Security Futures: 2018-2025+
Technology, Tools & Trends

Dr David E. Probert
VAZA International

36th International East West Security Conference

CyberSecurity
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Фьючерсы на Безопасность: 2018-2025+

Технологии, Инструменты и Тенденции

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"Visualisation of Cyberspace": *Global IP "WHOIS" Addresses*

...From 19th C Physical World To 21st C Intelligent World

"Visualisation of Cyberspace": *Global IP "WHOIS" Addresses*
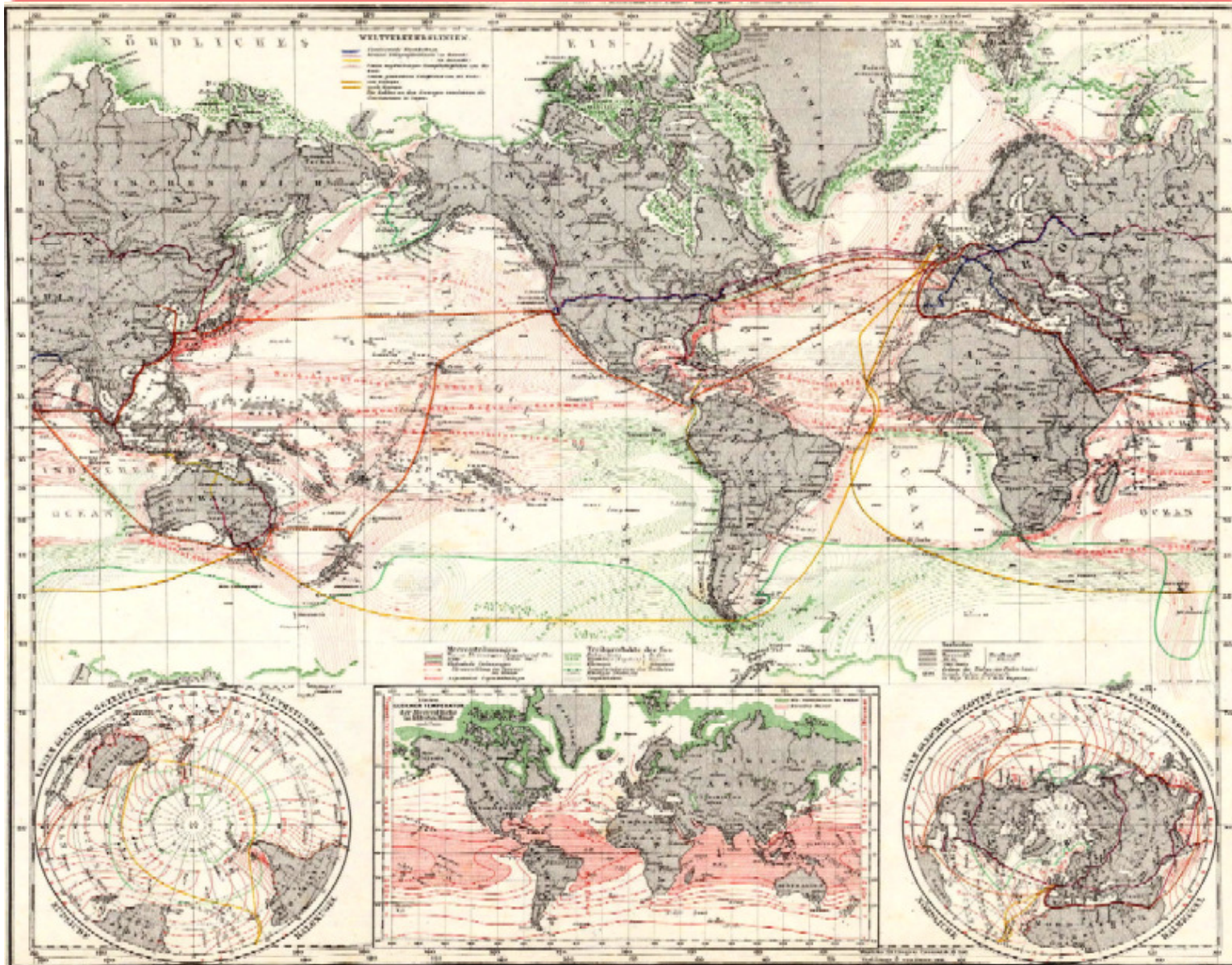
...From 19ᵗʰC Physical World To 21ˢᵗC Intelligent World

