What Are the National Security Implications of the Coming Technological Singularity?

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Stephen W. Long

Office of the Under Secretary of Defense for Intelligence

Stephen.Long@osd.mil   Stephen.Long@osd.smil.mil   Stephen.Long@osdj.ic.gov

This Briefing UNCLASSIFIED

Opening

- Predicting the Future is difficult job!
  - "The Best Way to Predict the Future is to Invent It." Alan Kay, 1971
  - We can generally predict the next 5 to 10 years because we have a hand in inventing it
- Predicting beyond 10 years (2022+) is murky because predictions about the future of technology tend to be tainted by macromyopia:
  - Tendency to overestimate the short-term effects and at the same time to underestimate the long-term effects of an innovation.
- Black Swan Events - Nassim Nicholas Taleb in his 2007 book, The Black Swan, regards almost all major scientific discoveries, historical events, and artistic accomplishments as "black swans" — undirected and unpredicted.
  - A small number of Black Swans explains almost everything in our world. Historical Black Swan events include World War 1, the personal computer, the rise of the Internet, and the September 11, 2001 attacks.
- The first half of the twenty-first century will be characterized by profound exponentially accelerated technological change, where the rate of change itself is increasing.

Be careful what you predict. It may come back to haunt you...... Or laugh at you…

- "Louis Pasteur's theory of germs is ridiculous fiction". *Pierre Pachet, Prof. of Physiology 1872*
- "This 'telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us." *Western Union internal memo, 1876*.
- "Heavier-than-air flying machines are impossible." *Lord Kelvin, president, Royal Society, 1895*.
- "Everything that can be invented has been invented." *Charles H. Duell, U.S. Patents, 1899.*
- "Airplanes are interesting toys but of no military value." *Marechal Ferdinand Foch, Professor of Strategy, Ecole Superieure de Guerre.*
- "The wireless music box has no imaginable commercial value. Who would pay for a message sent to nobody in particular?" *David Sarnoff's associates in response to investments radio in 1920s.*
- "Who the hell wants to hear actors talk?" *H.M. Warner, Warner Brothers, 1927*.
- "Stocks have reached what looks like a permanently high plateau." *Irving Fisher, Professor of Economics, Yale University, 1929.*
- "I think there is a world market for maybe five computers." *Thomas Watson, IBM, 1943*
- "Computers in the future may weigh no more than 1.5 tons." *Popular Mechanics, 1949*
- Beatles - "We don't like their sound, and guitar music is on the way out." *Decca Recording,1962*.
- "But ... what is it good for?" *Engineer at the Advanced Computing Systems Division of IBM, 1968,commenting on the microchip.*
- "There is no reason anyone would want a computer in their home." *Ken Olson, president, chairman and founder of Digital Equipment Corp., 1977*
- "640K ought to be enough for anybody." *Bill Gates, 1981*
- "$100 million dollars is way too much to pay for Microsoft." *IBM, 1982*

What Is the Singularity and Why Do We Care?

- Technological <u>singularity</u> refers to a prediction that technological progress will become extremely fast, and consequently will make the future (after the singularity) unpredictable and qualitatively different from today.

  – Most often associated with the ideas of futurist Ray Kurzweil.

- It is a core responsibility of the National and Defense Intelligence Communities to look to the future and identify potential threats and intelligence opportunities.

  – Rapid technological changes on the near horizon already have significant National Security implications.

  – Cumulative interaction and <u>in-progress acceleration of technological change will alter everything we think we know about how the future will unfold</u>.

Law of Accelerating Returns

- This "law of accelerating returns" applies to all of technology, indeed to any true evolutionary process, and can be measured with remarkable precision in information based technologies.

- There are a great many examples of the exponential growth implied by the law of accelerating returns in technologies as varied as

  - DNA sequencing, communication speeds,

  - electronics of all kinds, rapidly shrinking size of technology.

- Singularity results not from the exponential explosion of computation alone, but rather from the <u>interplay and myriad synergies</u> that will result from manifold intertwined technological revolutions.

