



Cambridge Centre for Risk Studies  
**Advisory Board Research Showcase – 29 January 2019**

# Digital Risk in the Economy

Centre for  
**Risk Studies**

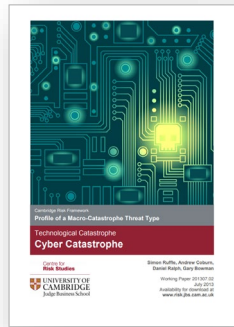


Dr. Andrew Coburn  
Chief Scientist  
Cambridge Centre for Risk Studies

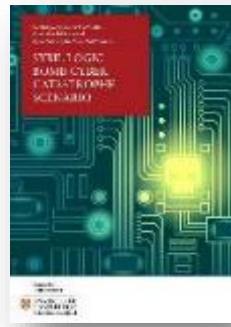




# A Lengthy History of Cyber Risk Research



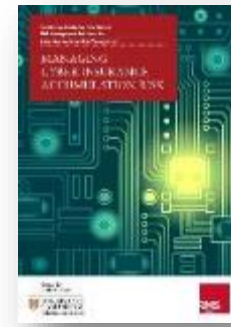
2013  
Cyber Catastrophe  
Threat Monograph



2014  
Sybil Logic Bomb  
Stress Test  
Scenario



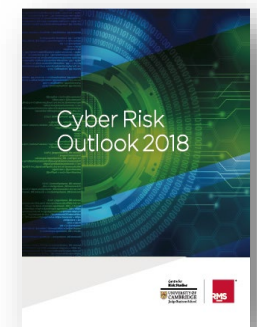
2015  
Business Blackout  
CNI Scenario



2016  
Exposure Data Schema  
and Accumulation Risk



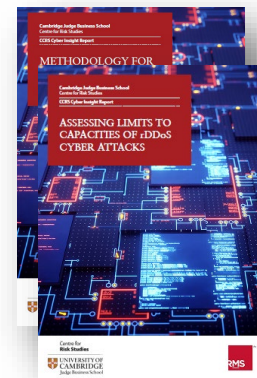
2017  
Cyber Risk  
Landscape Monitoring



2018  
Cyber Risk  
Outlook



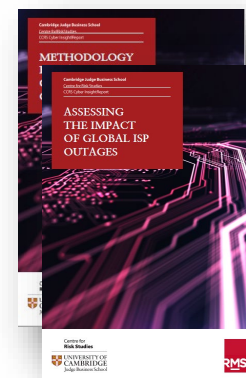
2018  
Threat Actors in the  
Cyber Black  
Economy



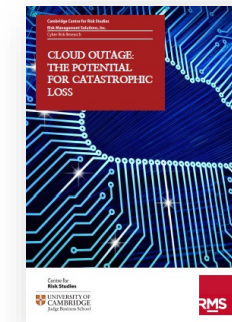
2018  
Assessing Limits to  
Capabilities of rDDoS  
Cyber Attacks



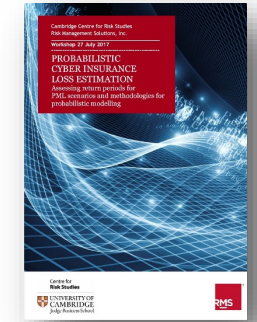
2018  
Insights from the  
MISP Database



2018  
Assessing the Impact  
of Global ISP Outages



2018  
Cloud Outage: The  
Potential for  
Catastrophic Loss



2018  
Probabilistic  
Cyber Assessment

## Our New Publication



# SOLVING **CYBER RISK**

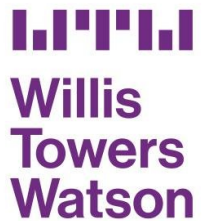
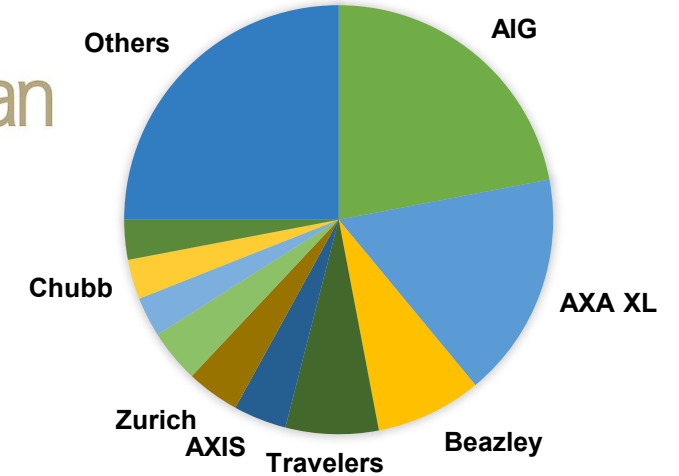
PROTECTING YOUR COMPANY  
AND SOCIETY