"Visualisation of Cyberspace": *Global IP "WHOIS" Addresses*

...From 19thC Physical World To 21stC Intelligent World
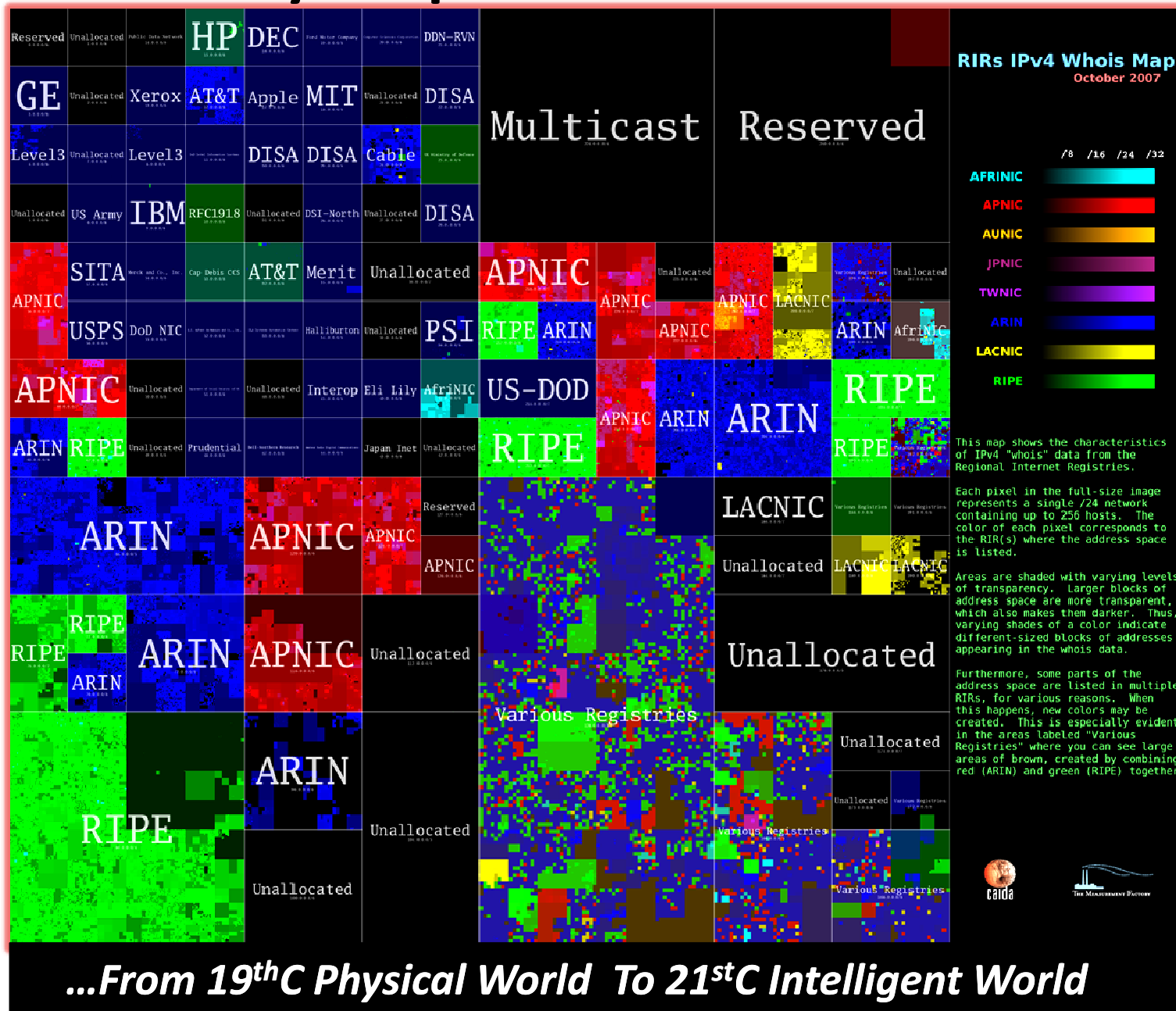
Cyber Futures & Defence: *"Dual Themes"*

Theme (1)" - *"Security Futures: 2018-2025+"* : **T**echnology, **T**ools and **T**rends...

- *Bringing CyberSecurity to **YOUR** Board Room with Budget & Mission!*
- *Future **Cyber-Scenarios** for Integrated, Adaptive, Intelligent Security!*
- *New CyberSecurity Toolkits to Defend **YOUR** Business Operations!*

" CyberVision: Machine Learning, AI & Neural Security"   ***21st Nov: 09:40– 10:20***

Theme (2) – *"Cyber Threats & Defence":* **Intelligent CyberSecurity for OUR 21st C...**

- **TOP 10 CyberThreats**: *Exploration, Penetration and Attack!*
- *Recent **Case Studies** of Cyber Crime, Terror & Political Attacks!*
- *Developing **YOUR** Action Plans & Cybersecurity Programme!*

"CyberDefence: Real-Time Learning, Detection & Alerts"   ***21st Nov: 14:30 – 15:10***

Download Slides: www.valentina.net/Seville2017/
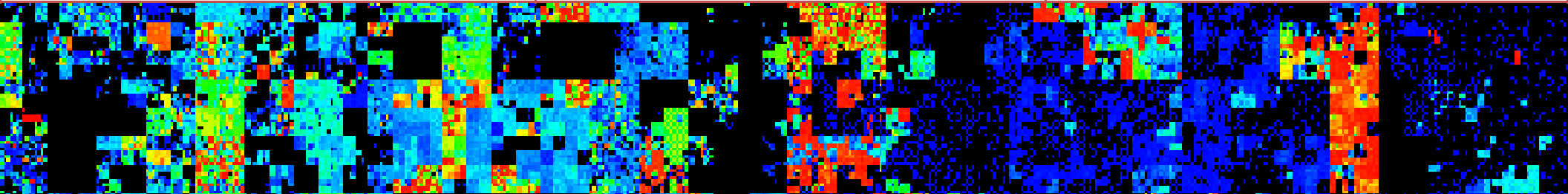
Topics suggested @ Genoa – June 2017

1. Biometrics in the 21st Century for *Global Security*
2. IT Security Trends: *Key Business & Security Drivers*
3. Managing Information Risk : *Solutions for Survival*
4. Modern Technical Security Tools for Protection
5. Technical Innovations in *Access Control Security*
6. Managing Enterprise Security in Changed World
7. Effective IT Security: *Prevent & Adapt to Threats*

