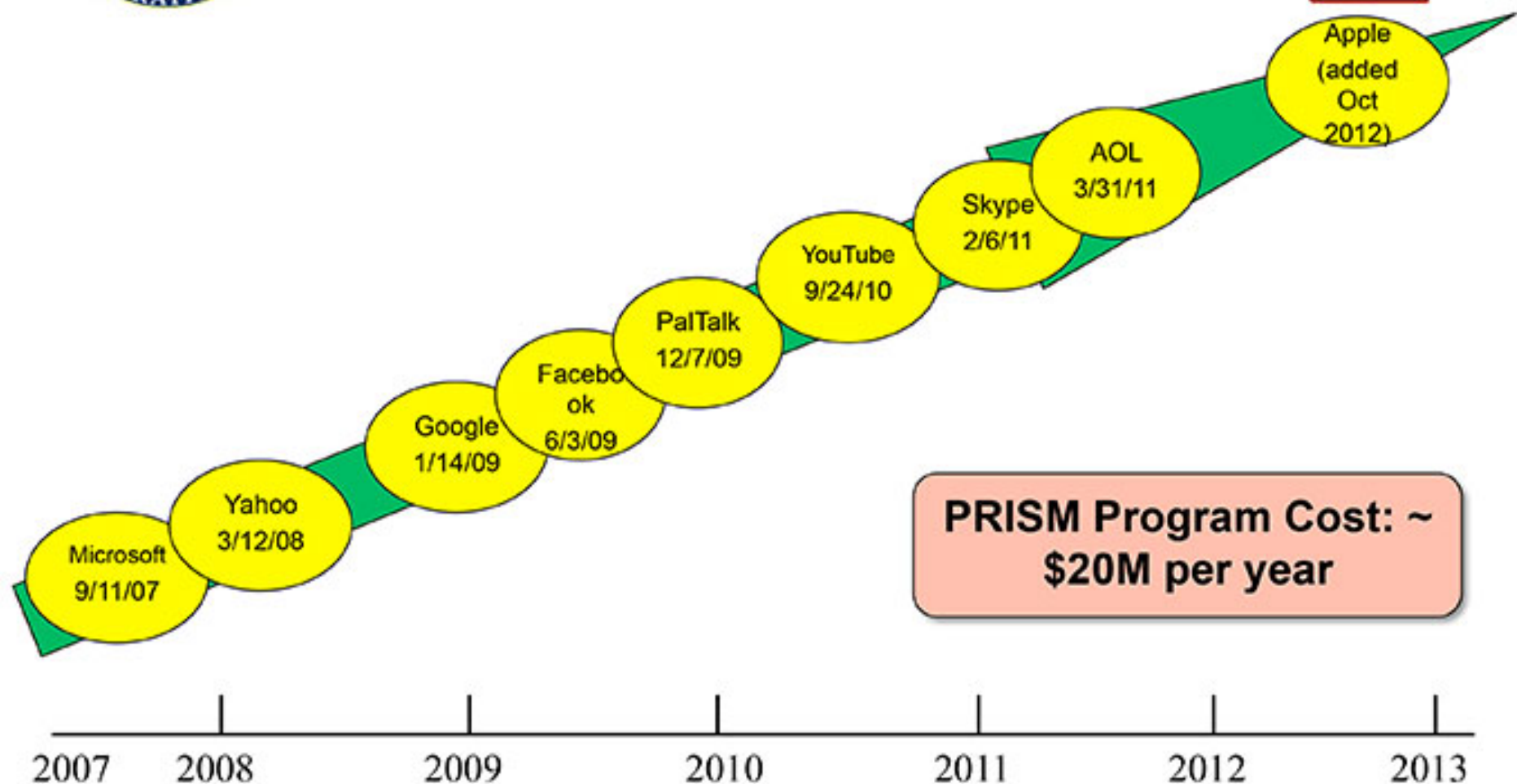


Hotmail

YAHOO!

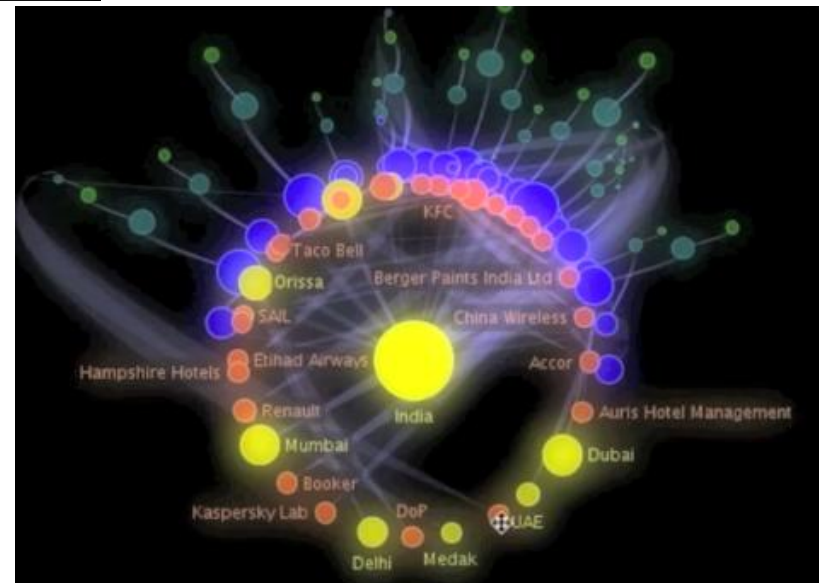
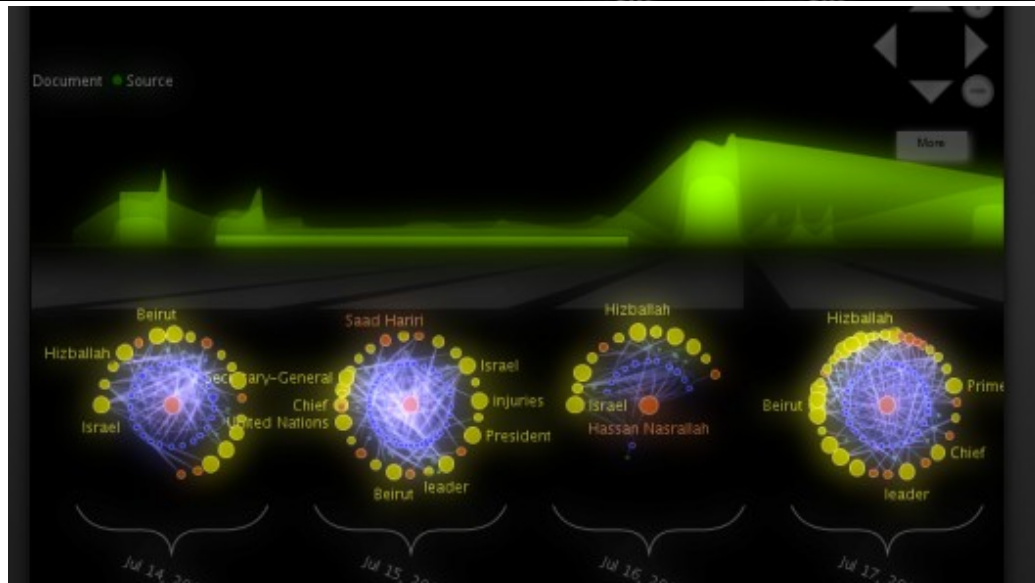
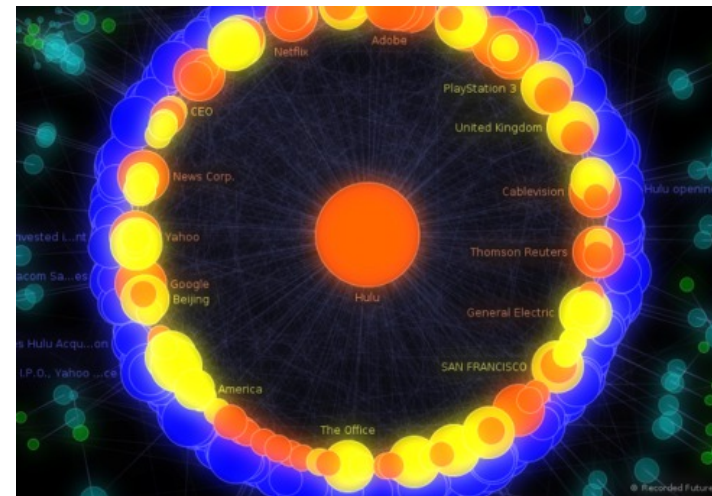


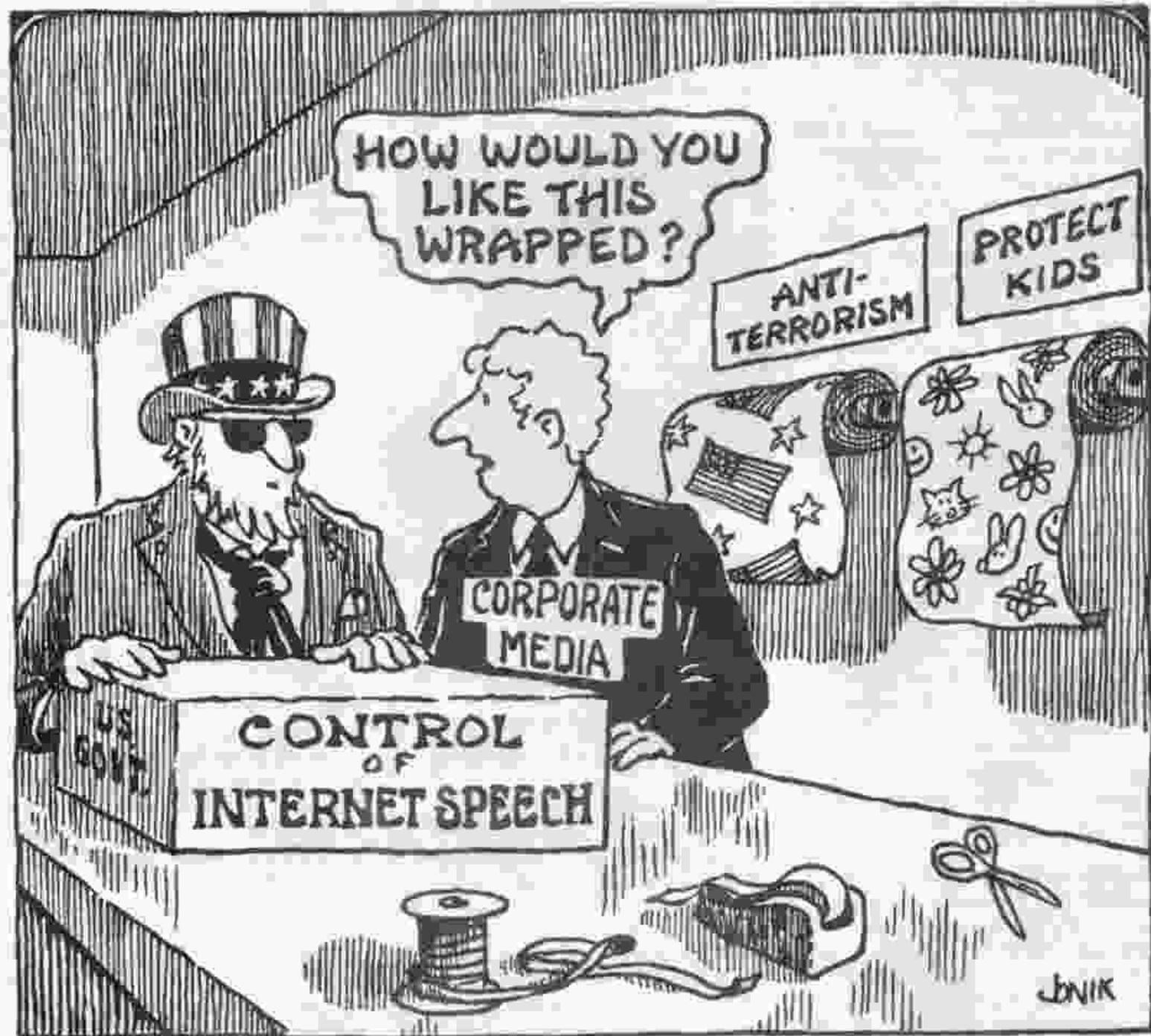
(TS//SI//NF) Dates When PRISM Collection
Began For Each Provider