- Every point on the exponential growth curves underlying these panoply of technologies represents <u>an intense human drama</u> of <u>innovation and competition</u>. It is remarkable therefore that these chaotic processes result in such smooth and predictable exponential trends.
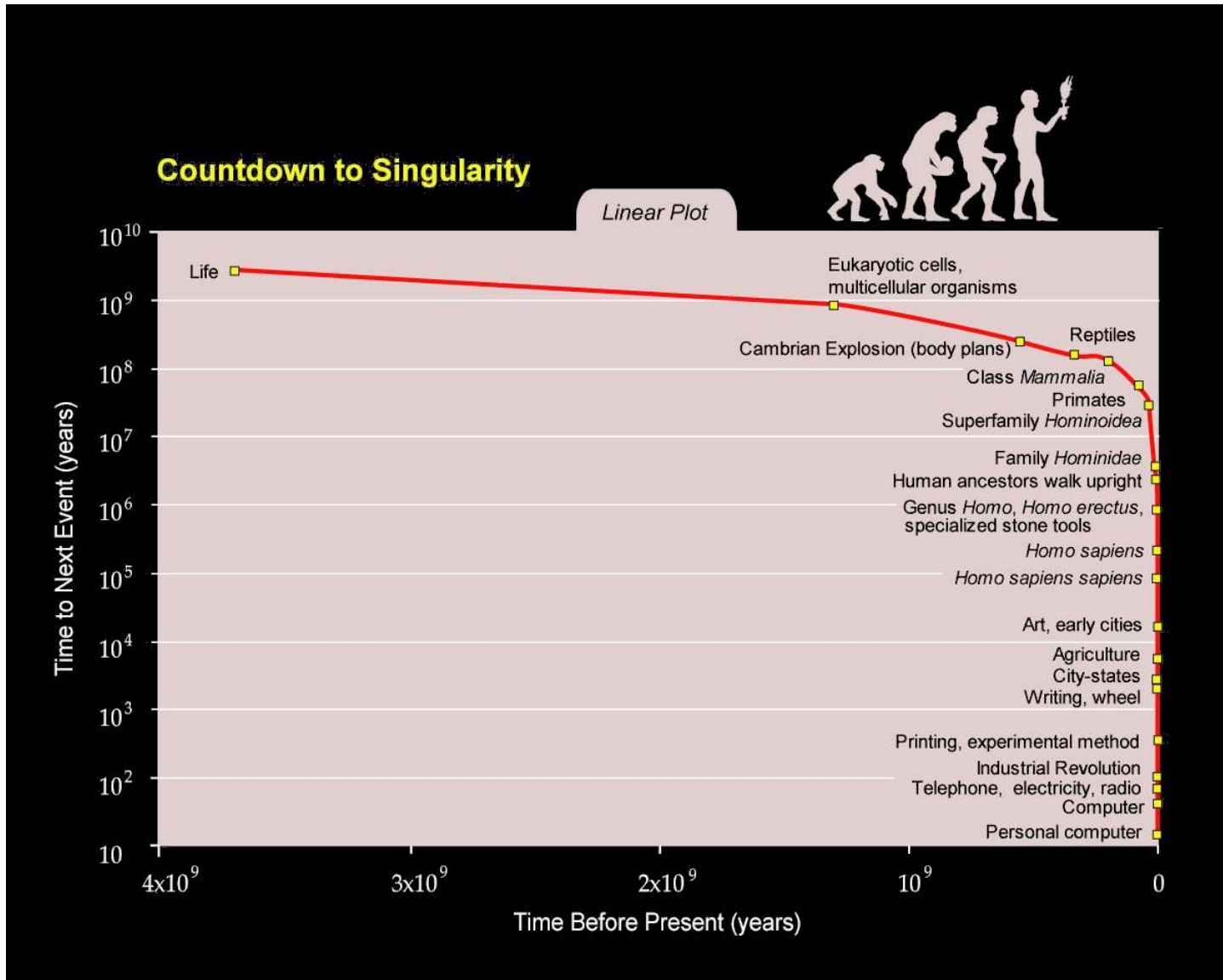
Paradigm Shifts for 15 Lists of Key Events
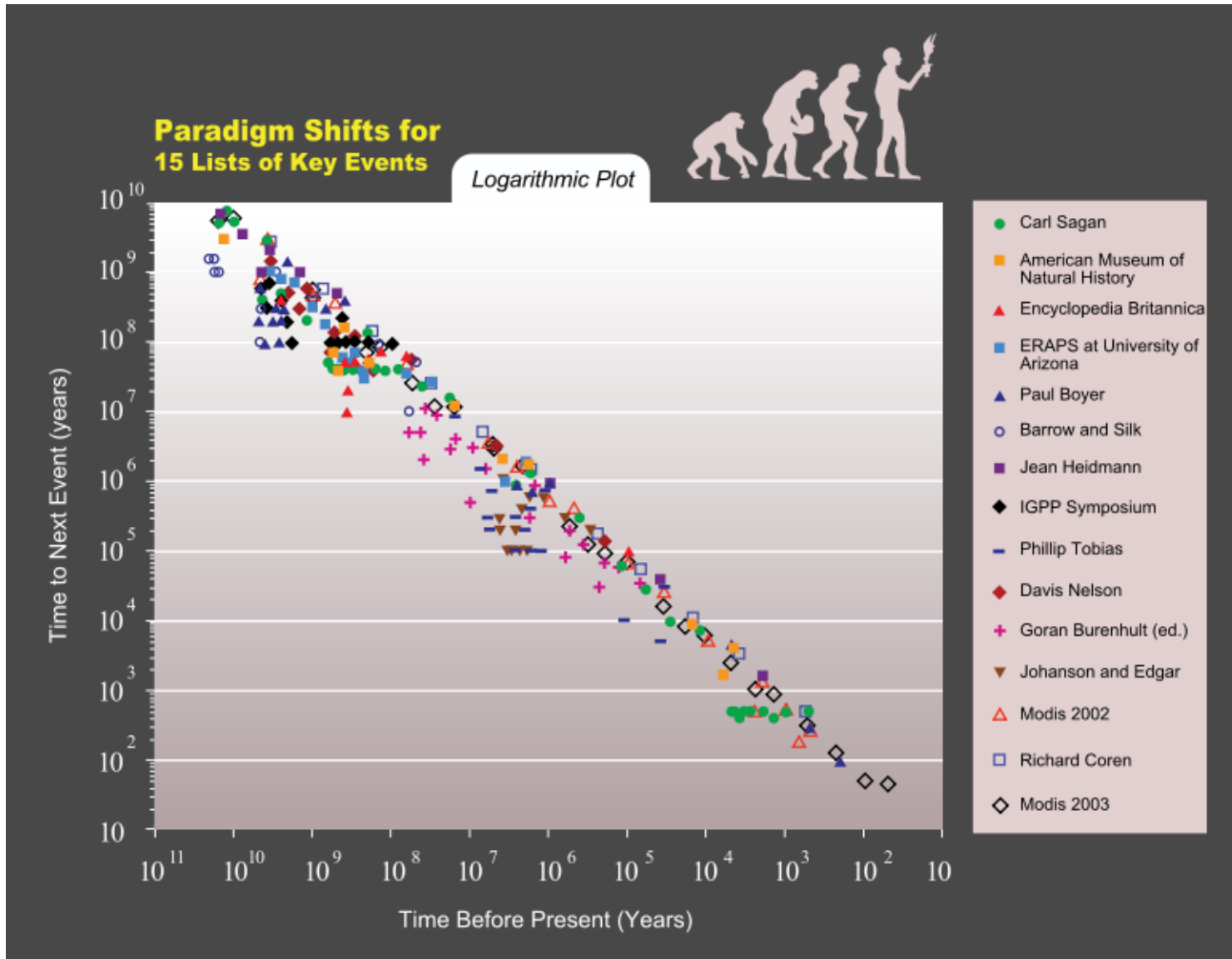
Paradigm Shifts for 15 Lists of Key Events