UNIVERSITY OF  
CAMBRIDGE  
Judge Business School

Centre for  
**Risk Studies**

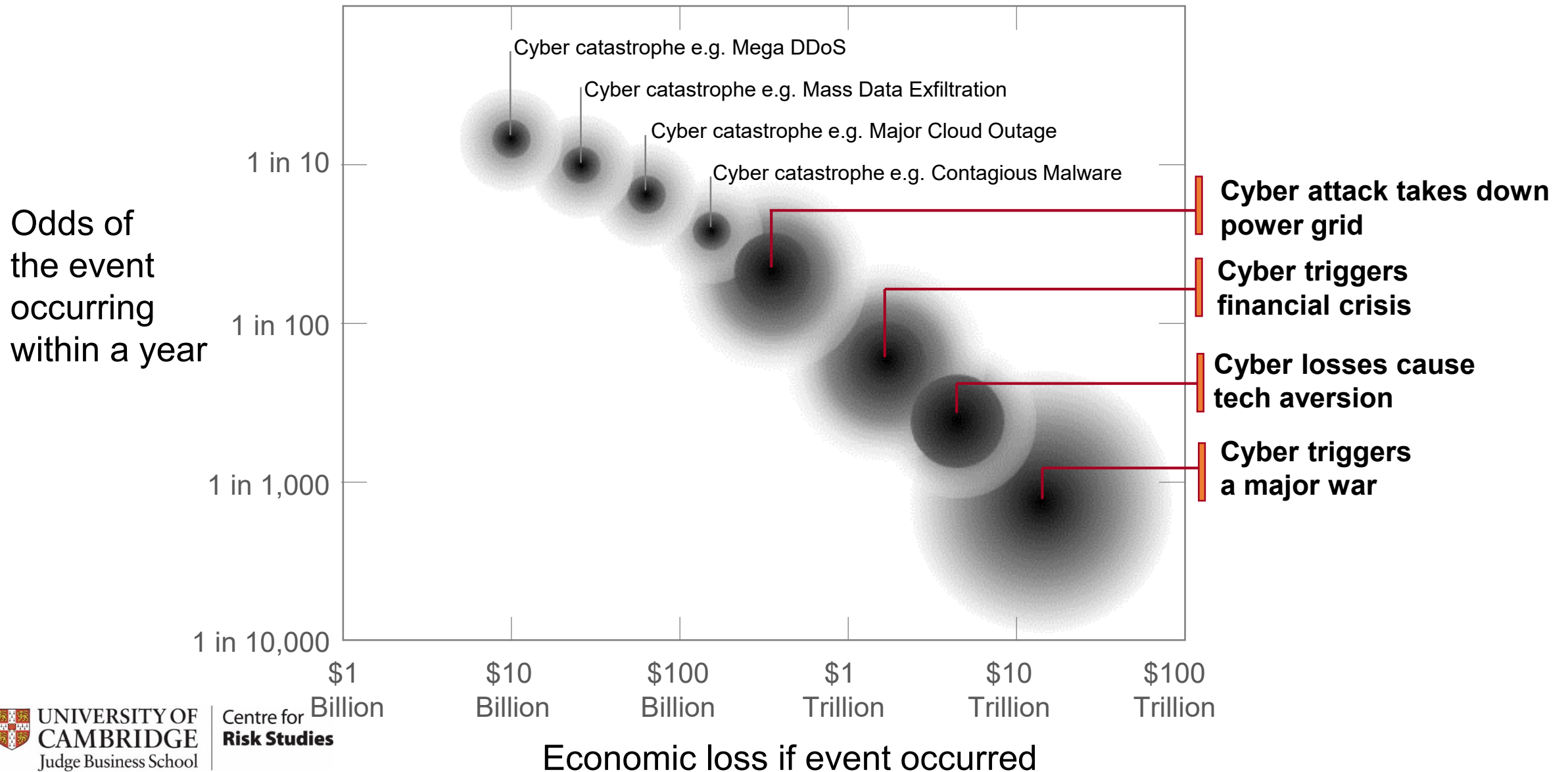
# Working With Many of the World's Leading Cyber Insurance Players



## Cyber Loss: A Modern Plague

- 1,000 companies a year report a theft of protected data
- A data theft of 10 million records can cost a company a billion dollars
- Over 3 billion personal data records have been stolen in US
  - Enough for each citizen to have lost their personal details 10 times
- Companies suffer attempted denial of service attacks every 8 minutes
- One in every 100 e-mails is suspected to carry malware
- Online financial theft is estimated at tens of billions of dollars a year
- Less than a hundred people were sent to jail for cyber crime in 2017
- **We estimate that cyber loss runs at over \$500,000,000,000 a year**
  - **Around 2% of Global GDP**

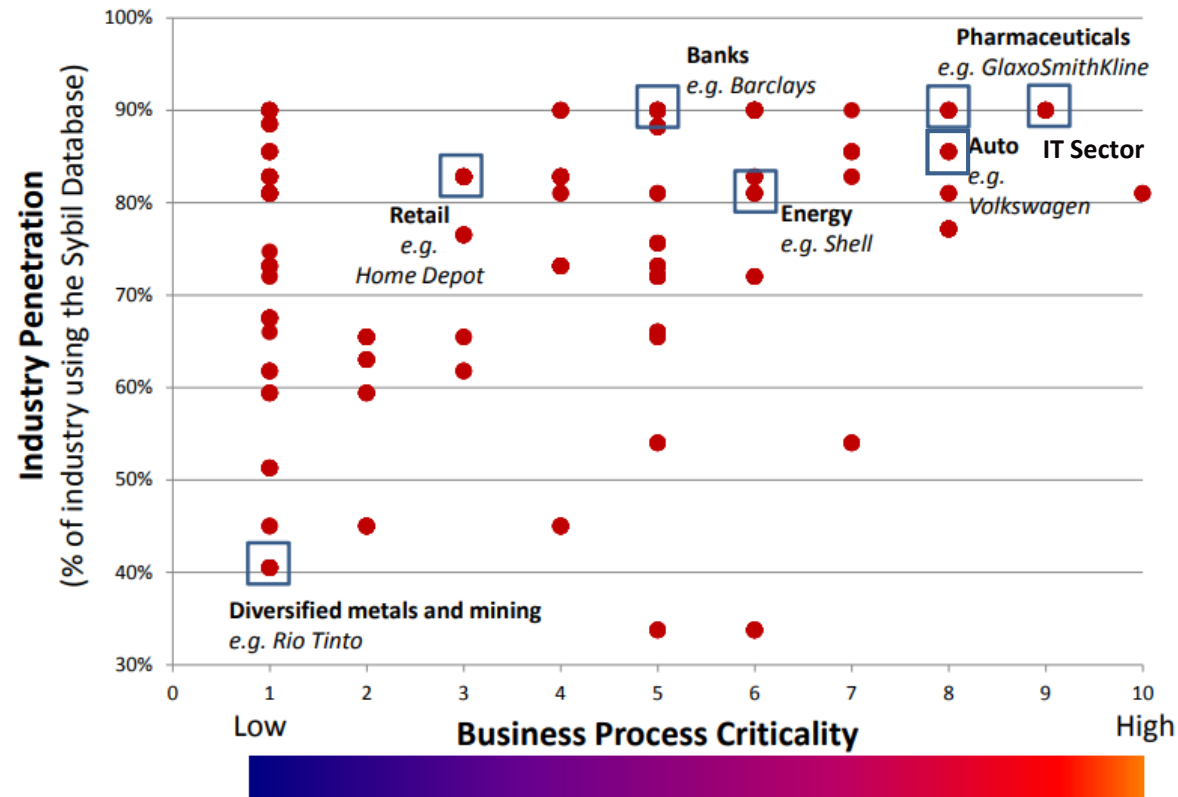
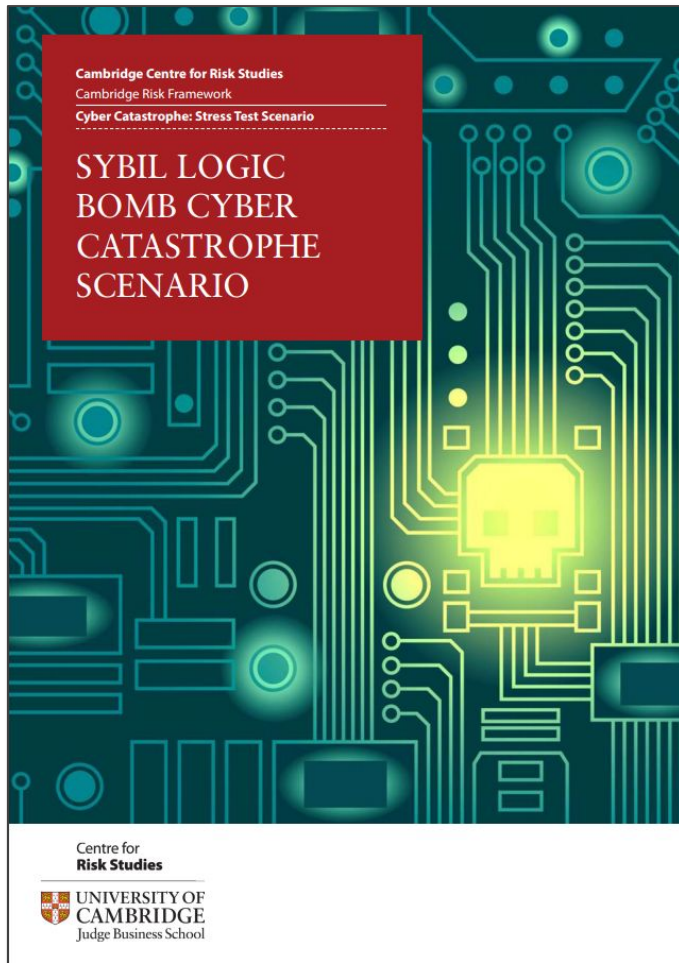
# The Potential for a Cyber Catastrophe