**PRISM Program Cost: ~
\$20M per year**

Recorded Future





There are many unintended,
harmful side effects

Government Trojan Horses

The “Flame” and “Stuxnet” VIRUSES, **WERE Created, By The U.S. and Israel!**

```
assert(loadstring(config.get("LUA_LIBS.table"))<br>if not __LIB_FLAME_PROPS_LOADED<br>LIB_FLAME_PROPS_LOADED__
```

```
flame_props = {}<br>flame_props.FLAME_ID_CONFIG_KEY = "GATOR.LEAK.BPS"<br>flame_props.FLAME_TIME_CONFIG_KEY = "GATOR.LEAK.BPS"<br>flame_props.FLAME_LOG_PER_SECOND = 100<br>flame_props.FLAME_VERSION = "1.0.0"<br>flame_props.SUCCESSFUL_INTERACTION = 1<br>flame_props.INTERNET_CHECK_KEY = "GATOR.LEAK.BPS"<br>flame_props.BPS_CONFIG = "GATOR.LEAK.BPS"<br>flame_props.BPS_KEY = "BPS"<br>flame_props.PROXY_SERVER_KEY = "GATOR.PROXY"<br>flame_props.getFlameId = function()
```

```
if config.hasKey(flame_props.FLAME_ID_CONFIG_KEY) then<br>local l_1_0 = config.get<br>local l_1_1 = flame_props.FLAME_ID_CONFIG_KEY
```