What Are The Technologies That Will Drive the Future: GNR Revolutions

- The first half of the twenty-first century will be characterized by three overlapping revolutions: GNR
  - Genetics (includes Bio Technology – Bioinformatics)
  - Nanotechnology
  - Robotics (includes Artificial Intelligence)
- We are in the early stages of the "G" revolution today. By understanding the information processes underlying life, we are starting to learn to reprogram our biology to achieve the virtual elimination of disease…
- The "N" revolution will enable us to redesign and rebuild – molecule by molecule – our bodies and brains and the world with which we interact, going far beyond the limitations of biology
- The "R" revolution is the most powerful – human-level robots with their intelligence derived from our own but redesigned to far exceed human capabilities. "R" is the most significant transformation, because intelligence is the most powerful "force" in the universe.

Genetics Revolution / Bio Technology - Bioinformatics

- We are in early stages of the "G" revolution today. By understanding information processes underlying life, we can reprogram our biology…

- Biotechnology on faster growth curve than computers! Biology as computation - Gene sequencing to nanotech as RAM is to micro tech

- First Human Epigenome – 2009 $48k, 2013 $100
  - Cost $10,000 to map 200 gigabases of DNA, 2 human genomes 3 days
    - China purchased 128 advanced sequencing machines - $750k each

- Synthetic Biology - Just Print a Gene
  - Don't clone it - $0.40 print a base 3D Printers for Cells – Organs soon

- Drag and Drop Genetic Engineering - Biology is moving outside of traditional education and industrial circles
  - First created life form – bacteria paper just published
  - More creative, more diverse, and more disruptive in short term
    - Pathogens and Epidemics, Bio-hacking and Bio-warfare, Bio Error
    - Bio-hackers – think about the potential for a "Biological Columbine"