# Cyber Malaise

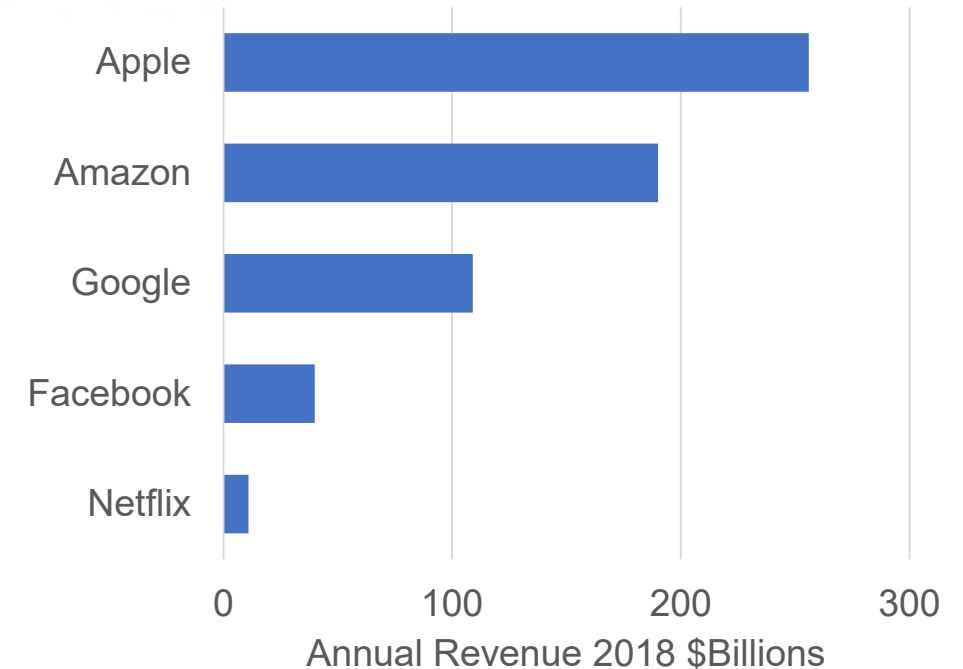
- We first identified the concept of economic loss through tech aversion in our 2013 Sybil Logic Bomb scenario
- Sybil's impact in causing distrust cost an estimated \$5 to \$15 Trillion to the global economy



## The FAANGs



- Facebook, Apple, Amazon, Netflix, Alphabet's Google
- Collective Market Capitalization is over \$3 trillion
- These five companies alone represent 11 percent of the S&P 500 index
- They have a combined annual revenue of over \$600 Bn
- They have grown very rapidly
- They represent the new digital economy