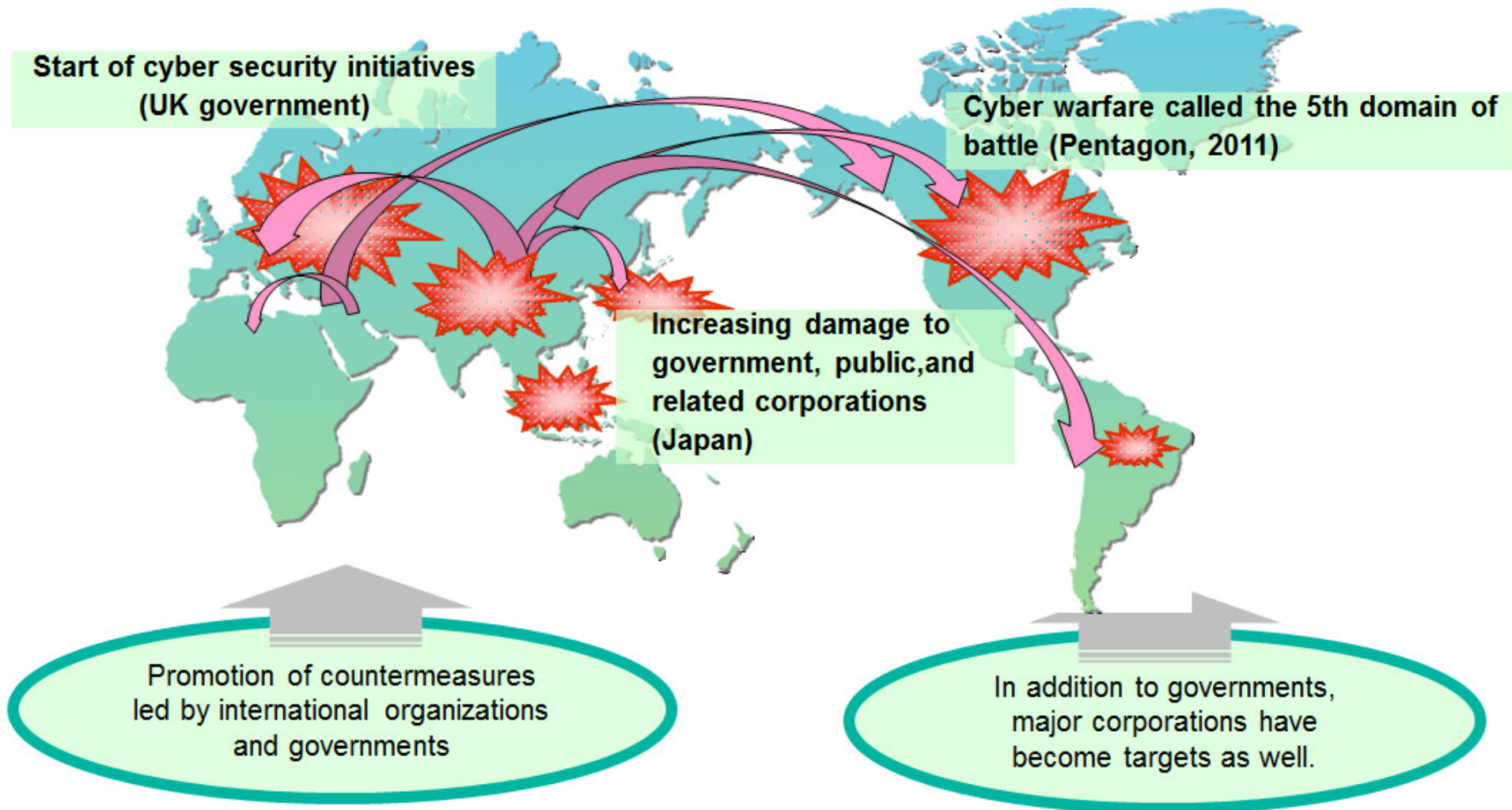






CYBER WAR

Cyberwar Engagements Seem to Make Everyone more Vulnerable





The “Crystal Ball” approach
doesn't work well







Financial Crisis



Arab Spring



War in Ukraine



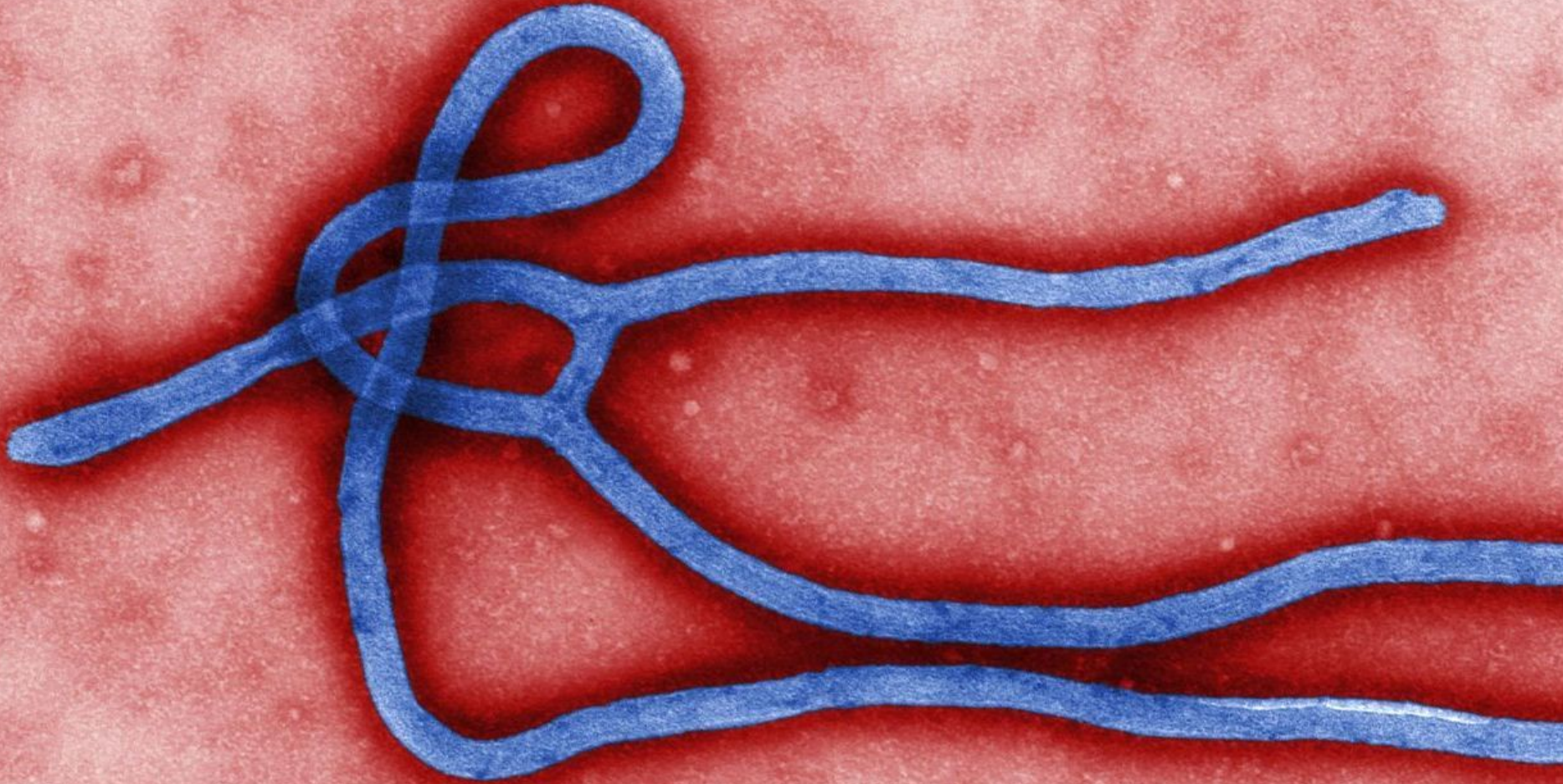
BREAKING NEWS

10 MINUTES
NON-STOP
NEWS

295 KILLED IN MALAYSIA AIRLINES DISASTER

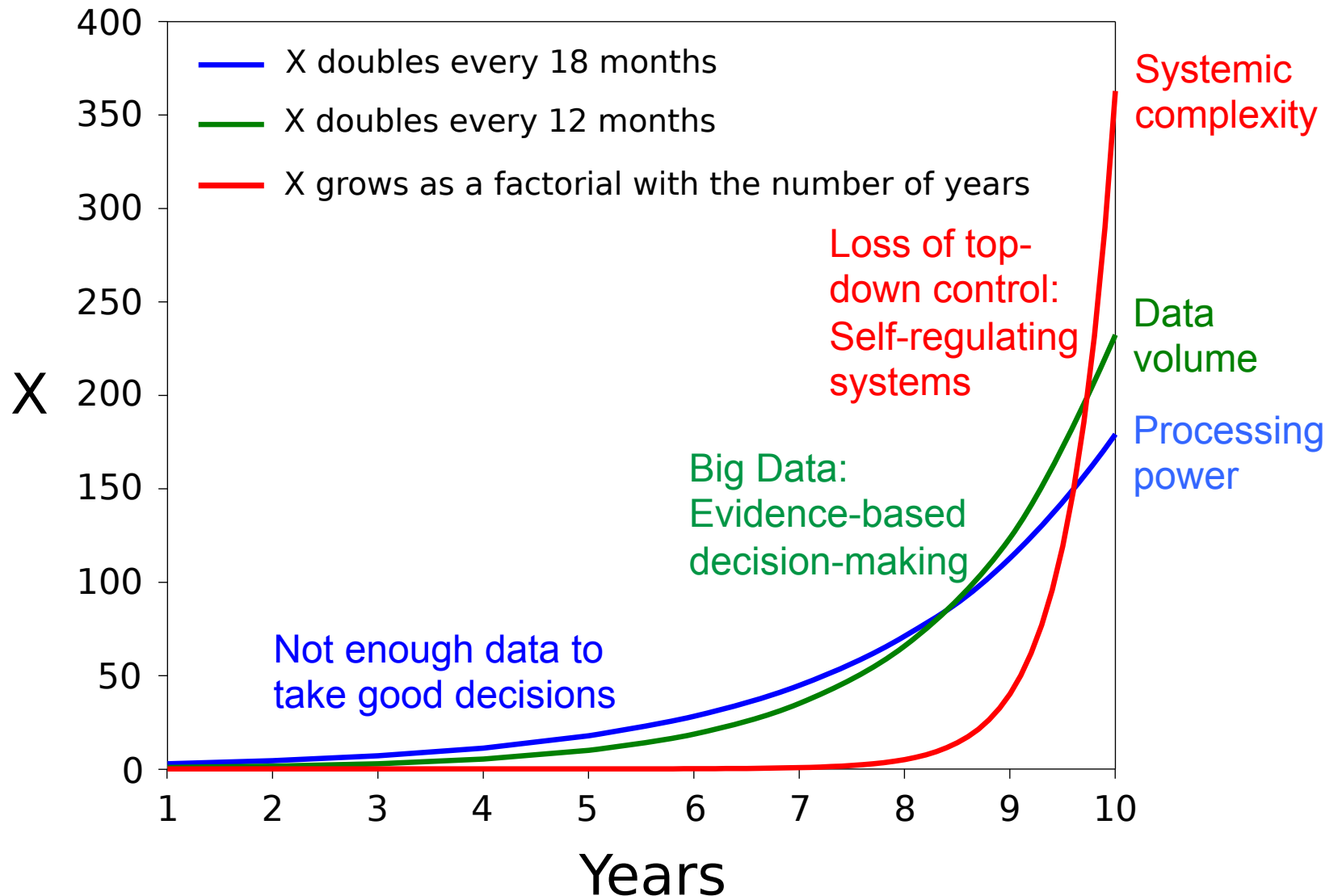
PLANE GOES DOWN IN UKRAINE

Spreading of Ebola

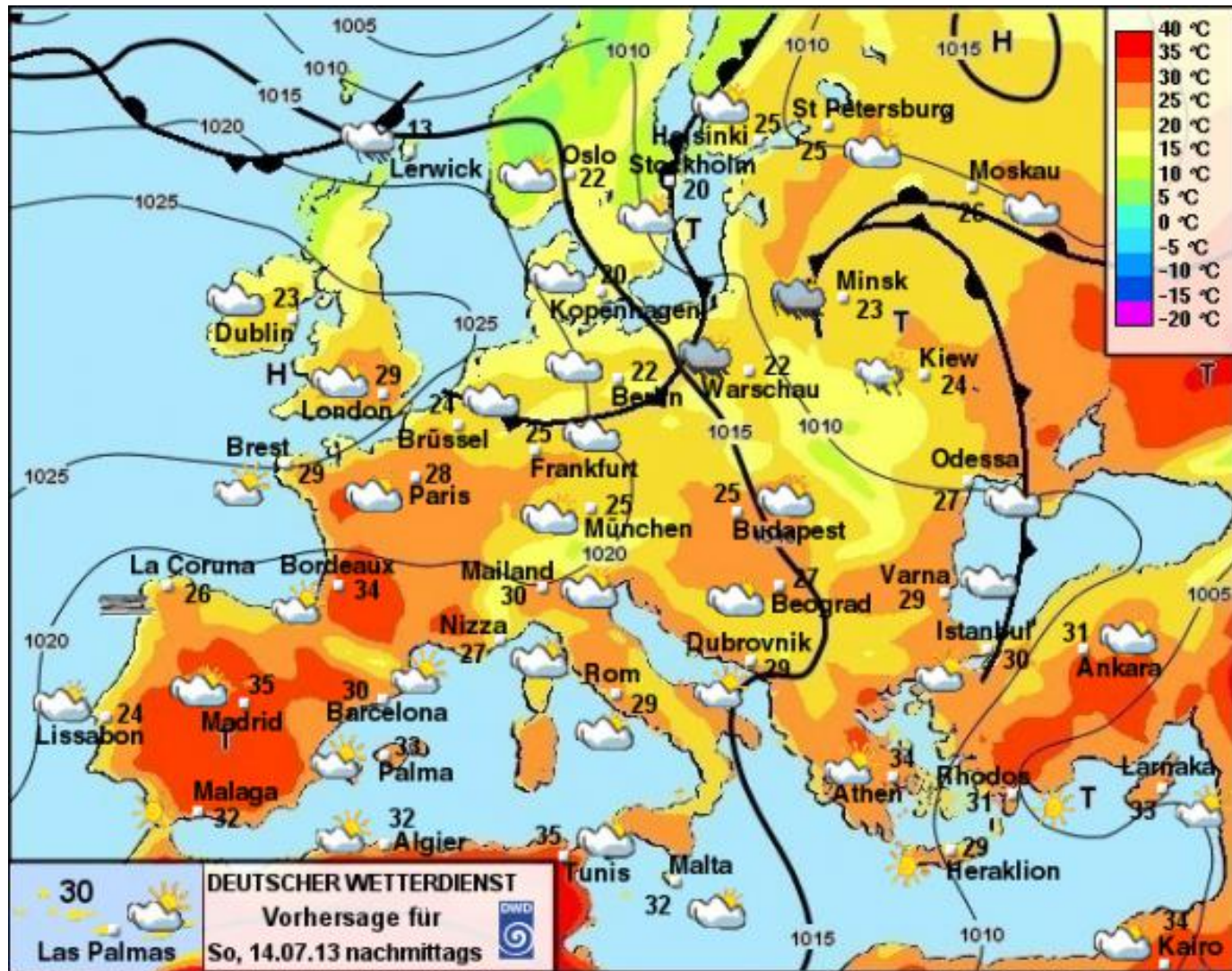


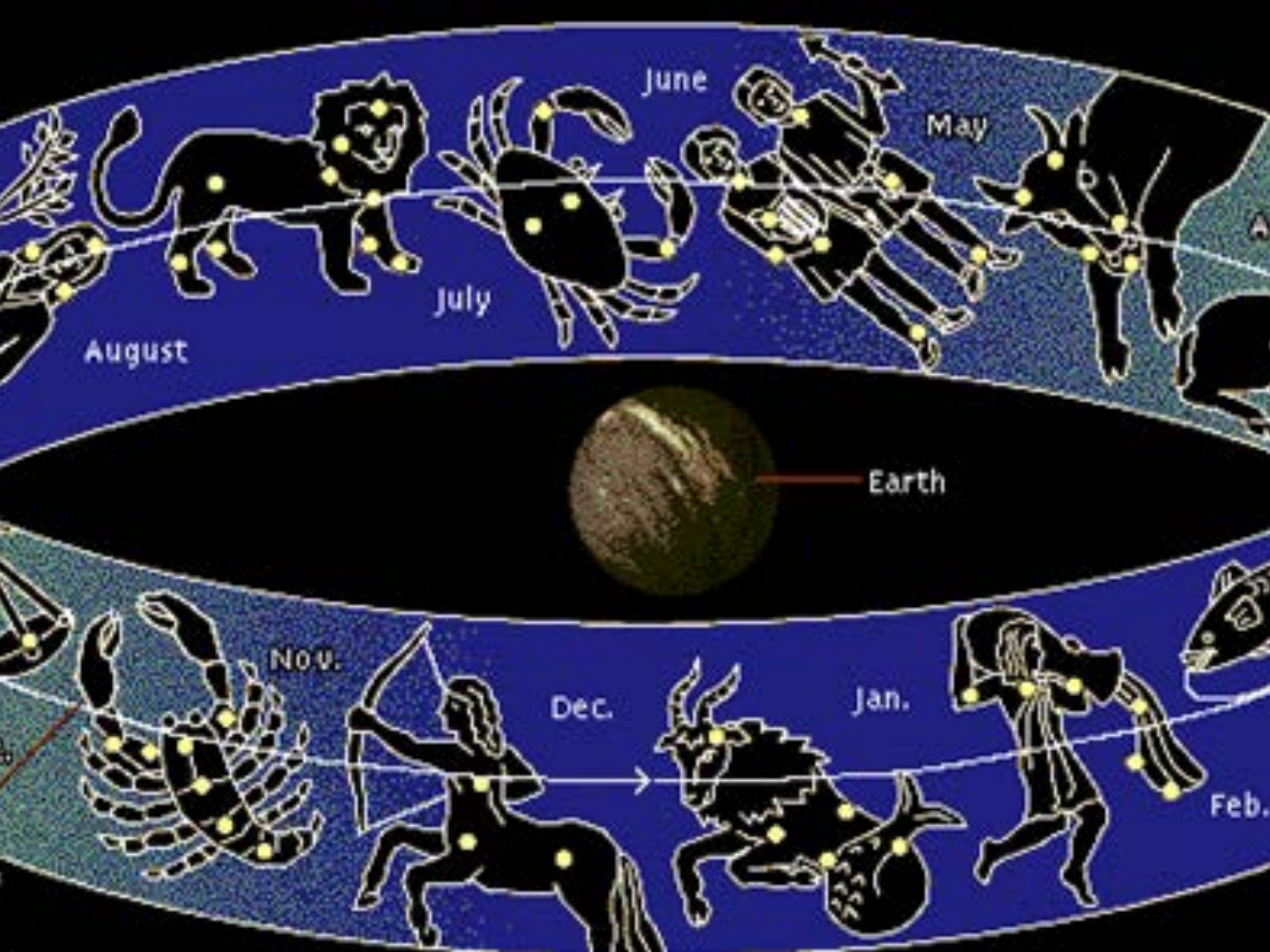
Why a “Crystal Ball” does
not work

Exponential vs. Factorial Growth – Implications for the Governance of Complex Systems