Genetics Revolution / Bio Technology - Bioinformatics
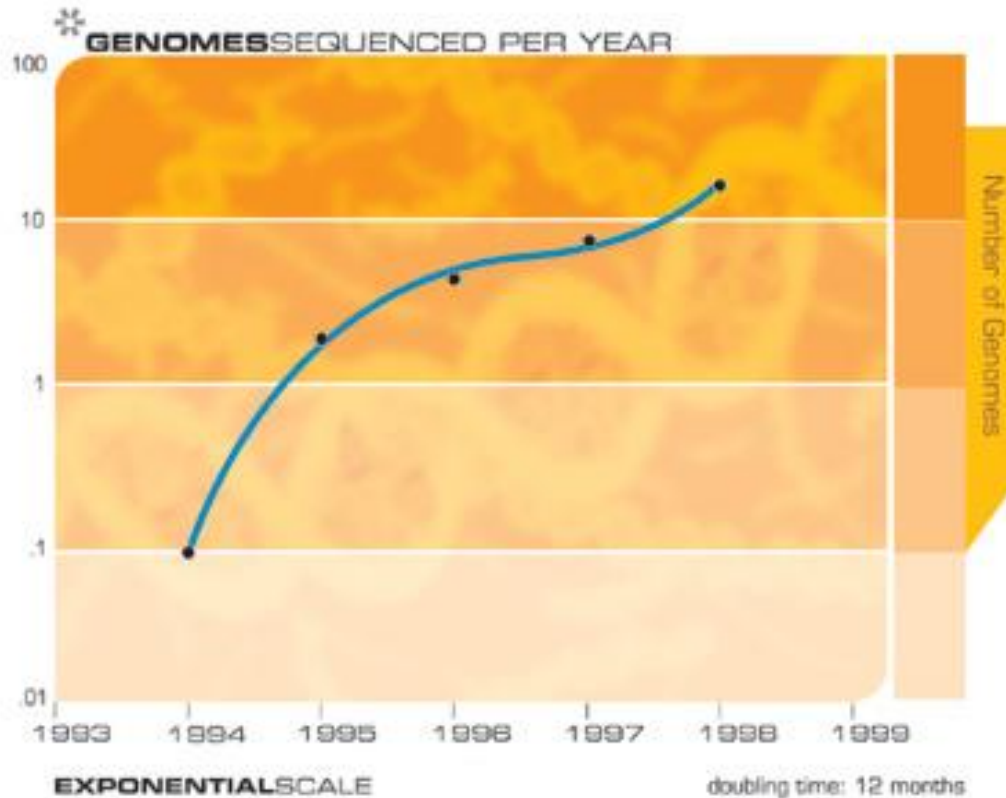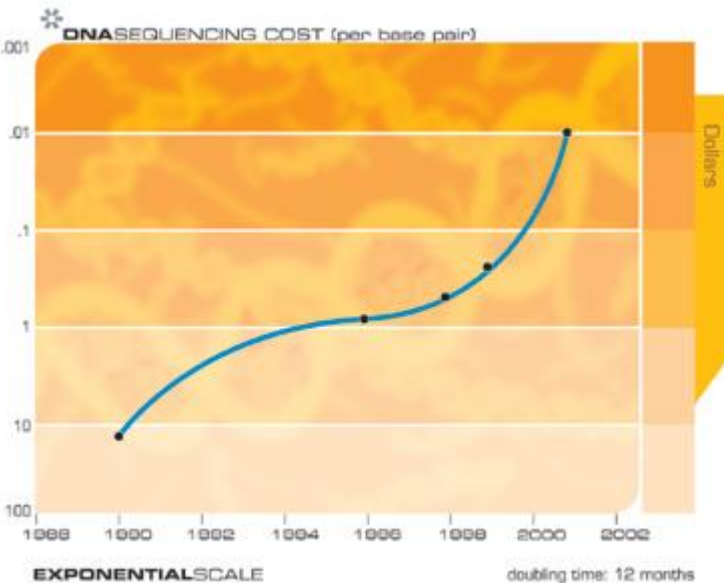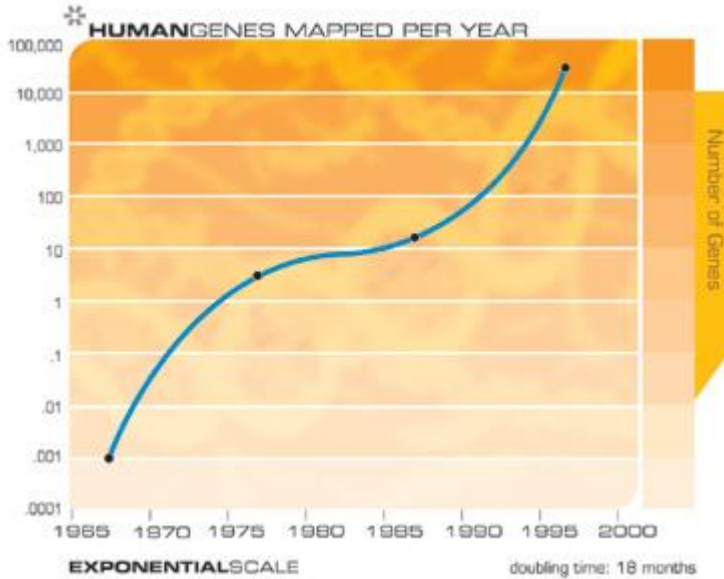
Nanotechnology

- "Nanotechnology has the potential to enhance human performance, to bring sustainable development for materials, water, energy, and food, to protect against unknown bacteria and viruses, and even to diminish the reasons breaking the peace [by creating universal abundance]." NSF Nanotechnology Report

- We are shrinking the key feature size of technology at exponential rate - a factor of four per liner dimension per decade. Key feature sizes for electronic and many mechanical technologies will be nano - under one hundred nanometers – by 2020s.