# Mapping of US Companies by Size & Sector

U.S.	Number of Employees:	Premier >2,000	Large 500-1,999	Medium 100-499	Small 20-99	All	% of total
	Revenue:	>\$3 Bn	\$40m-\$3Bn	\$10m-\$40m	\$2m-\$20m		
	Ave Annual Revenue:	\$14 Bn	\$240 m	\$28 m	\$11 m		
<b>Business Sector</b>							
Information Technology - Software		11	55	267	1,046	1,379	0.2%
Information Technology - Hardware		12	14	61	168	255	0.0%
Information Technology - Services		32	395	1,897	7,507	9,831	1.6%
Retail		177	2,177	12,645	80,486	95,485	16.0%
Financial Services - Banking		44	277	2,201	6,238	8,760	1.5%
Financial Services - Insurance		70	254	976	4,061	5,361	0.9%
Financial Services - Investment Management		52	205	2,201	2,362	4,820	0.8%
Healthcare		47	2,877	15,654	61,702	80,280	13.4%
Business & Professional Services		49	4,473	15,757	60,704	80,983	13.6%
Energy		58	27	338	1,838	2,261	0.4%
Telecommunications		13	43	221	1,013	1,290	0.2%
Utilities		89	94	527	2,986	3,696	0.6%
Tourism & Hospitality		27	681	6,292	87,155	94,155	15.8%
Manufacturing		285	2,119	8,805	40,876	52,085	8.7%
Pharmaceuticals		23	34	136	354	547	0.1%
Defense / Military Contractor		2	25	27	124	178	0.0%
Entertainment & Media		37	407	2,528	15,385	18,357	3.1%
Transportation / Aviation / Aerospace		43	896	2,937	13,985	17,861	3.0%
Public Authority / NGOs / Non-Profit		0	215	1,558	18,562	20,335	3.4%
Real Estate / Property / Construction		28	813	5,592	48,516	54,949	9.2%
Education		16	387	2,398	13,372	16,173	2.7%
Mining & Primary Industries		4	81	236	759	1,080	0.2%
Food & Agriculture		56	283	1,210	5,295	6,844	1.1%
Other		0	215	1,558	18,562	20,335	3.4%
All		1,173	17,047	86,021	493,056	597,297	
		0.2%	2.9%	14.4%	82.5%		

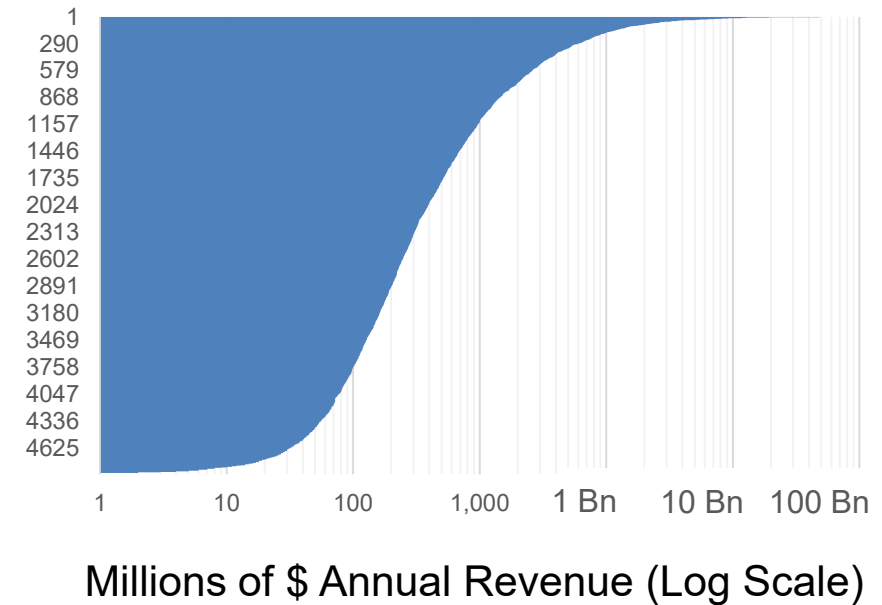
IT Sector  
Premier 55  
Large 464  
Total 519

Companies whose  
revenues are  
derived completely  
online: 277

# Profile of the Large IT Company Sector

	IT		
	Software	Hardware	Services
Total Number of Companies in Sector	421	125	896
Number of Companies Reporting Revenue	286	80	596
% of Companies with Reported Revenue	68%	64%	67%
Total Revenue of Companies Reporting (\$m)	184,086	528,296	804,436
Average Revenue of Reported (\$ millions)	644	6,604	1,350
Revenue of Largest Company in Sector (\$m)	19,089	220,288	85,320
Largest Company in Sector	Schlumber Technologies Inc.	Apple Inc.	Microsoft Corp
Company ID	5215	452	3938
Median Revenue (50th %ile) of Sector (\$m)	<b>225</b>	<b>482</b>	<b>199</b>
Example Company at 50th %ile with that revenue	HubSpot, Inc.	Quantum Corporation	Turning Technologies, LLC
Example Company ID	3021	4876	6248
No. of Companies with Web Address & IP info	305	74	644
% of Companies in Sector with Known Web Info	72%	59%	72%
Monthly Visitors of Websites in Sector (billions)	3.1	3.2	216.0