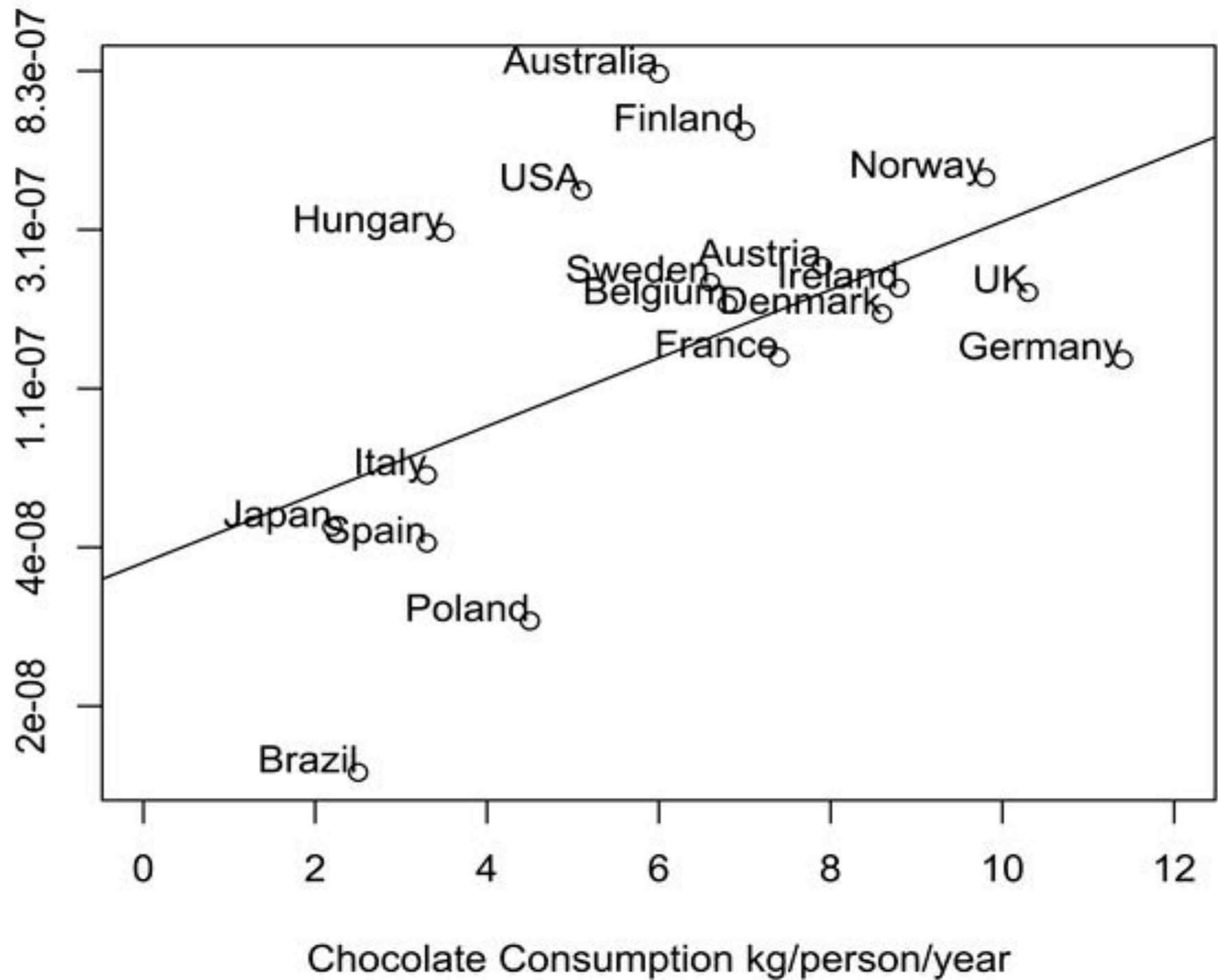


Complex Systems: Limits of Predictability



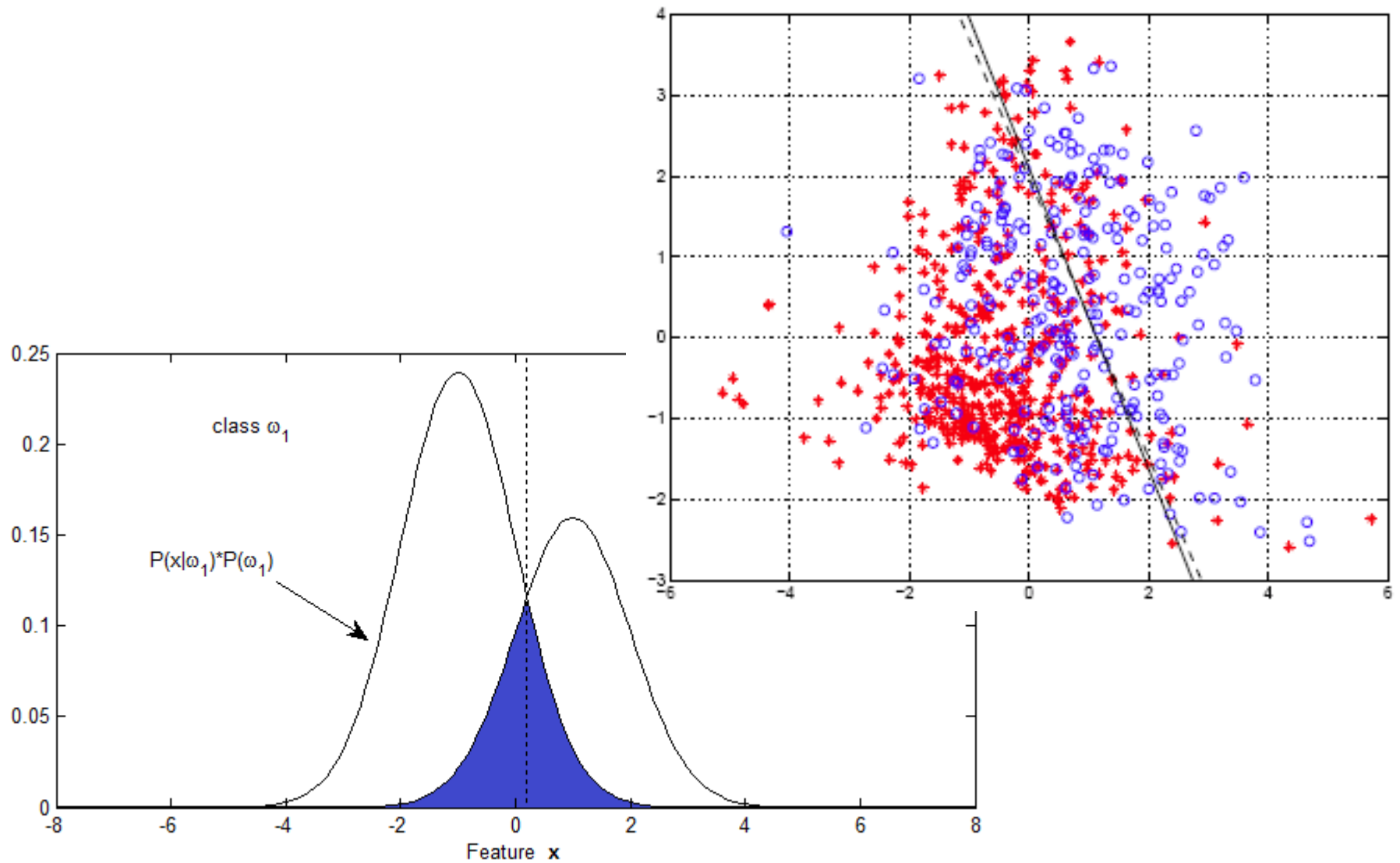


Number of Serial and Rampage Killers per capita



Dangerous side effects for
citizens, businesses, and
politics

Classification Errors Implies Discrimination



Are the Right Kinds of People in Prison?



About 45 million arrests connected with war on drugs.

“Too many Americans go to too many prisons for far too long, and for no truly good law enforcement reason.”

US Attorney General Eric Holder

Proportion of People in Prisons

Country	Prison Pop. per 100,000	Rank
USA	716	1
Cuba	510	5
Russia	477	8
Brazil	274	46
Mexico	210	67
Saudi Arabia	162	90
Spain	147	104
UK (England & Wales)	147	104
China	121	127
Italy	106	143
France	102	147
Switzerland	82	161
Germany	79	167
Sweden	67	180
Pakistan	39	208
India	30	215

Source: ICPS,
www.prisonstudies.org

Establishing Safety? Or Filling Budget Gaps?



Hier klicken **Blick ins Buch!**

Ein Bertelsmann Buch - und viel mehr...
JÜRGEN SCHMIEDER

MIT EINEM BEIN IM **KNAST**



Mein Versuch, ein Jahr lang
gesetznstreu zu leben

C.Bertelsmann

Ein Bertelsmann Buch - und viel mehr...