- Revolution in nanotechnology will ultimately enable us to redesign and rebuild, molecule by molecule, our bodies and brains and the world…full realization of nanotechnology lags behind the biotechnology revolution by about one decade.

- Impacts of Nanotechnology on Aerospace & Defense
    - Structural materials, Coatings, Fuel
    - Electronics & electromechanical systems
    - Weapons, Surveillance, Smart battle dress
    - Life support and environmental

- <u>Nanobased replicators have the potential to present a grave threat to the world</u>. This is particularly true in view of the vastly greater strength and speed of nanobased replicators over any biological system.

Robotics (which includes Artificial Intelligence) Revolutions

- The "R" revolution is the most powerful – human-level robots with their intelligence derived from our own but redesigned to far exceed human capabilities. "R" is the most significant transformation, because intelligence is the most powerful "force" in the universe.

- Narrow Artificial Intelligence - Narrow AI now – expert systems – currently at the tipping point
  - AI's that improve their own code, learning from the web

- Strong Artificial Intelligence

- Internet/Web – Single Global Machine – 5000 days old
 - Hidden "web" is 400-500 times larger than visible one

Networks and Computing Systems

- All of the changes in computation are because the costs have changed – costs plummet

- Networks and Computing Systems Trends
  - Merging Storage at the point of computation (a key premise of Cloud Computing)
  - Latency is at the core of computer problems
  - Networking revolution – interconnecting worlds of atoms and bits

- New era of design / Executable notation
  - How to build reliable systems from unreliable parts
  - Overlapping forms of intellectual technology

- Energy per operation is NOT declining – the question becomes how much energy are you willing to spend to perform calculations

- On-the-horizon breakthroughs
  - Joules per bit, Silicon Photonics, Quantum Computing
  - Biological materials as computers, Nanoscale