Ranking of Companies by Revenue  
of 4,904 Enterprises reporting revenue



# 'Internet Businesses': Online Revenue Dependency

277 IT companies have revenues that are 90+% dependent on online

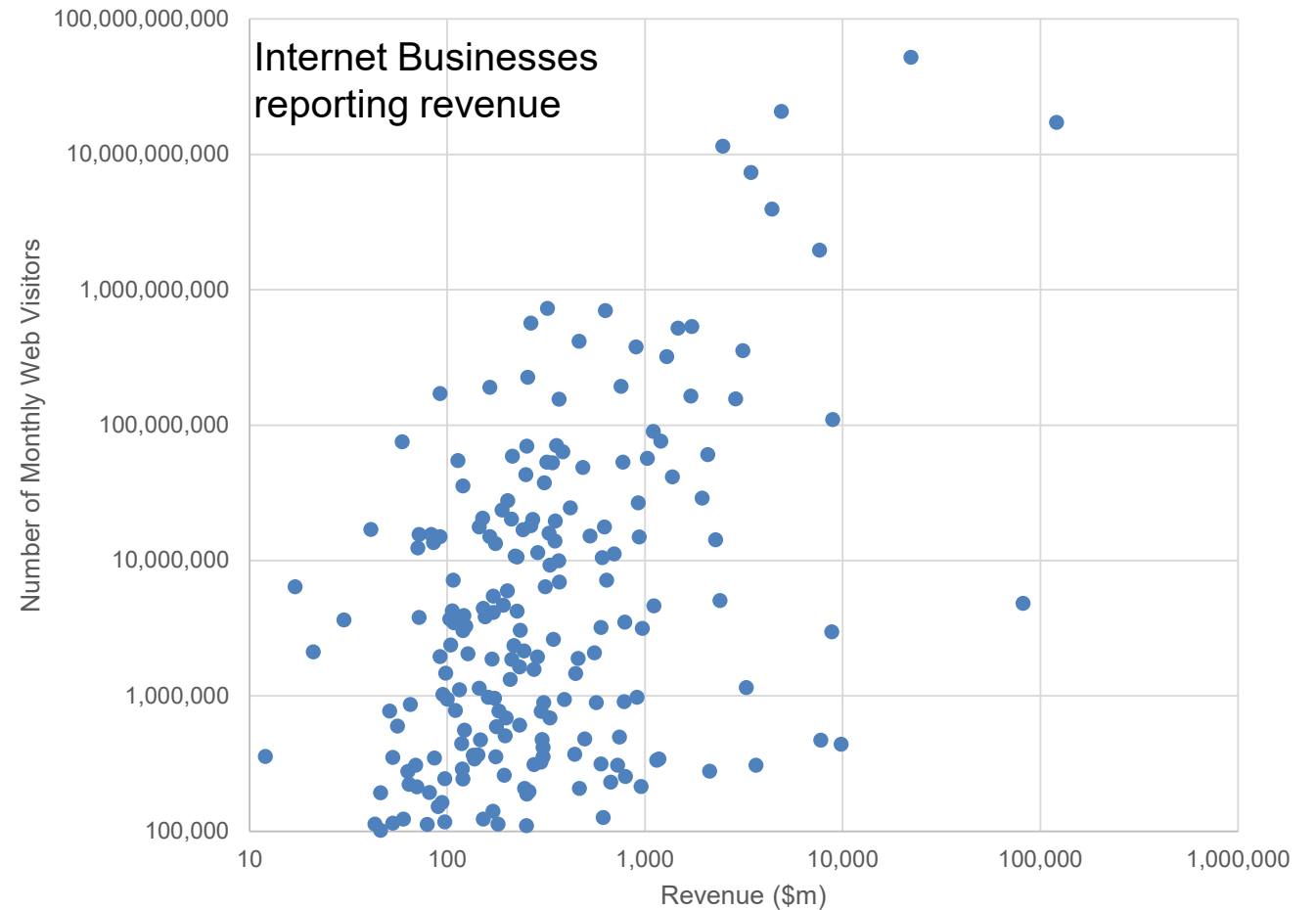
## Internet and Direct Marketing Retail (Sample)

### Internet and Direct Marketing Retail

Newegg Inc.

- zulily, llc
- Woot Inc.
- Barnes & Noble Booksellers, Inc.
- Barnesandnoble.com, Inc.
- Orbitz Worldwide, Inc.
- Kmart.Com LLC
- Travelocity, Inc.
- The Neiman Marcus Group, LLC
- drugstore.com, inc.
- Vitacost.com, Inc.
- Eastbay Inc.
- Musician's Friend Inc.
- Blair Corporation
- CustomInk, LLC
- The Sportsman's Guide, Inc.
- Peapod LLC
- FTD Group, Inc.
- 1-800 CONTACTS, Inc.
- AmeriMark Direct, LLC
- dELIA\*s, Inc. (OTCPK:DLIA.Q)
- Current Media Group LLC
- American Blind and Wallpaper Factory,
- BSN Sports, Inc.
- CobornsDelivers, LLC
- Worldwide Vacation & Travel, Inc.
- **Amazon.com, Inc.**
- The Priceline Group Inc. (QVC, Inc.
- Expedia Inc
- **Netflix, Inc.**
- HSN, Inc.
- Groupon, Inc.
- Wayfair Inc. (NYSE:W)
- America's Collectibles Network, Inc.
- Bluestem Group Inc. (OTCPK:BGRP)
- Central Purchasing LLC
- Overstock.com Inc.
- TripAdvisor Inc.
- Lands' End, Inc.
- 1-800-Flowers.com Inc.
- Shutterfly, Inc.
- Mouser Electronics, Inc.
- OTC Direct, Inc.
- HSNi, LLC
- EVINE Live Inc.
- BSCV Department Store, LLC
- Backcountry.com, LLC
- LTD Commodities, LLC
- Duluth Holdings Inc.
- Etsy, Inc. (NasdaqGS:ETSY)
- Gilt Groupe, Inc.
- Fresh Direct, LLC
- U.S. Auto Parts Network, Inc.
- Fareportal, Inc.
- Drs. Foster & Smith, Inc.
- Thirty-One Gifts, LLC
- Sierra Trading Post, Inc.
- Starcrest Products of California, Inc.
- Footlocker.com, Inc.