.....We'll respond to ALL these during this talk on "Security Futures": Technology, Tools & Trends
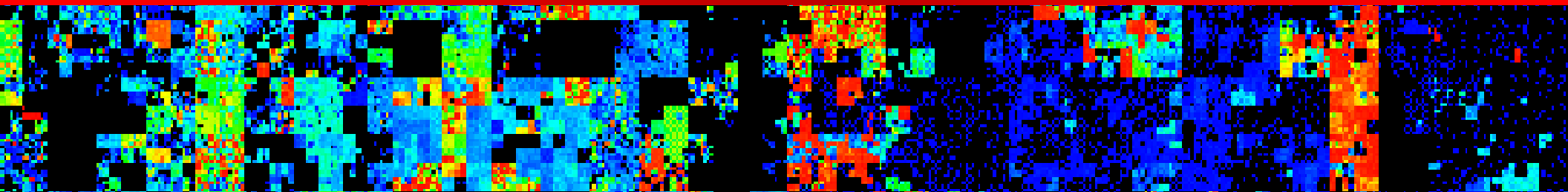
(1)-Security 2018-2025: *YOUR Cyber* Mission

1 – "CyberSecurity @ Board Level" "YOUR Cyber Mission"	2 –CyberCrime:CyberTerror:CyberWar "OUR Cyber Society"	3 –Scenario 2018: Cyber & Physical Tools "Integrated Security"
4 – Scenario 2019: Internet of Things-!OT "Self-Adaptive"	5 –Scenario 2020: Machine Learning "Self-Learning"	6 – Scenario 2025: Artificial Intelligence "Cyber-Intelligent"
7 – Scenario 2040: Artificial Silicon Life!. "Neural Security"	8– Cyber VISION to Security NOW!.. "New Cyber Toolkit"	9 –YOUR Action Plan for 21stC Cyber!.. "CyberSecurity Plan"

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1 – "CyberSecurity @ Board Level"
"YOUR Cyber Mission"

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- 21stC Security Futures: 2018 – 2025 -
*** "Technology, Tools & Trends" ***
Seville, Spain – 20th–21st November 2017
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"CyberSecurity @ Board Level"

- **High** CyberSecurity Risks require Business and Governments to Plan & Invest @ **Board Level**!

- CyberSecurity Tools are now in Transition from:
  - **1st Gen:** Malware Signatures & Perimeter Firewalls
  - **2nd Gen:** Machine Learning & Artificial Intelligence

- Smart IoT Devices, Homes & Cities ALL require Embedded CyberSecurity in Chips & Networks!

....We provide a 7 Year CyberVision & RoadMap for C$O led Investment in Effective Cyber Defence!

CyberAttacks: *"Impact on Share Price"*
CGI & Oxford Economics – April 2017

The Cyber-Value Connection
Revealing the link between cyber vulnerability and company value

www.cgi-group.co.uk/CyberValueConnection

CyberAttacks: *"Impact on Share Price"*
CGI & Oxford Economics – April 2017

SHARE PRICE IMPACT FOLLOWING CYBER ATTACK

SECTOR	COUNTRY OF LISTING	INCIDENT YEAR	SHARE PRICE FALL (%)
Media & Communications	UK	2015	-15.0%
Retail	UK	2014	-12.9%
Media & Communications	USA	2015	-9.3%
Technology	Japan	2013	-8.5%
Technology	Japan	2016	-8.3%

TECH CHECK

CGI: CYBER ATTACKS CAN WIPE 15% OFF COMPANY VALUATIONS

CGI
Experience the Commitment®

Investors have lost at least **£42Billion** since **2013** due to **Cyber Attacks** ...**Severe Cyber Attacks** typically *wipe out* **£120M** of company value!...
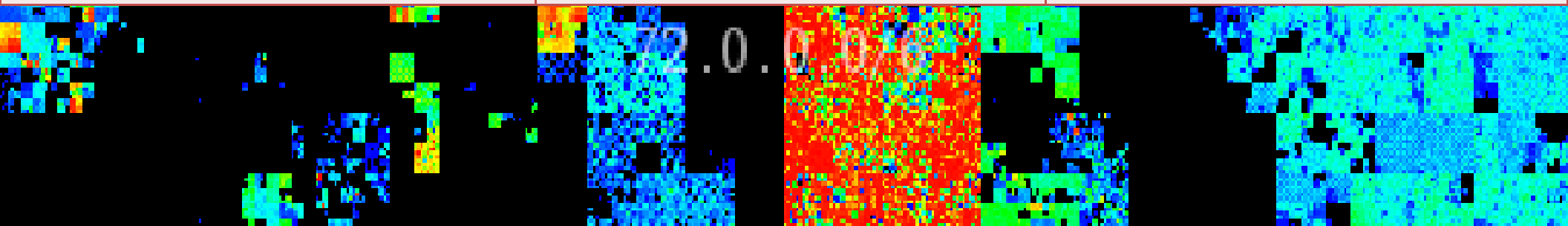
www.cgi-group.co.uk/CyberValueConnection

www.cgi-group.co.uk/CyberValueConnection

CyberAttacks: *"Impact on Share Price"*
CGI & Oxford Economics – April 2017

Report *Recommends* following **CyberSecurity Defence:**

1) Appoint **Board Level CSO** in Leadership Role!
2) Include **CyberSecurity** on **EVERY Board Agenda**
3) Consider **CyberSecurity** as **Trans-Business Risk**
4) **Recruit** & **Train** Professional **Cyber Specialists**
5) Establish **Cyber Operations** **$$$Budget** & RoadMap
6) Assume that **Cyber Defences** are already **Breached**!...