Exponential Growth of Computing

Exponential Growth of Computing

Twentieth through twenty first century

Logarithmic Plot

All Human Brains

One Human Brain

One Mouse Brain

One Insect Brain

2012
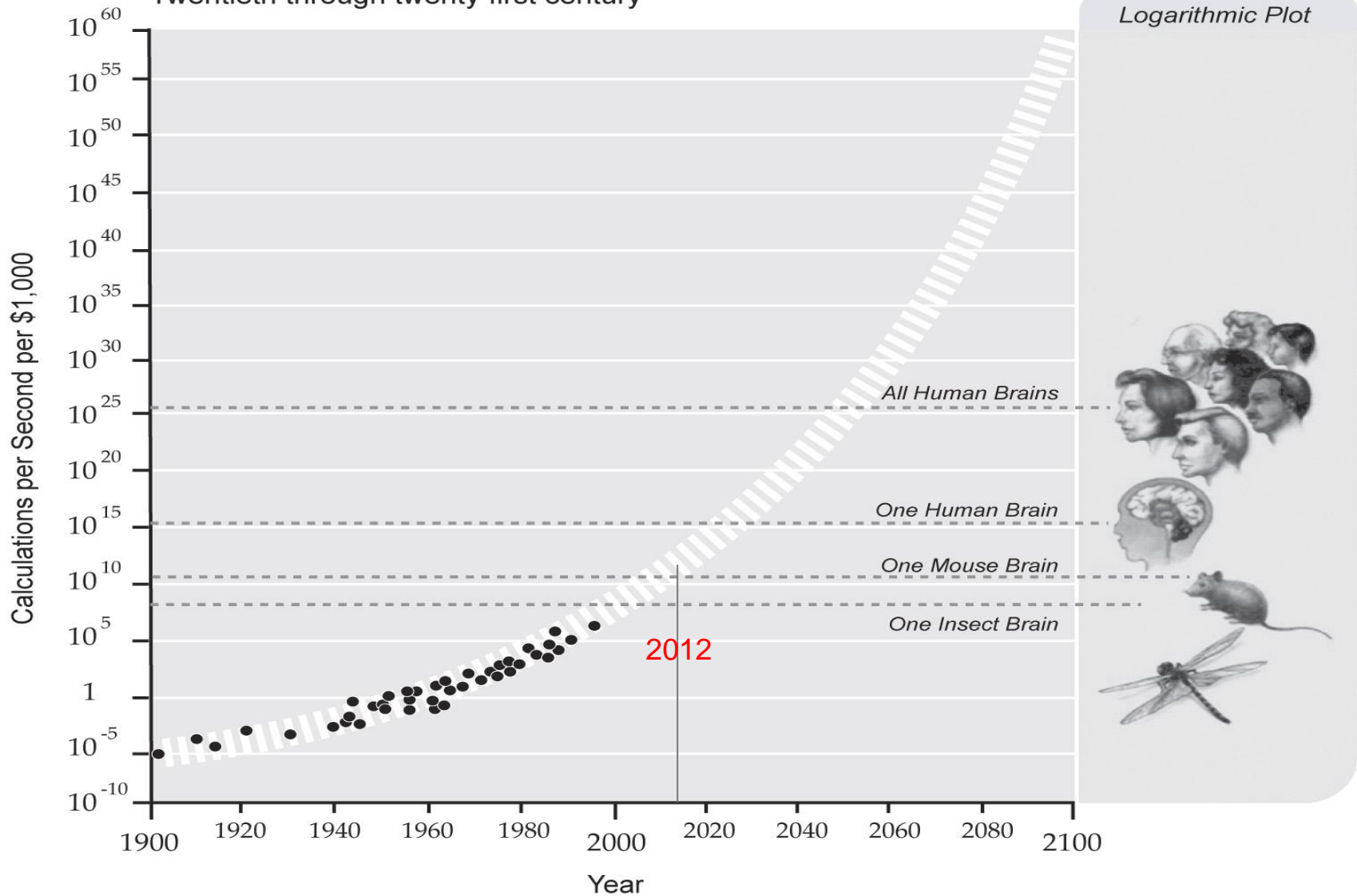
What Are the National Security Implications of Singularity? When and What Should We Do?
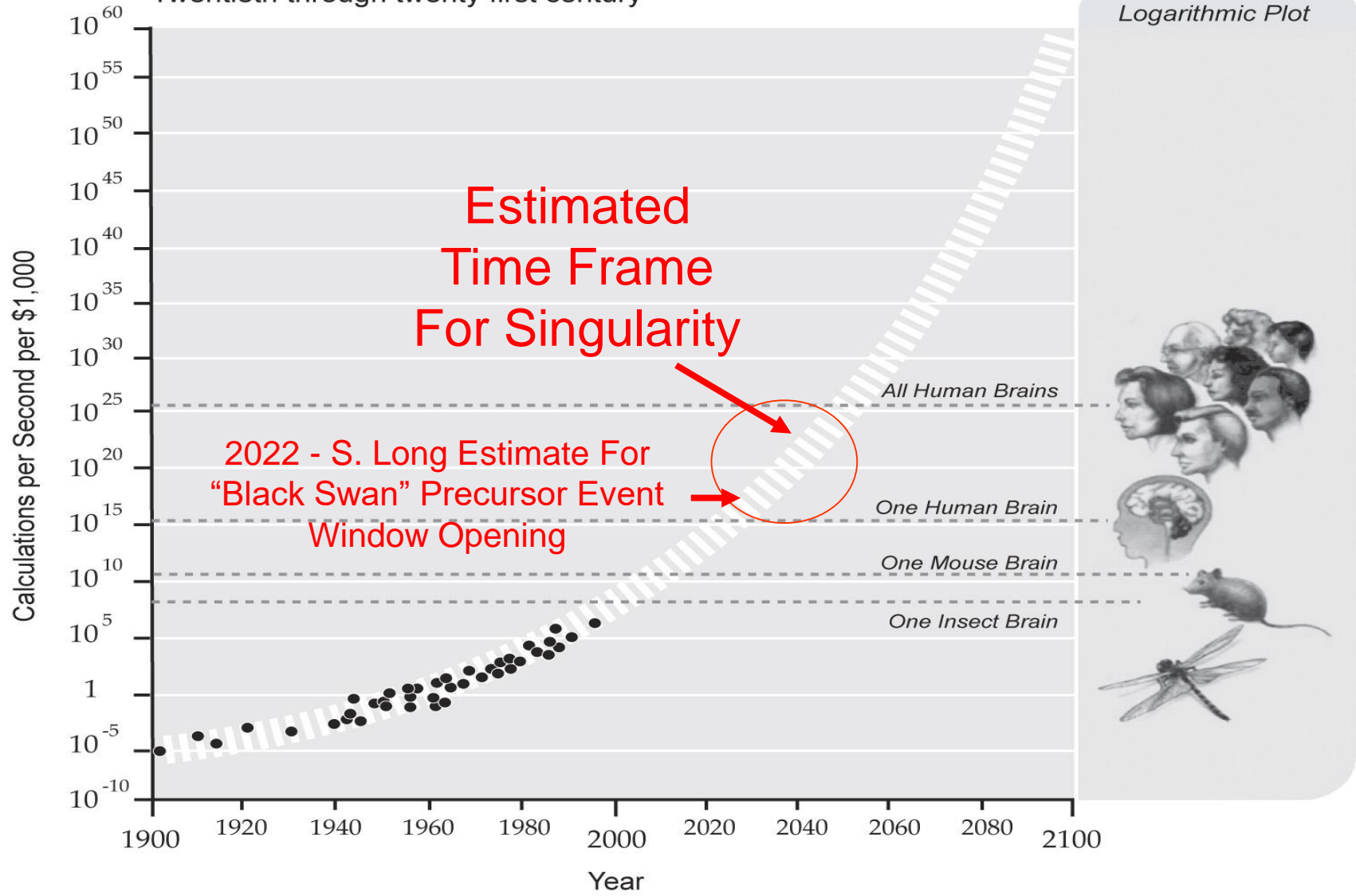
- Government processes move slowly. But the Government has ability to think long term – decades. - Joint Vision 2010 was drafted in late 1990s – and drove much of what we know about Network Centric Warfare today.
  - We already have JV 2020, and JV 2030 is probably under consideration
  - Long term Intelligence Architecture plans already include mid 2020's dates
  - Not aware of a single Intelligence document that acknowledges the technological exponential rate of change of rate of change.

