Charting Cyber Terra Incognita: A CIO's Perspective and Challenges

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personal views
This is our home
3.7 billion miles away
This is our home
3.7 billion miles away

a “Pale Blue Dot”
sunlight reflected from Earth took
$5\frac{1}{2}$ hours to reach Voyager I in 1990
when Voyager I launched in 1977
4.2 billion humans lived on Earth
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global GDP = 7.2 trillion USD
and the Apple II went on sale that year
running at 1 MHz w/ 4 KB of RAM
Voyager I traveled 3.7 billion miles by 1990. 5.3 billion humans lived on Earth.
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Global GDP = 22 trillion USD.

Windows 3.0 released and CERN sets up the first web server at info.cern.ch.
by 2013 >850 million web servers online
7.1 billion humans lived on Earth
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7.1 billion humans lived on Earth

global GDP = 75 trillion USD
7 billion global networked devices
4 ZB (billion TB) of digital content globally
by 2022, 75-300 billion networked devices
8 billion humans will live on Earth
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8 billion humans will live on Earth

global GDP = ?? trillion USD
7 billion humans online & 96 ZB content
digital content > all human eyes see/year
The Importance of Public Service

Public Service = What “We The People” Do Together
The Importance of You

- Public
- Government workers
- Private sector
We’re Confronting Terra Incognita

Latin for “unknown land”
We’re Confronting **Terra Incognita**

Latin for “unknown land”

complexity of all legacy infrastructure

more new internet-connected systems

human actors & behaviors
Confront an average Internet **Minute**

- 204,000,000+ emails sent globally (2014)
- 4,000,000+ Google search queries
- 2,460,000+ pieces of Facebook content shared
- 72+ hours of new YouTube video uploaded
- 48,000+ iOS apps downloaded (per Domo.com)

Stats will grow exponentially in the years ahead.
Confront an average Internet Minute

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20 MINUTES INTO THE FUTURE.
Confront an average Internet Minute

McAfee: 200+ new threat vectors/minute (2013)
FireEye: new malware every 3 mins (2013)
DOE/NNSA: receives 6,940+ attacks/min (2015)
DoD: 85% of emails received = spam (2015)
and receives 13,800+ nefarious emails/minute

stats will grow exponentially in the years ahead
Confront an average Internet minute so how best to venture forth?
(1) Challenges will span All Sectors while in Australia, asked who will protect your grandmother’s car? or her refrigerator?
Challenges will span All Sectors just like “infectious diseases”, cyber threats will not stop at borders, we must build bridges

We The People, Building Bridges
while in Taiwan, saw that most “Internet of Everything” prototypes were based on industrial control endpoints
(2) DIY & the Internet of Everything

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Challenge: Industrial controls historically have not been connected to the internet & historically have had less security vs. TCP/IP.
(2) DIY & the Internet of Everything

makers movement → institutions must encourage & empower “intrapreneurs” to pioneer civic & social innovation
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(3) Be Ready for **Machine-Learning**

pair humans w/ machine-learning assistants
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pair humans w/ machine-learning assistants
work alongside humans, learn from their actions in the appropriate context
we’ve already done this to detect cancer cells & heart anomalies better w/ humans
(3) Be Ready for Machine-Learning

identify strengths & weakness of approach

like a 5 y.o., machines can be great at spotting abnormalities → experts still needed re: why?
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will still need humans to monitor diagnostics to ensure machines aren’t compromised
Bravely Mapping Terra Incognita

1969
Bravely Mapping Terra Incognita

1982
Bravely Mapping Terra Incognita

“in his locis scorpiones nascuntur”

1993
Bravely Mapping Terra Incognita

“in his locis scorpiones nascuntur”

2007
Reflections on the Future

2010
If We Take the $2^{32}$ (~4.3 billion) Numbers Addressable by IPv4 & Put Them Into a Beach Ball
The $2^{128}$ (~340 Followed By 36 zeros) Numbers Addressable by IPv6 = The Volume of Our Sun
Carl Sagan in 1994:
Look again at that dot.
That's here. That's home.
That's us.
On it everyone you love, everyone you know –

Everyone you ever heard of, every human being who ever was, lived out their lives.
To me, it underscores our responsibility to deal more kindly with one another – And to preserve and cherish the pale blue dot, the only home we’ve ever known.
We Will Need More #ChangeAgents in our Exponential Times
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