### Internet Businesses



# More Companies Whose Revenues are Dependent on Being Online

277 US companies have revenues that are 100% dependent on online  
Internet Software and Services (203):

## Internet Software and Services (203)

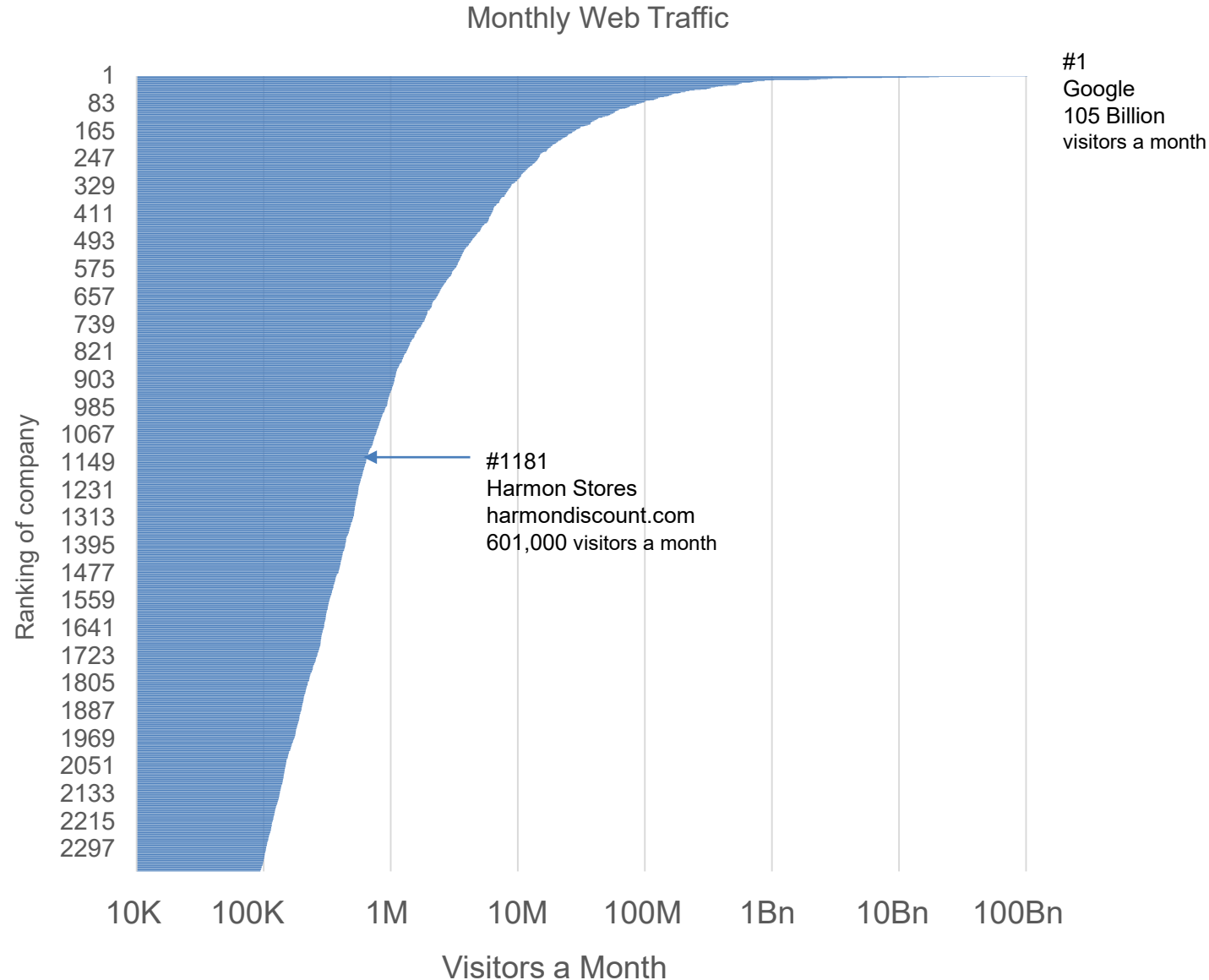
- Google Inc.
- IAC Search & Media, Inc.
- Historic AOL LLC
- Trulia, Inc.
- Cisco WebEx LLC
- eCollege.com, Inc.
- Rackspace US, Inc.
- OpenTable, Inc.
- Playboy Enterprises International, Inc.
- CyberSource Corporation
- Network Solutions, LLC
- OCLC Online Computer Library Center, Inc.
- LendingTree, LLC
- LegalZoom.com, Inc.
- Salary.com, Inc.
- Digital River Inc.
- Travelport Limited
- Dealertrack Technologies, Inc.
- Genesys Telecommunications Laboratories, Inc.
- Active Network, LLC
- Active Network, LLC
- Move, Inc.
- Millennial Media Inc.
- Netscape Communications Corporation
- Freightquote.com, Inc.
- Digital Insight Corporation
- Internet Brands, Inc.
- TravelClick, Inc.
- Radial
- Workfront, Inc.
- Verio Inc.
- HERE Holding Corporation
- Saba Software, Inc.
- Telogis, Inc.
- Dialogic, Inc.
- Piksel Inc.
- Cox Automotive, Inc.
- Vertafore, Inc.
- GXS Worldwide, Inc.
- Infogroup Inc.
- E2open, Inc.
- ASG Technologies Group, Inc.
- EasyLink Services International Corporation
- NorthgateArinso, Inc.
- NaviSite, Inc.
- The Cobalt Group, Inc.
- Webloyalty, Inc.
- CenturyLink Technology Solutions
- Alphabet Inc. (NasdaqGS:GOOGL)
- Facebook, Inc. (NasdaqGS:FB)
- eBay Inc. (NasdaqGS:EBAY)
- Yahoo! Inc. (NasdaqGS:YHOO)
- MSN
- LinkedIn Corporation (NYSE:LKND)
- IAC/InterActiveCorp (NasdaqGS:IAC)
- Twitter, Inc. (NYSE:TWTR)
- Akamai Technologies, Inc. (NasdaqGS:AKAM)
- Rackspace Hosting, Inc. (NYSE:RAX)
- GoDaddy Inc. (NYSE:GDDY)
- Pandora Media, Inc. (NYSE:P)
- AutoTrader.com, Inc.
- Inmar, Inc.
- VeriSign, Inc. (NasdaqGS:VRSN)
- EarthLink Holdings Corp. (NasdaqGS:ELNK)
- Sabre GLBL Inc.
- Mitchell International, Inc.
- Endurance International Group Holdings, Inc. (NasdaqGS:EIGI)
- Hulu, LLC
- j2 Global, Inc. (NasdaqGS:JCOM)
- CoStar Group Inc. (NasdaqGS:CSGP)
- Yardi Systems, Inc.
- LivingSocial, Inc.
- Ancestry.com LLC
- Zillow Group, Inc. (NasdaqGS:ZG)
- WebMD Health Corp. (NasdaqGS:WBMD)
- Yelp Inc. (NYSE:YELP)
- LexisNexis Group Inc.
- Web.com Group, Inc. (NasdaqGS:WEB)
- j2 Cloud Services, Inc.
- Blue Coat, Inc.
- Premiere Global Services, Inc.
- Gogo Inc. (NasdaqGS:GOGO)
- ProQuest LLC
- Envestnet, Inc. (NYSE:ENV)
- HomeAway, Inc.
- GTT Communications, Inc. (NYSE:GTT)
- Shutterstock, Inc. (NYSE:SSTK)
- Rocket Fuel Inc. (NasdaqGS:FUEL)
- Nutanix, Inc.
- InComm, Inc.
- GrubHub Inc. (NYSE:GRUB)
- Cornerstone OnDemand, Inc. (NasdaqGS:CSOD)
- Bankrate, Inc. (NYSE:RATE)
- comScore, Inc. (NasdaqGS:SCOR)
- Constant Contact, Inc.
- 1&1 Internet Inc.
- Research Now Group, Inc.