- What Should We Do Now: Awareness and Education
  - Create a core group of people within the Intelligence Community / DoD Community (standing Commission?) that has responsibility to understand and prepare the Nation for the Singularity.
    - Establish East Coast branch of the Singularity University
  - _Need Studies that rigorously examine the National Security implications of exponential technological growth, with specific attention to GNR topics_.
    - Costs are minimal now, will grow significantly later if playing "catch-up"
    - No amount of funding will be sufficient when the curves tip vertical – too late

Exponential Growth of Computing

Exponential Growth of Computing
Twentieth through twenty first century

Estimated
Time Frame
For Singularity

2022 - S. Long Estimate For
"Black Swan" Precursor Event
Window Opening

Closing: Accelerating Technological Change is an Opportunity and a Threat

- You don't have to believe in a Singularity event per say, but we should be profoundly concerned about impacts of accelerating technological change

  - At NASA AIMS, they had to use their existing Super Computer to design the management of the thermodynamics of their next Super Computer, which is being assembled right now – humans could no longer independently design the next generation of supercomputer

- Profound and accelerating technological change is an <u>opportunity and a threat</u> - best defense to survive and prosper is <u>preparation</u>

  - National / Defense Intelligence Communities need to establish Technology Singularity equivalents to a missile early warning – people and tools that would prepare for and recognize precursors to Singularity

- It is a core responsibility of the National and Defense Intelligence Communities to look to the future and identify potential threats and intelligence opportunities - take proactive steps NOW to understand, and even shape that which will come

  - Singularity Precursor Recognition is fundamentally an Intelligence Problem – therefore it is our problem to address.