Investors have lost at least **£42Billion** since **2013** due to **Cyber Attacks**
...**Severe Cyber Attacks** typically *wipe out* **£120M** of company value!...

# (2)-Security 2018-2025: *OUR Cyber* Society

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7 – Scenario 2040: Artifical Silicon Life! **"Neural Security"**	8 – Cyber VISION to Security NOW! **"New Cyber Toolkit"**	9 – *YOUR* Action Plan for 21stC Cyber!... **"CyberSecurity Plan"**

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(2)-Security 2018-2025: *OUR Cyber* Society

# 2 –CyberCrime:CyberTerror:CyberWar
"OUR Cyber Society"
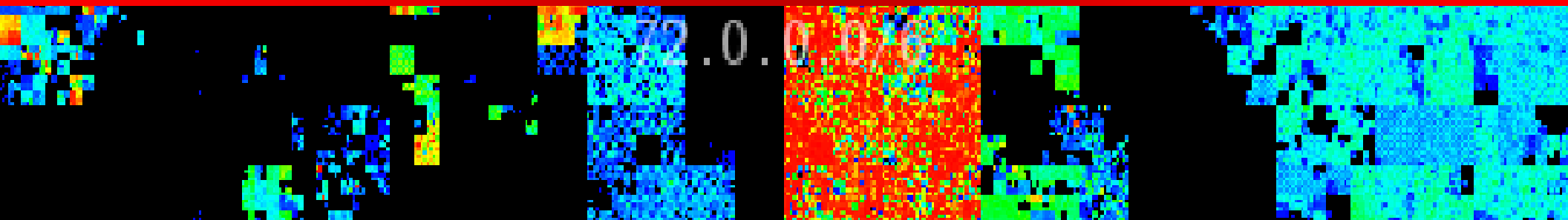
"CyberCrime, CyberTerror & CyberWar"

1) **Media:** Global News Reports of Cyber Attacks!

2) **TOP Threats:** We explore the TOP 10 Threats, & Mechanisms exploited by "Bad Guys"!

3) **Cyber Reality:** Understand the Criminal & Political Reality behind Cyber Attacks!

4) **Practical Defence:** Discuss Practical Cyber Defence to these Threats for YOUR Business!

.....These same TOP 10 Threats are used in some combination in EVERY Cyber Hack & Attack!....

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Warning! : CyberTerror Travels @ *"Light Speed"*

О том,как
мечта одного человека
о преодолении сверхзвукового
барьера могла бы содействовать
успеху Вашего бизнеса
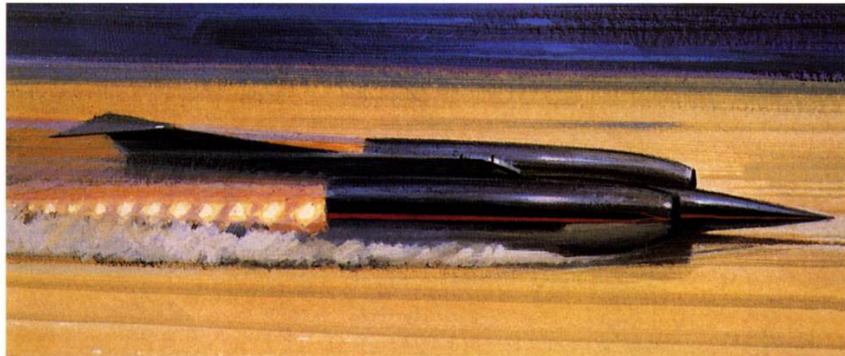
Physical Terror = "Spatial": Attacks on Physical Infrastructure , Corporate Assets, Staff and Citizens
*** *Sound Waves = 340metres/sec* ***

Cyber Terror = "Temporal": Anonymous Attacks on, Network Hubs, Servers, Databases & Social Media
*** *Light Waves = 300,000,000 metres/sec* ***

Thrust SSC: *1st Supersonic Car - 15th Oct 1997*

Thrust SSC: *World Speed Record: 1997-2017*

© Vaza International

Web Archive: www.thrustssc.com

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Warning! : CyberTerror Travels @ *"Light Speed"*

BloodHound SSC   **2017**

1997   **Thrust SSC**

Transition from "Cyber Now - 2018" to "Intelligent AI/ML Cyber - 2025"

Sci-Fi Movie – "13th Floor" (1999): "Real-World & Cyber World"

Transition from "Cyber Now - 2018" to "Intelligent AI/ML Cyber - 2025"

2017 - "Cyber Now"

- "Signature" Detection
- Multi-DMZ Firewalls
- Anti-Virus & Malware
- Supervised Learning
- Zero-Day Attacks
- Objects & Assets

- **"Known BAD!"**

2025 - AI/ML Cyber

- Behaviour Modelling
- Learning the Baseline
- "Smart Security"
- Unsupervised Learning
- Zero-Second Attacks
- Events & Experience

- **"Known GOOD!"**

Scenario 2025: Defence In-Depth requires Augmentation of **Traditional " Cyber" Tools** to include **Intelligent AI/ML Security Tools** that model **BOTH "Known GOOD & BAD!"**

"Cybernetics & Security": 1943 - 2018!
- *Back to the Future: The Last 75 Years!* -

- 1943 – "Neural Networks" – Perceptrons (AI – McCulloch/Pitts)
- 1948 – "Cybernetics" – Norbert Wiener
- 1969 – ARPANet Launched – 4 Packet Switching Net Nodes -
- 1974 – Internet Protocol Published – Vint Cerf/Bob Kahn
- 1982 – Elk Cloner - 1st "Apple Computer Virus
- 1986 – "Brain" – 1st Microsoft MS-DOS Virus
- 1988 – 1st "Packet Filter" Firewall (DEC: Digital Equipment Corp)
- 1990 – World Wide Web – CERN Labs - Sir Tim Berners Lee
- 1993 – Mosaic Browser – NCSA – Illinois, USA
- 2018 –Transition to AI/ML Apps for 21stC CyberSecurity!