(Image Source:

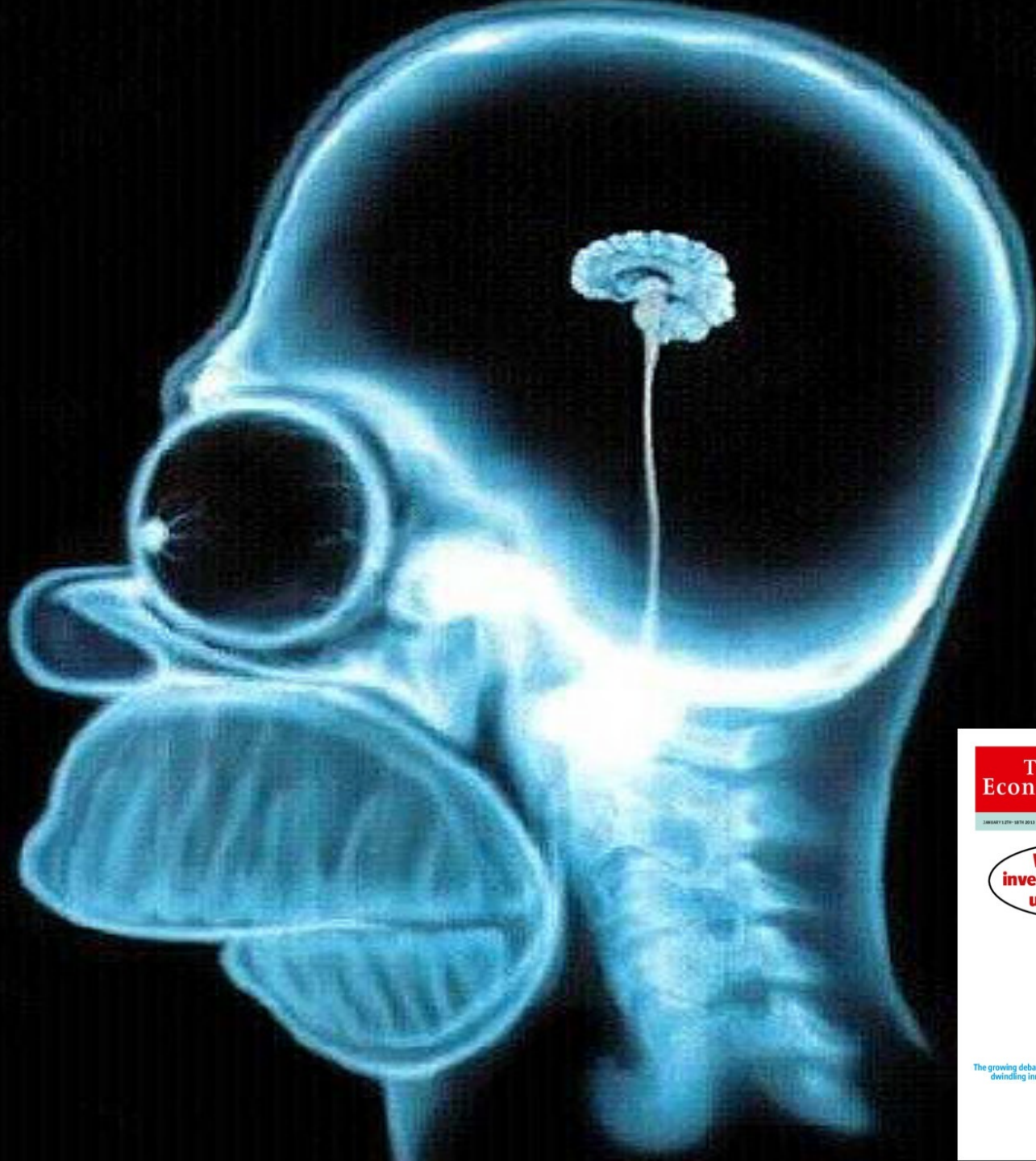
<http://www.tempo.co/read/news/2012/12/18/064448827/Pekerja-Sonia-Mansion-Dapat-Rp-7-Juta-per-Pekan>)

Principle of Secret Vote Has Been Undermined



054028 L

OCEAN LARIX MEDIUM



**The
Economist**

JANUARY 12-19, 2013 \$13

economist.com

Obama's controversial new men
Pressure for change builds in China
Men close the longevity gap
The ghastly gurus of personal finance
Microchipping your children

**Will we ever
invent anything this
useful again?**



The growing debate about
dwindling innovation



1984

GEORGE ORWELL'S

Adapted by NICK LANE
Directed by TONY ESTRELLA

APRIL 26 - MAY 27

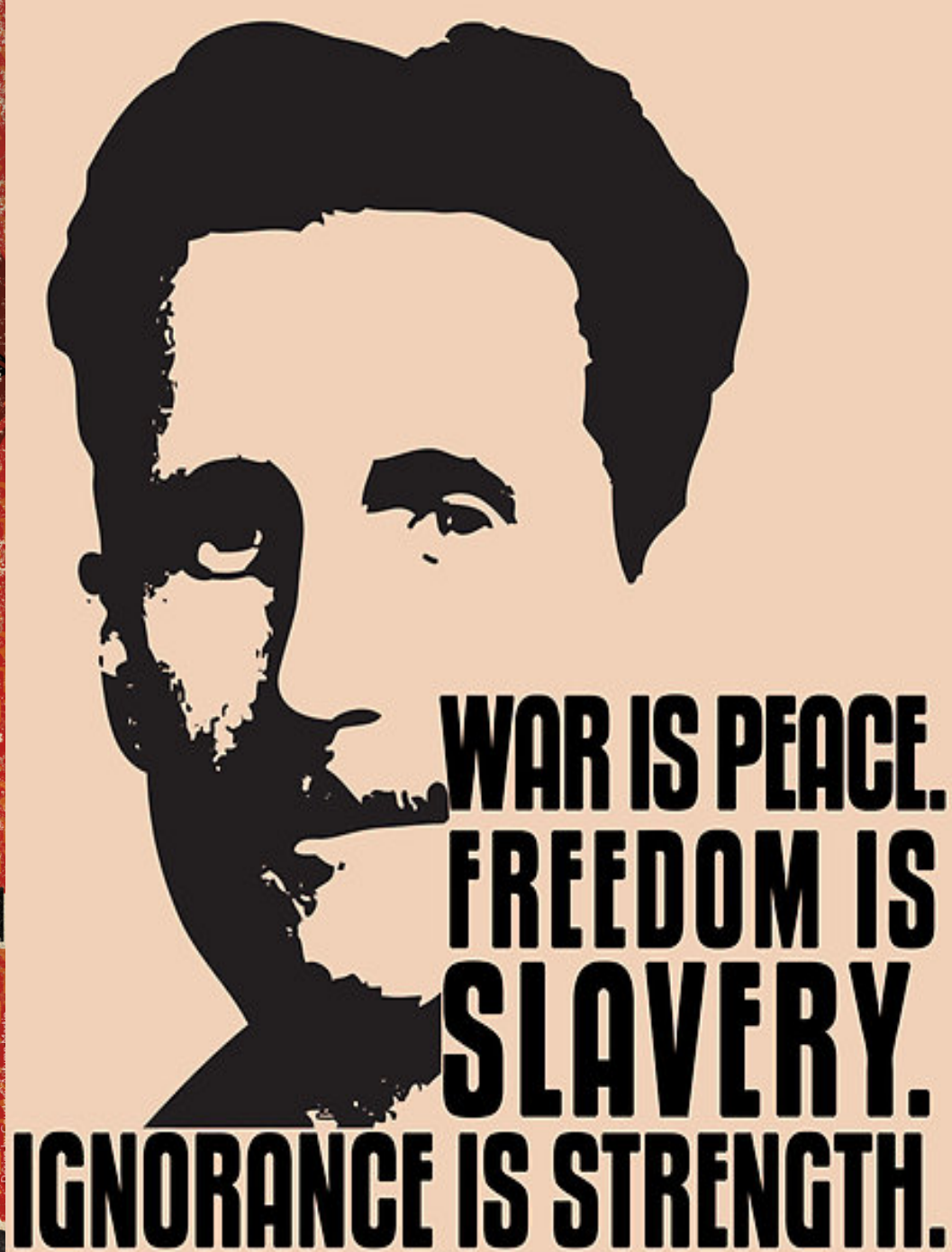
401.723.4266

GAMMTHEATRE.ORG

172 Exchange St., Pawtucket, RI

sandra feinstein-

GAM
theatre



WAR IS PEACE.
FREEDOM IS
SLAVERY.

IGNORANCE IS STRENGTH.

"You're already a walking sensor platform... You are aware of the fact that somebody can know where you are at all times because you carry a mobile device, even if that mobile device is turned off. You know this, I hope? Yes? Well, you should... Since you can't connect dots you don't have, it drives us into a mode of, we fundamentally try to collect everything and hang on to it forever... It is really very nearly within our grasp to be able to compute on all human generated information."

Ira "Gus" Hunt, CIA Chief Technology Officer

”Mit dem Recht auf informationelle Selbstbestimmung wären eine Gesellschaftsordnung und eine diese ermöglichende Rechtsordnung nicht vereinbar, in der Bürger nicht mehr wissen können, wer was wann und bei welcher Gelegenheit über sie weiß. Wer unsicher ist, ob abweichende Verhaltensweisen jederzeit notiert und als Information dauerhaft gespeichert, verwendet oder weitergegeben werden, wird versuchen, nicht durch solche Verhaltensweisen aufzufallen. [...] Dies würde nicht nur die individuellen Entfaltungschancen des Einzelnen beeinträchtigen, sondern auch das Gemeinwohl, weil Selbstbestimmung eine elementare Funktionsbedingung eines auf Handlungsfähigkeit und Mitwirkungsfähigkeit seiner Bürger begründeten freiheitlichen demokratischen Gemeinwesens ist. Hieraus folgt: Freie Entfaltung der Persönlichkeit setzt unter den modernen Bedingungen der Datenverarbeitung den Schutz des Einzelnen gegen unbegrenzte Erhebung, Speicherung, Verwendung und Weitergabe seiner persönlichen Daten voraus. Dieser Schutz ist daher von dem Grundrecht des Art. 2 Abs. 1 in Verbindung mit Art. 1 Abs. 1 GG umfasst. Das Grundrecht gewährleistet insoweit die Befugnis des Einzelnen, grundsätzlich selbst über die Preisgabe und Verwendung seiner persönlichen Daten zu bestimmen.” (Volkszählungsurteil)

Diversity Is Important

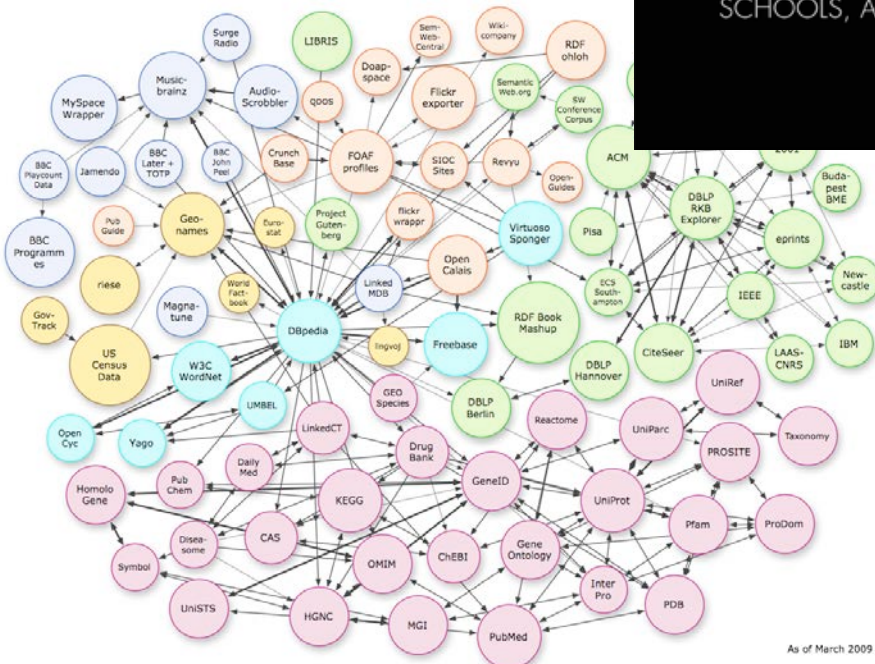
Scott E. Page

Scott E. Page (2007): The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies. Princeton University