- Box, Inc. (NYSE:BOX)
- ReachLocal, Inc.
- Angie's List, Inc. (NasdaqGS:ANGI)
- MetricStream, Inc.
- AppNexus, Inc.
- LogMeIn, Inc. (NasdaqGS:LOGM)
- Internap Corporation (NasdaqGS:INAP)
- GXS, Inc.
- NIC Inc. (NasdaqGS:EGOV)
- Datapipe, Inc.
- QuinStreet, Inc. (NasdaqGS:QNST)
- Blucora, Inc. (NasdaqGS:BCOR)
- Stamps.com Inc. (NasdaqGS:STMP)
- IntraLinks Holdings, Inc. (NYSE:IL)
- Demandware, Inc.
- DocuSign, Inc.
- Zillow, Inc.
- TrueCar, Inc. (NasdaqGS:TRUE)
- Quotient Technology Inc. (NYSE:QUOT)
- RetailMeNot, Inc. (NasdaqGS:SALE)
- Jet.com, Inc.
- Ruffalo Noel Levitz, LLC.
- Tradeweb Markets LLC
- Everyday Health, Inc. (NYSE:EVDY)
- DHI Group, Inc. (NYSE:DHX)
- inContact, Inc. (NasdaqCM:SAAS)
- Marketo, Inc.
- Alarm.Com Holdings, Inc. (NasdaqGS:ALRM)
- LivePerson Inc. (NasdaqGS:LPSN)
- Extreme Reach, Inc.
- EBSCO Information Services, Inc.
- Twilio, Inc. (NYSE:TWLO)
- Benefitfocus, Inc. (NasdaqGM:BNFT)
- Cvent, Inc. (NYSE:CVT)
- Yodle, Inc.
- New Relic, Inc. (NYSE:NEWR)
- Bazaarvoice, Inc. (NasdaqGS:BV)
- Turning Technologies, LLC
- INRIX, Inc.
- YourPeople, Inc.
- Allconnect, Inc.
- Appirio Inc.
- 2U, Inc. (NasdaqGS:TWOU)
- SPS Commerce, Inc. (NasdaqGS:SPSC)
- SoftLayer Technologies, Inc.
- YuMe, Inc. (NYSE:YUME)
- Cision, Inc.
- Carbonite, Inc. (NasdaqGM:CARB)
- Limelight Networks, Inc. (NasdaqGS:LLNW)
- Airbnb, Inc.
- Consumer Source Holdings, Inc.
- Hortonworks, Inc. (NasdaqGS:HDP)
- OPower, Inc.
- Velocity Technology Solutions, Inc.
- Care.com, Inc. (NYSE:CRCM)
- XO Group Inc. (NYSE:XOXO)
- Five9, Inc. (NasdaqGM:FIVN)
- Apptio, Inc. (NasdaqGM:APTII)
- Trading Technologies International, Inc.
- Newscycle Solutions, Inc.
- Triple Point Technology, Inc.
- Spredfast, Inc.
- MINDBODY, Inc. (NasdaqGM:MB)
- AppDynamics, Inc.
- Fieldglass, Inc.
- RealNetworks Inc. (NasdaqGS:RNWK)
- BurrellesLuce, Inc.
- CLEAR Wireless LLC
- TechTarget, Inc. (NasdaqGM:TTGT)
- Coupa Software Incorporated
- Marin Software Incorporated (NYSE:MRIN)
- ChannelAdvisor Corporation (NYSE:ECOM)
- SciQuest, Inc.
- Yodlee, Inc.
- Ooyala, Inc.
- Lanyon Solutions, Inc.
- Beeline.com, Inc.
- Sedgwick Claims Management Services, Inc.
- Charles River Systems, Inc.
- Instructure, Inc. (NYSE:INST)
- ZocDoc, Inc.
- Dotster, Inc.
- AppFolio, Inc. (NasdaqGM:APPF)
- Hobsons, Inc.
- PubMatic, Inc.
- St. Louis Post-Dispatch, LLC
- CAMP Systems Inc.
- e-gatematrix, llc
- Amber Road, Inc. (NYSE:AMBR)
- eGain Corporation (NasdaqCM:EGAN)
- Support.com, Inc. (NasdaqCM:SPRT)
- OneSource Virtual, Inc.
- EagleView Technologies, Inc.
- Market Track, LLC
- Qualtrics, LLC
- Inter.Net Global, L.L.C.
- xAd, Inc.
- Vubiquity, Inc.
- Digital Globe Services Inc. (AIM:DGS)
- Citrix Online, LLC
- MuleSoft, Inc.
- Nearpod Inc.
- ReserveAmerica Inc.
- OneNeck IT Solutions LLC
- Zscaler, Inc.
- Bisk Education, Inc.