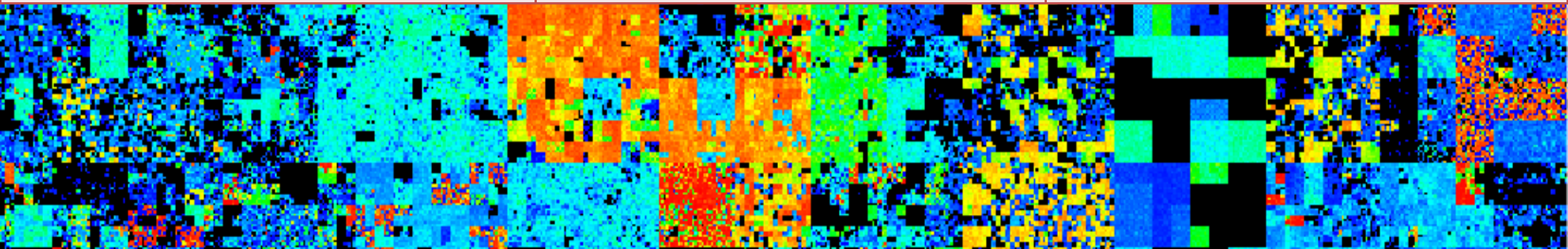**- Exploring "Cyber Visions" requires us to *Research the Past!***

Our CyberVision: 2018 to 2025+

- **Scenario 2018 –** *Integrated Security*: Managed "Smart" *Cyber* & *Physical* Operations under *"CSO"*

- **Scenario 2019 –** *Adaptive Security:* Distributed "Smart Security" for networked *"Internet of Things"*

- **Scenario 2020 –** *Learning Security:* Transition to *"Machine Learning"* Cybersecurity Apps & Tools

- **Scenario 2025 -** *Intelligent Security:* CyberSecurity based upon Networked *"Artificial Intelligence"* Tools

Security 2018-2025: Techno, Tools & Trends

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Security 2018-2025: Techno, Tools & Trends

3- Scenario 2018: Cyber & Physical Tools
"Integrated Security"
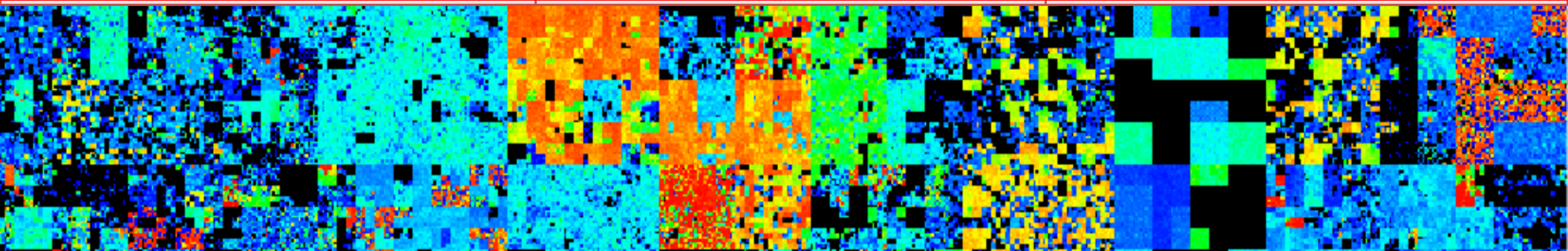
Scenario 2018: "Cyber Tools Transition"
*** Integrated Security***

- Major Trends & Developments: **Scenario 2018**:

  – **C$O led Integration** of Physical and Cyber Security Assets across Corporate Business and Government : CCTV, ANPR, Access Control, Cyber Defence & Alerts

  – **Adaptive AI/ML** Solutions launched by Major Cyber Vendors alongside Cylance, Darktrace & Deep Instinct

  – Increased **National Government Priority** & Investment in fighting Organised CyberCrime and CyberTerrorism

  ..."**Cyber**" goes "**TOP Agenda**" in **Scenario 2018**!

Integration of *Physical and Cybersecurity*

Integrated CSO-led Management Team – *Merged HQ Operations*

Physical Security Operations   Cyber Security Operations

Shared Alerts

Smart Security = *Virtual Integration*

Corporate CSO-led Security Team
ONE – Shopping List!

Integrated Management, Training, Standards, Plans
ONE – Architecture!