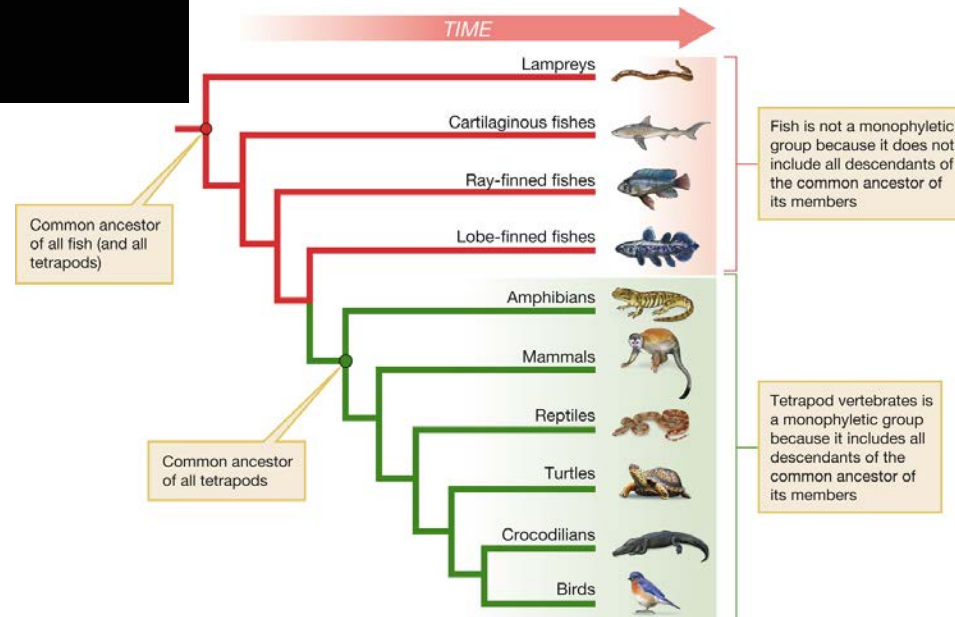
THE DIFFERENCE

HOW THE POWER OF DIVERSITY
CREATES BETTER GROUPS, FIRMS,
SCHOOLS, AND SOCIETIES

Diversity is important
for innovation, societal
resilience, happiness,
collective intelligence



As of March 2009



Netflix Challenge: Diversity Wins, Not the Best



Top-down
and majority
decisions
obstruct
collective
intelligence

Leaderboard

Display top leaders.

Rank	Team Name	Best Score	% Improvement	Last Submit Time
1	BellKor's Pragmatic Chaos	0.8558	10.05	2009-06-26 18:42:37
Grand Prize - RMSE $\leq$ 0.8563				
2	PragmaticTheory	0.8582	9.80	2009-06-25 22:15:51
3	BellKor in BigChaos	0.8590	9.71	2009-05-13 08:14:09
4	Grand Prize Team	0.8593	9.68	2009-06-12 08:20:24
5	Dace	0.8604	9.56	2009-04-22 05:57:03
6	BigChaos	0.8613	9.47	2009-06-23 23:06:52
Progress Prize 2008 - RMSE = 0.8616 - Winning Team: BellKor in BigChaos				
7	BellKor	0.8620	9.40	2009-06-24 07:16:02
8	Gravity	0.8634	9.25	2009-04-22 18:31:32
9	Opera Solutions	0.8638	9.21	2009-06-22 05:53:30
10	xlvector	0.8639	9.20	2009-06-26 13:49:04
11	xiangliang	0.8639	9.20	2009-06-26 07:47:34
12	BruceDengDaoCiYiYou	0.8641	9.18	2009-06-02 17:08:31
13	Ces	0.8642	9.17	2009-06-24 14:34:14
14	majia2	0.8642	9.17	2009-06-23 08:07:50

Wisdom of
crowds
requires
independent
exploration
and then
integration

Gesetzliches Schutzprogramm

Alexander Roßnagel

Datenschutzprinzipien

- Interessenabwägung
- Einwilligung
- Transparenz
- Zweckbegrenzung
- Zweckbindung
- Erforderlichkeit
- Datensparsamkeit

Big Data

- Entindividualisierung
- Freiwilligkeit fraglich
- Daten und Zwecke intransparent
- Vorratsdatenspeicherung
- Auswertung heterogener Daten
- Für alle Zwecke erforderlich
- Sammlung ohne Begrenzung

U N I K A S S E L
V E R S I T Ä T

provet

Projektgruppe
verfassungsverträgliche
Technikgestaltung

Kann Big Data datenschutzrechtlich zulässig sein?

“We cannot solve our
problems with the same
kind of thinking that
created them”

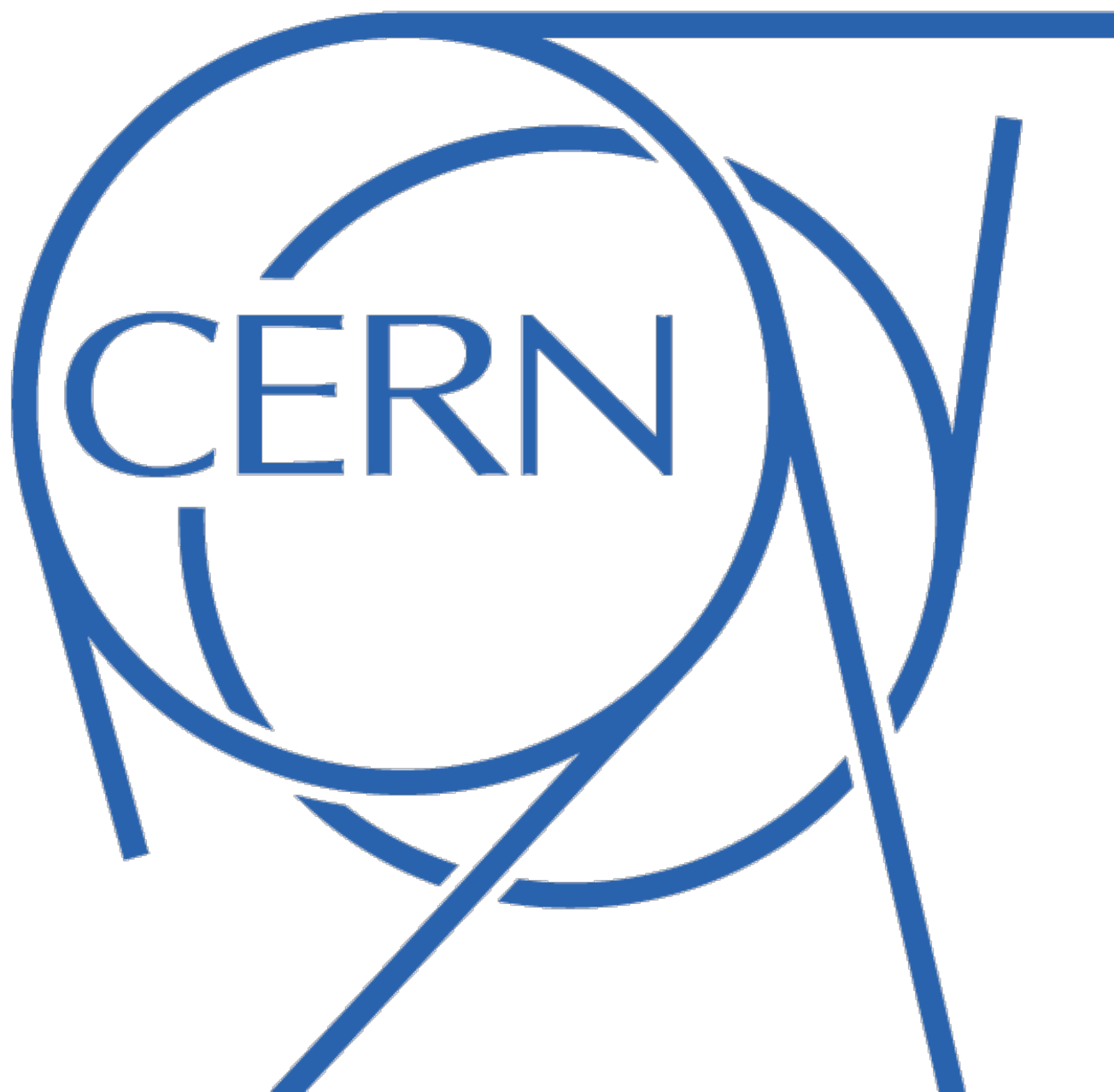
Albert Einstein

We are often trying to solve 21st century problems with 20th century thinking

A new approach: Creating a
Citizen Web for real-time
measurement







On log	On share	Accelerometer
On log	On share	Light
On log	On share	Temperature
On log	On share	Humidity
On log	On share	Gyroscope
On log	On share	Proximity
On log	On share	Battery
On log	On share	Atm. Pressure
On log	On share	Magnetic
On log	On share	Noise