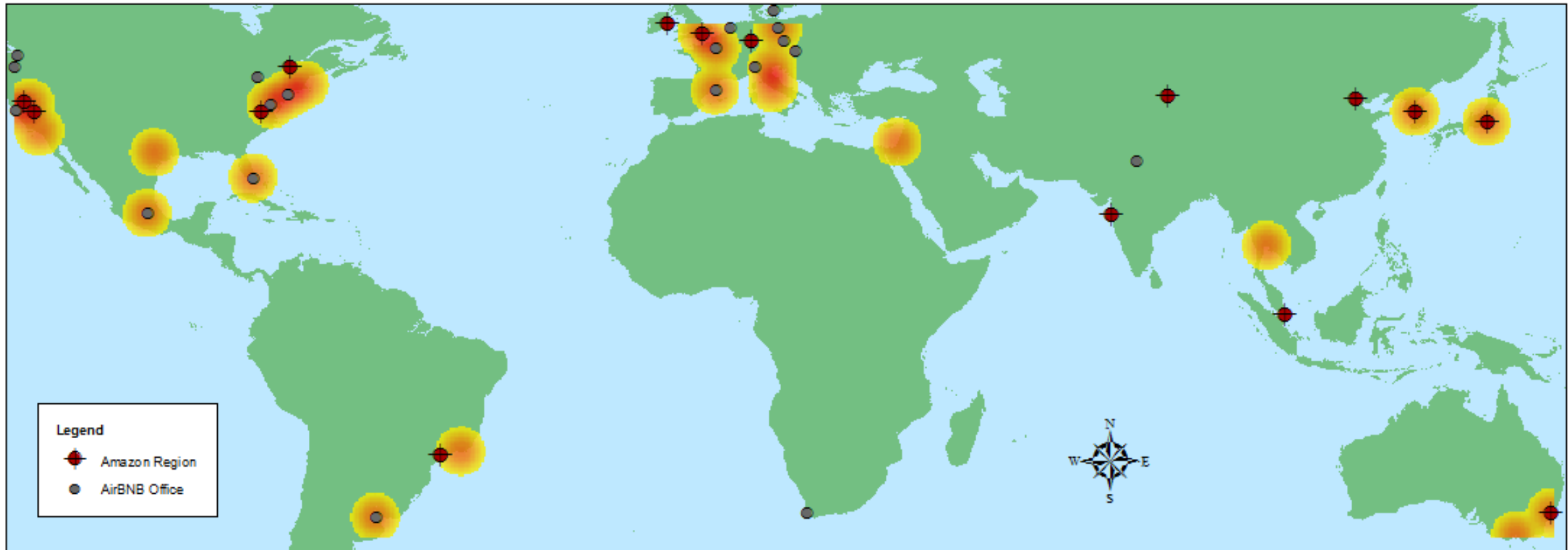


# Web Traffic of Companies in Cambridge Enterprise Sample

- In IT, financial services, and retail, large companies have a collective **260 billion** visitors a month to their websites
- We estimate that **\$2.8 Trillion** of the \$10.7 Tr annual revenue from the 6,838 companies is dependent on online activity
- This represents 15% of the US economy



# Example Company Profile



Kernel Density Map showing global office & client locations for AirBnB. Density of client locations depicted by colour coding

# Revenue Models from Online Services & Traffic

1. Advertising
2. Premium Model
3. E-commerce
4. Affiliate Marketing
5. Subscription Model
6. Licensing
7. Selling Data from Users
8. Sponsorship/Donations
9. Build to Sell
10. Mobile and Gaming Revenue Models

<https://yourstory.com/2014/03/ultimate-master-list-revenue-models-web-mobile-companies/>

Third party calculator to help a website developer calculate the monetization of their online traffic value

Ad Unit or Container type	Measure	Site
	Pages served	1,000,000
Display advertising (CPM)	CPM (Cost Per Thousand)	£10
	% Inventory served	20%
	Avg. Clickthrough (CTR %)	0.10%
	Ad units served per page	2
	Clicks - CPM ads	400
	Revenue - display ads	£4,000
	Earnings per 100 clicks (EPC)	£1,000.0
Fixed Run-of-site Sponsorship	eCPM - display ads	£4.00
	% Inventory served	100%
	Avg. Clickthrough (CTR %)	0.30%
	Ad units served 1	1
	Clicks - fixed	3,000
	Revenue - fixed sponsorship*	£3,000
	Earnings per 100 clicks (EPC)	£100.0
Text ad advertising (CPC)	eCPM - fixed	£3.00
	% Inventory served	100%
	Avg. Clickthrough (CTR %)	1.00%
	Avg. Cost Per Click	£0.30
	Ad units served per page	1
	Clicks - CPC ads	10,000
	Revenue - CPC ads	£3,000
Affiliates Commission (and PPV)	Earnings per 100 clicks (EPC)	£30.0
	eCPM - CPC ads	£3
	% Inventory served	100%
	Avg. Clickthrough (CTR %)	0.50%
	Ad units served per page	1
	Clicks - Affiliates	5,000
	Desination conversion rate (%)	3%
Overall metrics for site	Average order value	£100
	Commission %	10%
	Revenue - affiliates	£1,500
	Earnings per 100 clicks (EPC)	£30.0
	eCPM - affiliates	£1.50
	Clicks - total	18,400
	Revenue - total	£11,500
	Earnings per 100 clicks (EPC) - tot	£62.50
	eCPM - total	£11.50

Blue cells = input variables - vary these for 'what-if' analysis

Orange cells = output variables (calculated - do not overtype)

# Key Risks to IT Companies



## Technology Threats

- Failure of cloud service provision
- Failure of software counterparties
- Failure of internet infrastructure
- Cyber attacks



## Geopolitical Threats

- Censorship of the Internet
- Terrorist attacks on datacenters



## Financial Threats

- Taxation structures ('Google Tax')
- Financial crisis



## Environmental

- Natural hazards impact data centers
- Solar storms take down power grid



## Social & Humanitarian

- Loss of trust by consumers
- 'Facebook' switch-off
- Disruptive competitors
- Insider threats



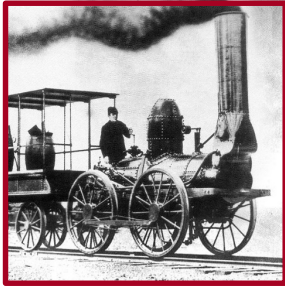
## Governance & Liability

- Regulatory changes
- Antitrust and anti-monopoly break-up
- Gender inequality staff strikes





# Cyber Jeopardizes the 4<sup>th</sup> Industrial Revolution



## 1<sup>st</sup> Industrial Revolution

### The Steam Age

1760 to 1830

GDP per capita (2019 value)

**\$1,800 to \$3,600**



## 2<sup>nd</sup> Industrial Revolution

### The Technology Age

1870 to 1914

GDP per capita (2019 value)

**\$4,800 to \$8,000**



## 3<sup>rd</sup> Industrial Revolution

### Globalization

1970 to 2008

GDP per capita (2019)

**\$17,400  
to  
\$40,000**



## 4<sup>th</sup> Industrial Revolution

### The Digital Age

2019 to ???

GDP per capita

**\$38,200**

to

**???**

# Solving Cyber Risk



Centre for  
**Risk Studies**

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