Final phase of Cyber-Physical Integration - Embedded Intelligence in ALL Devices - Internet of Things

"Real-Time" CCTV *City Surveillance*

Analysing and Tracking Targets requires *Intelligent Video Analytics*

Regional CCTV *Control & Surveillance*

CCTV Control Room Operators with Multiple Displays need Cyber Analysis Tools Including High Speed Video Analytics, Facial Recognition and Data Mining Tools

Metro Surveillance: *Charing Cross, London*

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Real-Time Surveillance: *Transportation*

Smart Analysis Tools: *3D Simulation Modelling* for *"Security Crisis"* & *"Disaster Management"*

"Smart Security" = Cyber + PSIM + SIEM

- **Cyber:** Spans **ALL ICT** Networks, Servers & Devices
- **PSIM:** **P**hysical **S**ecurity **I**ntegration **M**anagement
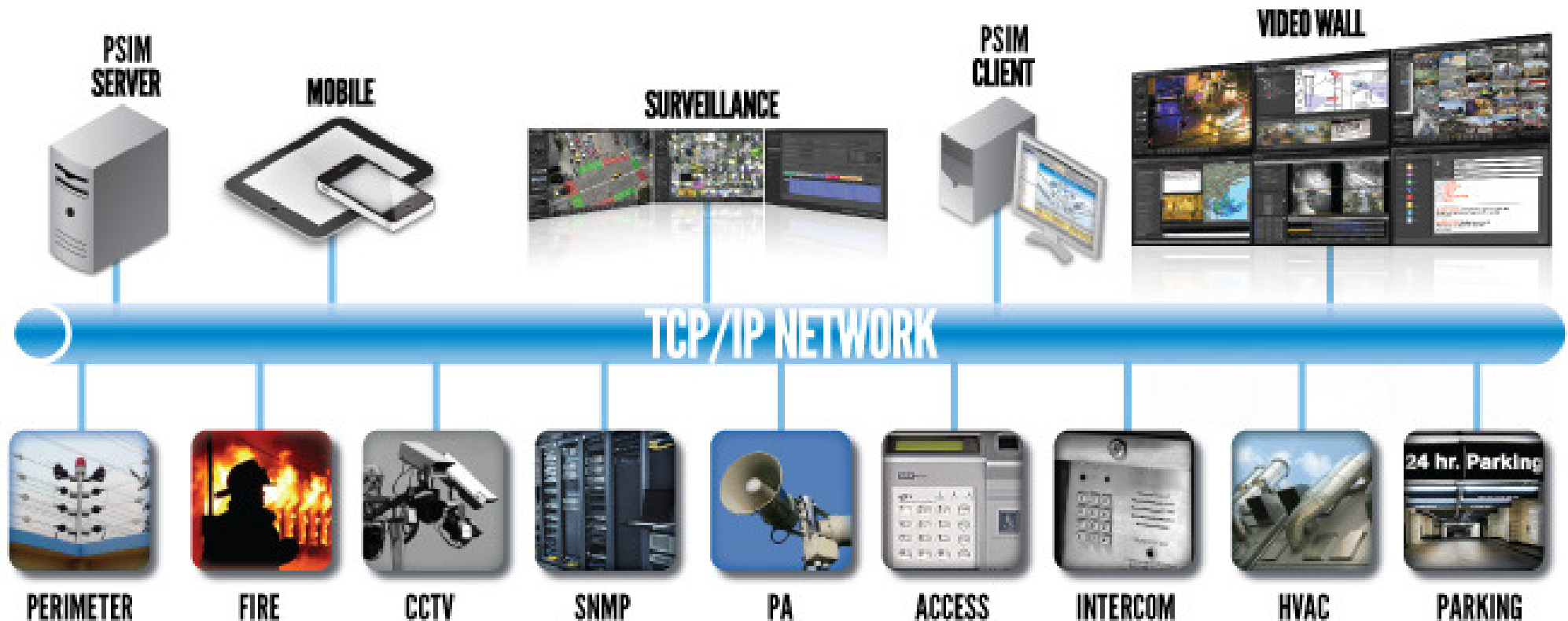- **SIEM:** **S**ecurity **I**nformation & **E**vent **M**anagement

Image: AventuraCCTV.com/PSIM : New York, USA

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Integrated *Cyber* Biometrics: *Pre-Attack*

- *Intelligent Biometrics Tools* can significantly reduce **YOUR** Risks of Cyber Threats & Attacks...

  – Device & Access Authentication by Fingerprints, Retinal/Iris Scan or Palm Vein Scan
  – Facility Access with "Live" 3D Facial Recognition
  – "Behavioural Biometrics" for Secure User Authentication
  – City/Campus Regional Tracking with Intelligent 4K Networked CCTV & Real-Time *Self-Learning* Video Analytics
  – "Live" **CBRN** Scanning for Hazardous materials – (**C**hemical, **B**iological, **R**adiological, **N**uclear)

...It is crucial that *Cyber Biometrics Tools* are Integrated with the CSO-led ***Business Security Operations***

Typical Cyber-Biometric Solutions

FINGERPRINTS
- 5-9 Second Processing Time
- Commonly Used in Border Management
- Also Used in Law Enforcement

FACIAL RECOGNITION
- Non-invasive Collection
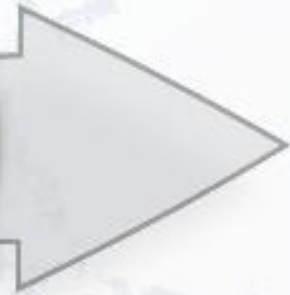- Currently Used for Passports and National ID Documents