PRIVACY

While controlling
how it is used



PERSONAL DATA

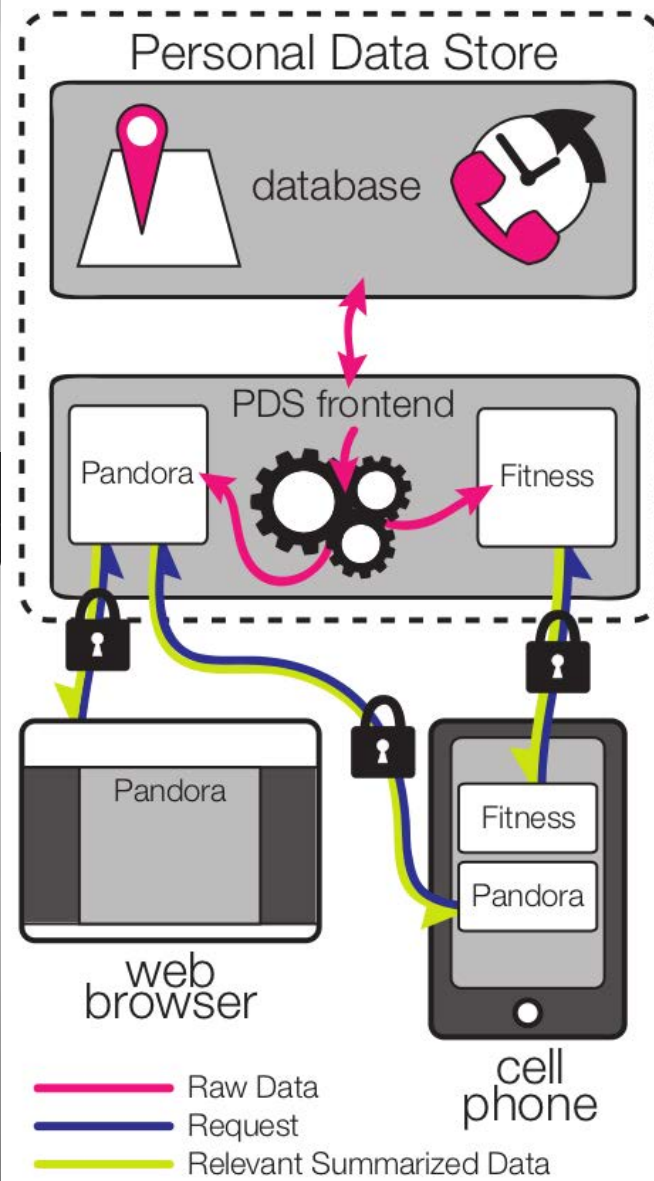
Collect it, Own it
Share it

PRIVACY

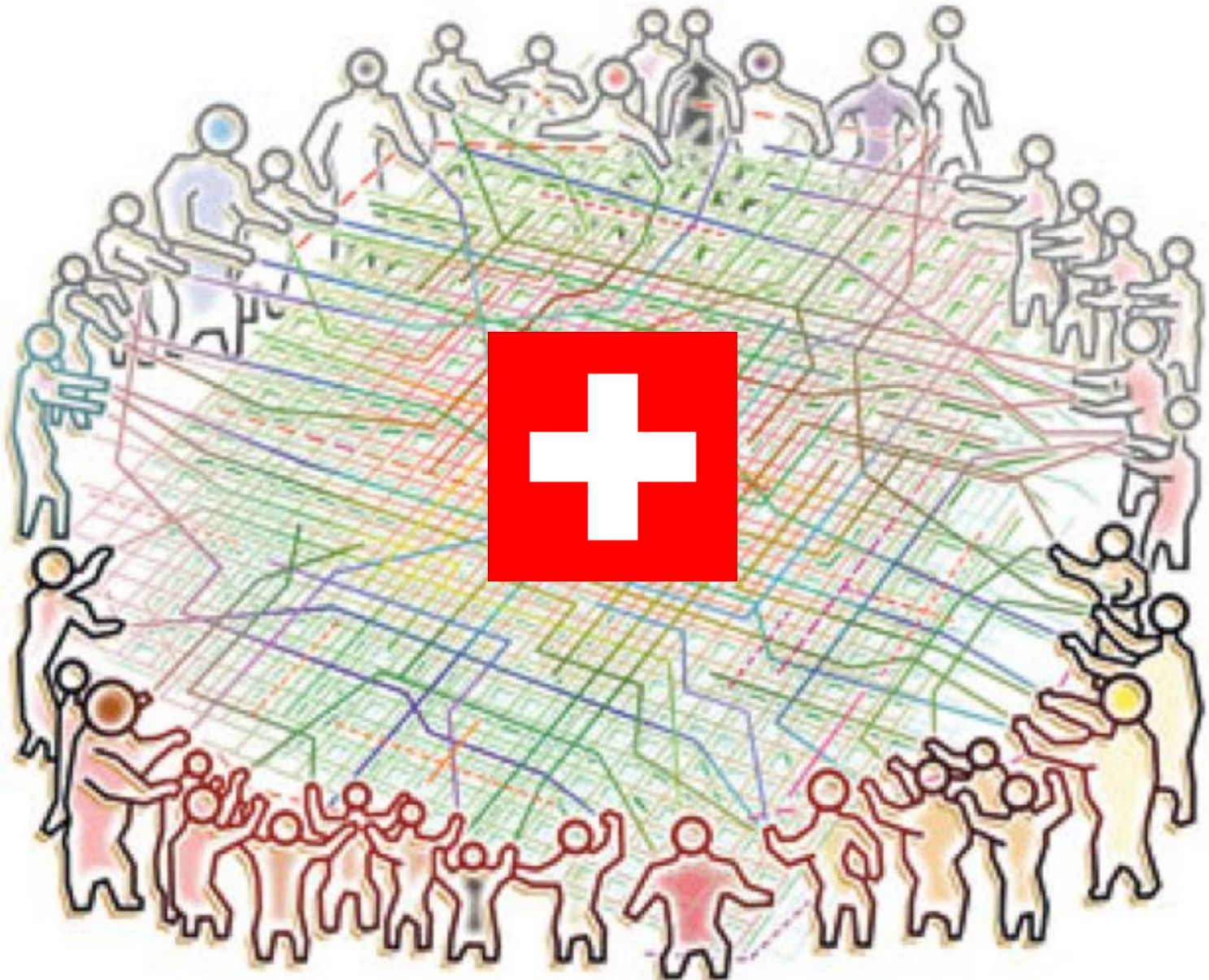
openPDS helps
you protect your data

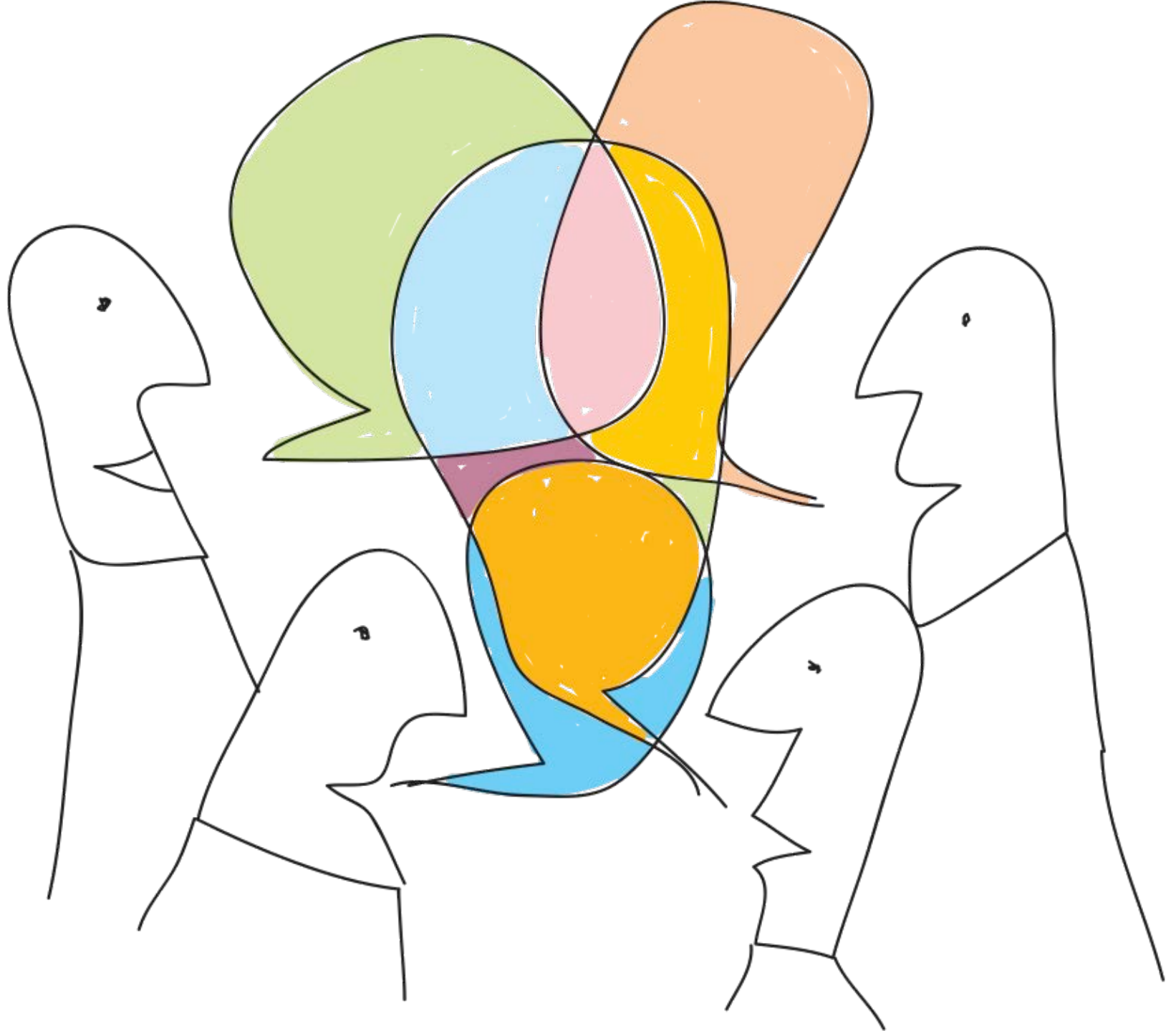


Privacy and Data Ownership



„Planetary Nervous System“ as Citizen Web





Create New Opportunities for Everyone





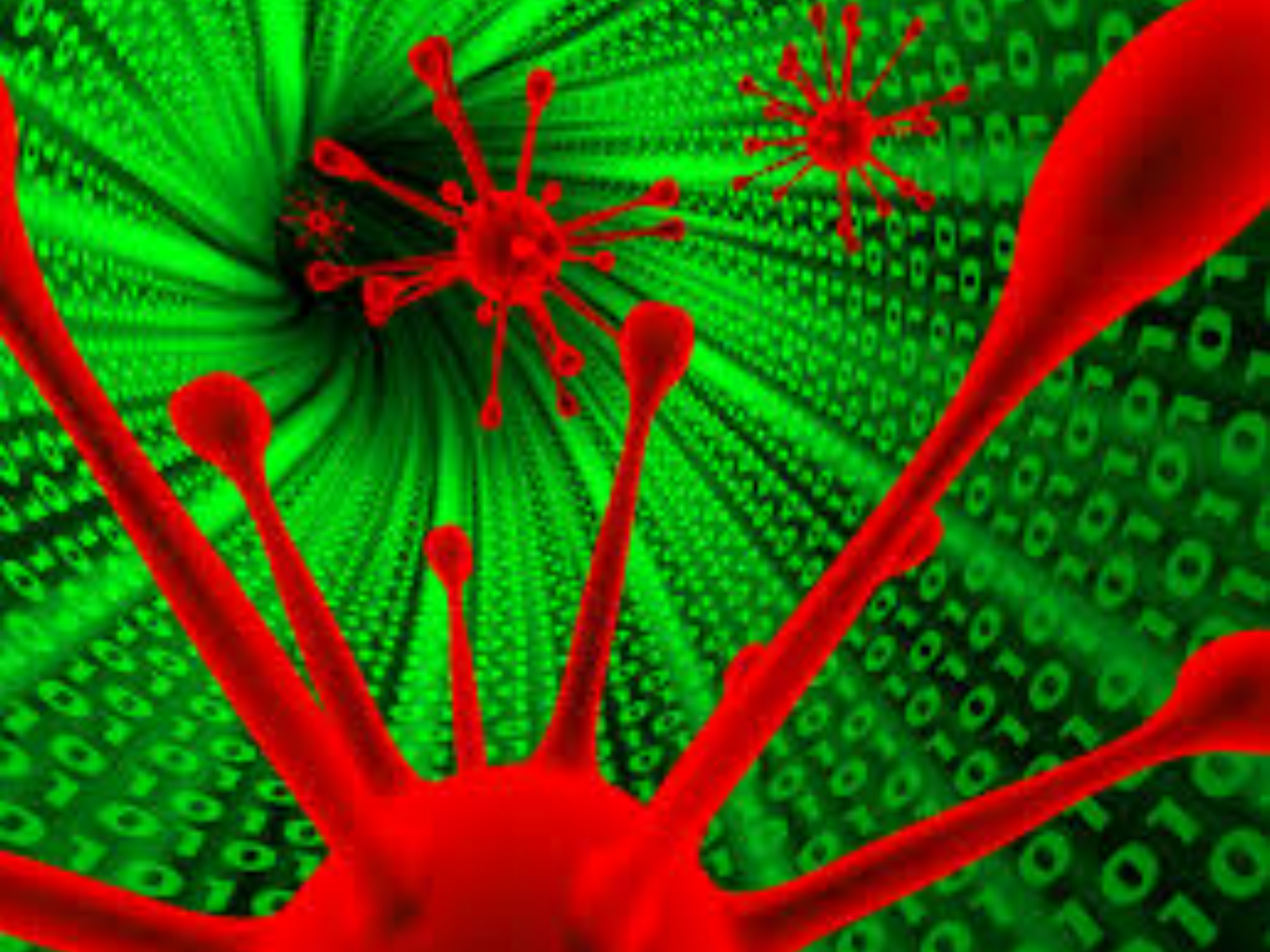


(Image Source: <http://demosite.in/applicationdevelopment.php>)

“Give and
take is
fair **play.**”

English Proverb

Cybersecurity



Reputation Systems

Generation L, the...

Like

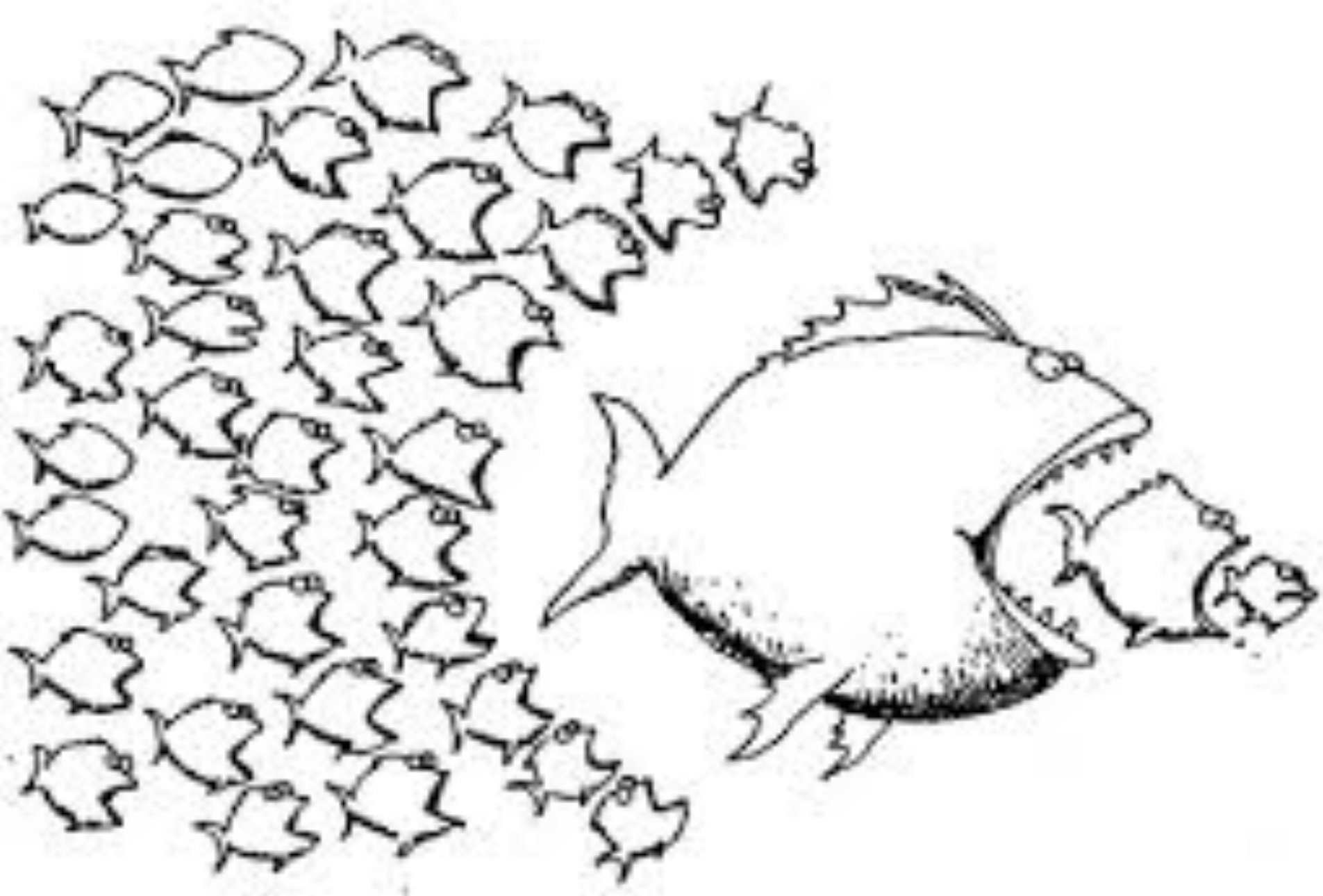
Us



Generation



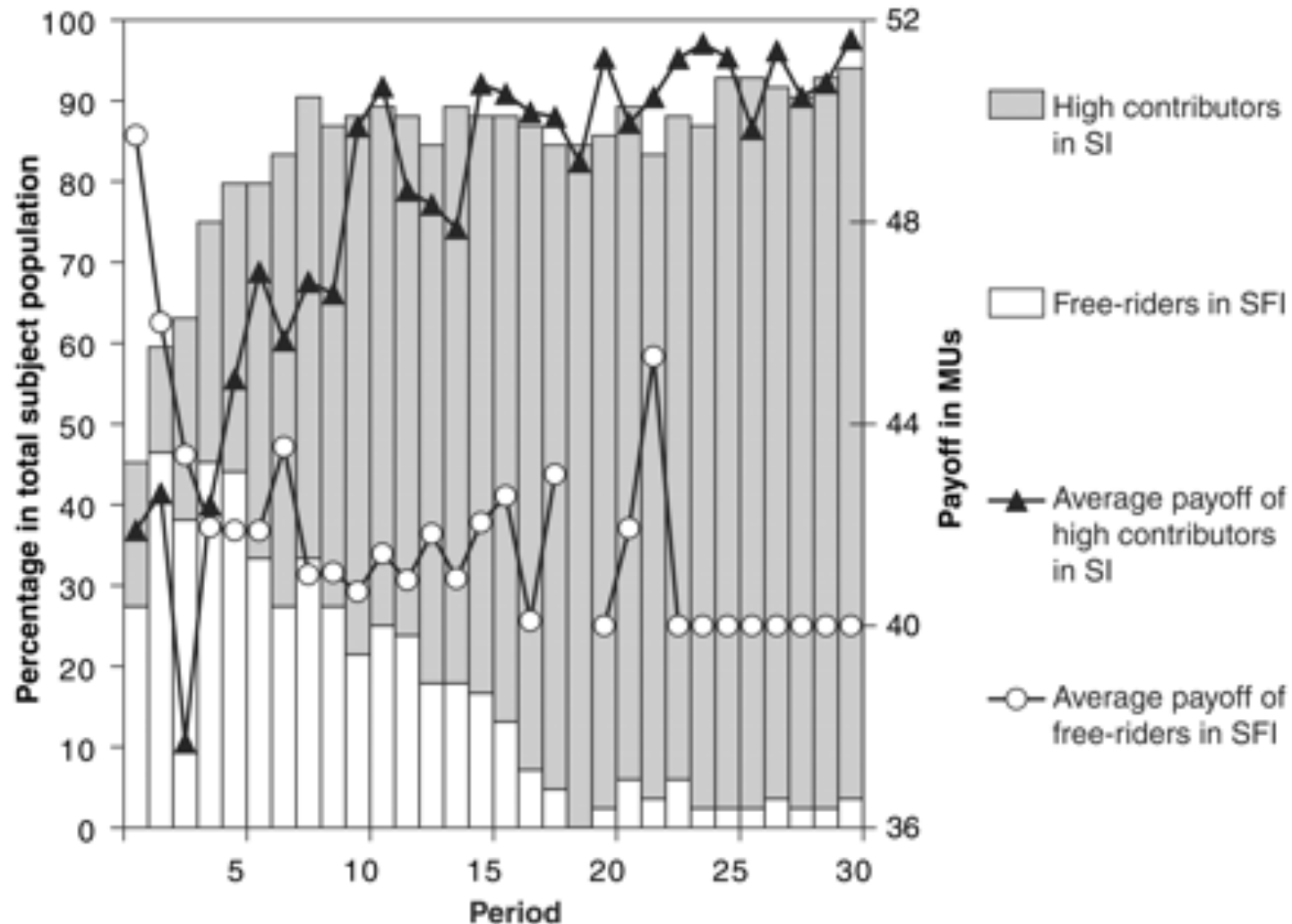
WIKIPEDIA
The Free Encyclopedia



Crowd Security

Larson

Self-Regulation Works, if a Sanctioning Institution is Available



Empirical Studies of Self-Governance Confirm Efficiency, Given Proper Design Principles



ELINOR OSTROM

2009 Nobel Laureate
in Economic Sciences

Nobel medal © © The Nobel Foundation





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