IRIS
- Low False Acceptance Rates
- Difficult to Replicate
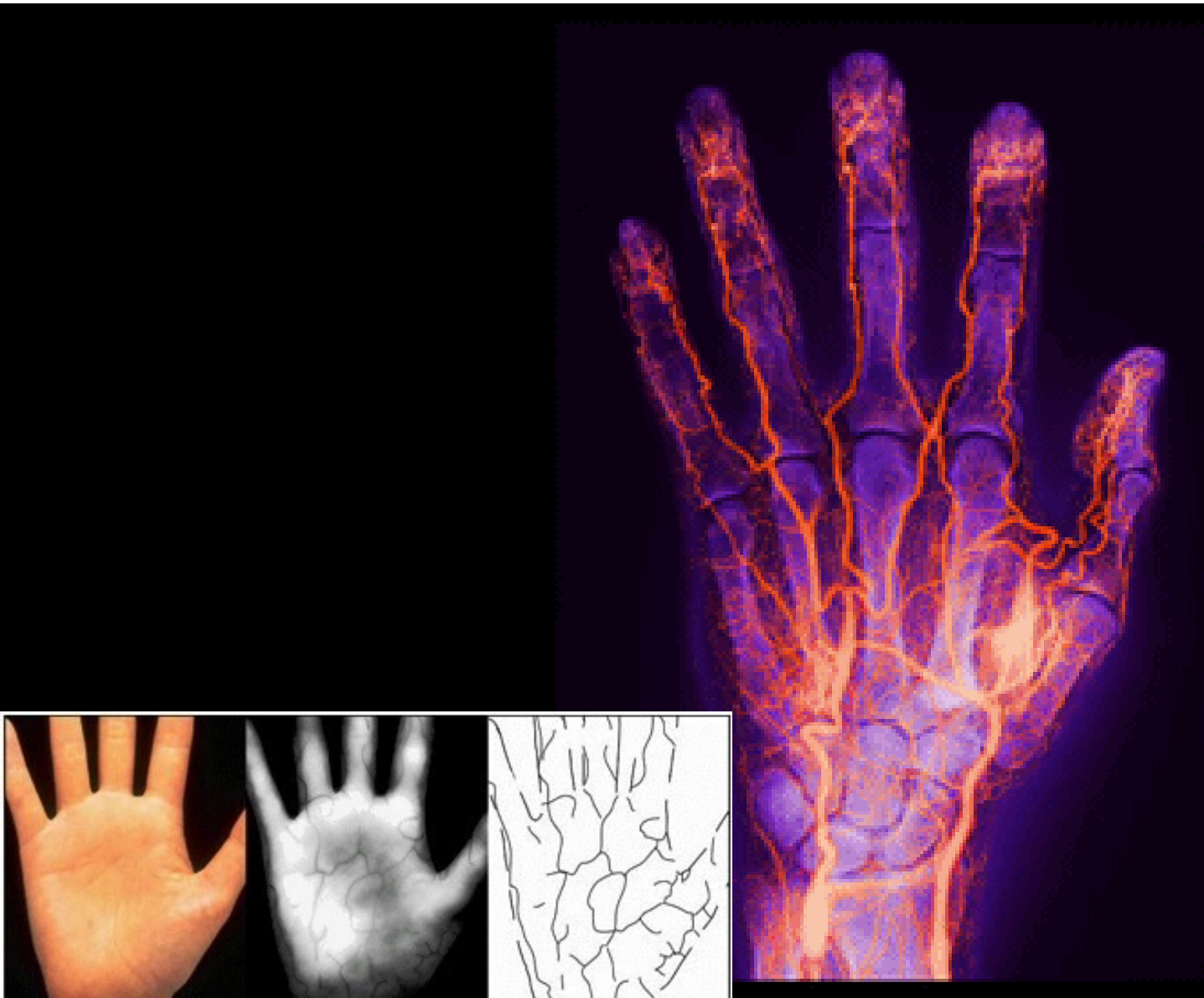- Two Second Processing Time

DNA
- Establishes Familial Relationship
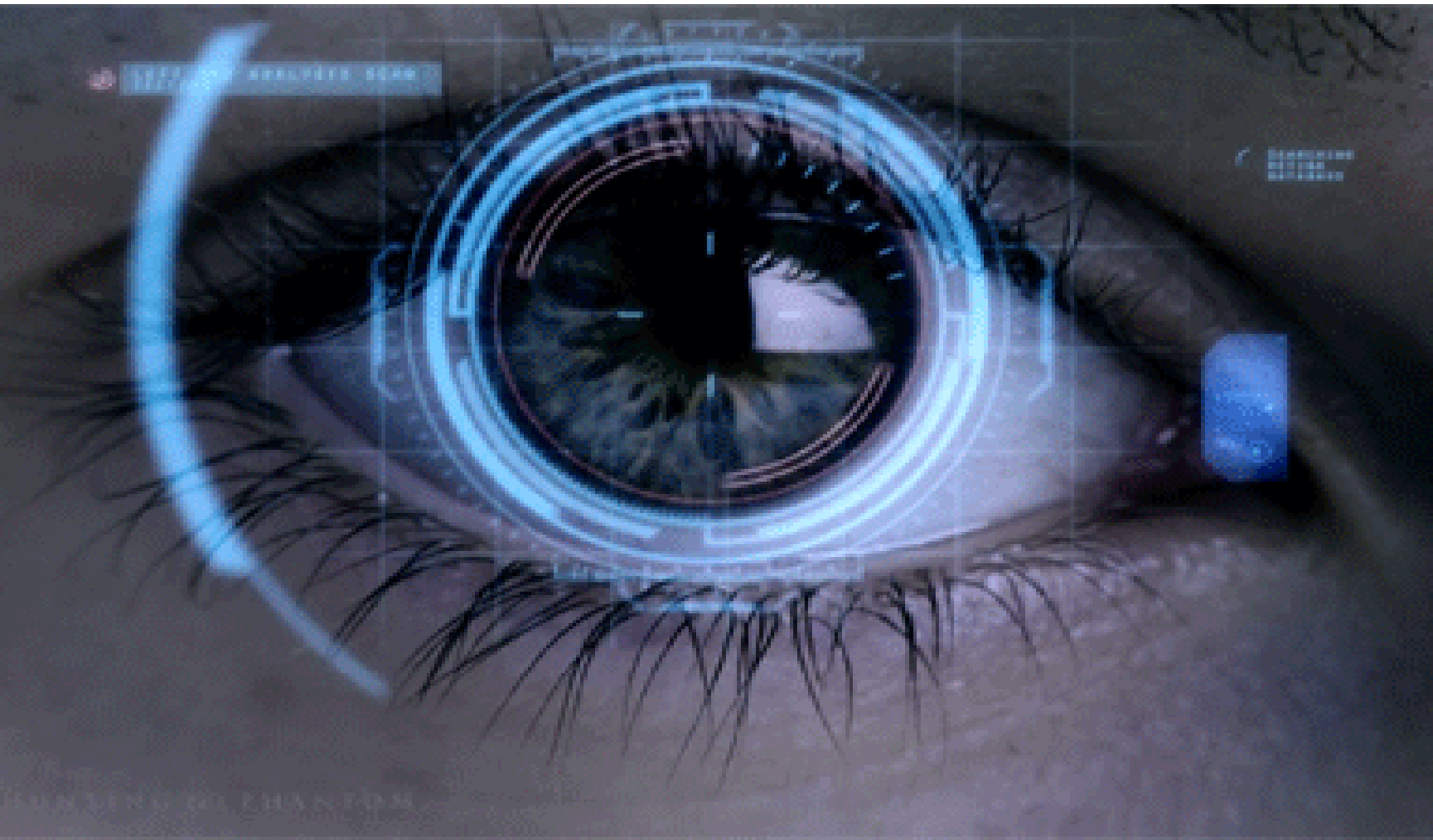- Commonly Used in Law Enforcement
- Highly Unique/ Impossible to Replicate

Cyber-Biometrics: *Fingerprint Solutions*

Cyber-Biometrics: *"Live" Vein Analytics*

Cyber-Biometrics: *Retinal & Iris Scans*

Cyber Digital Forensics: *Post-Attack*

- Evidence from Cyber Digital Forensics can help to identify the Criminals, Terrorists and Cyber Attackers:

- **Physical Forensics:**

  - Blood & Tissue Samples

  - DNA & Genetic Analysis

  - Chemical Agents, GSR, Fibres

- **Cyber Forensics:**

  - Cyber Attack IP Address/DNS/Proxies

  - Malware/Trojan/Virus Analysis

  - Botnet/DDOS , Targets & Payload

  - RansomWare/Encryption & Attack "Signatures"

...Evidence from BOTH *Cyber & Physical Forensics* will be relevant to 21stC Terror Threats & Attacks!...
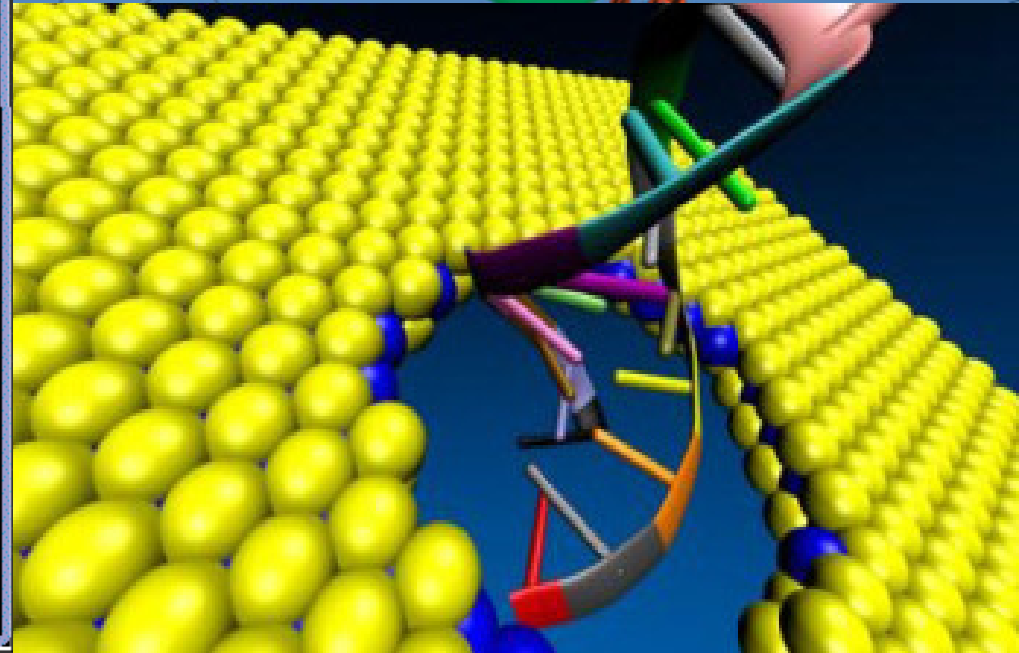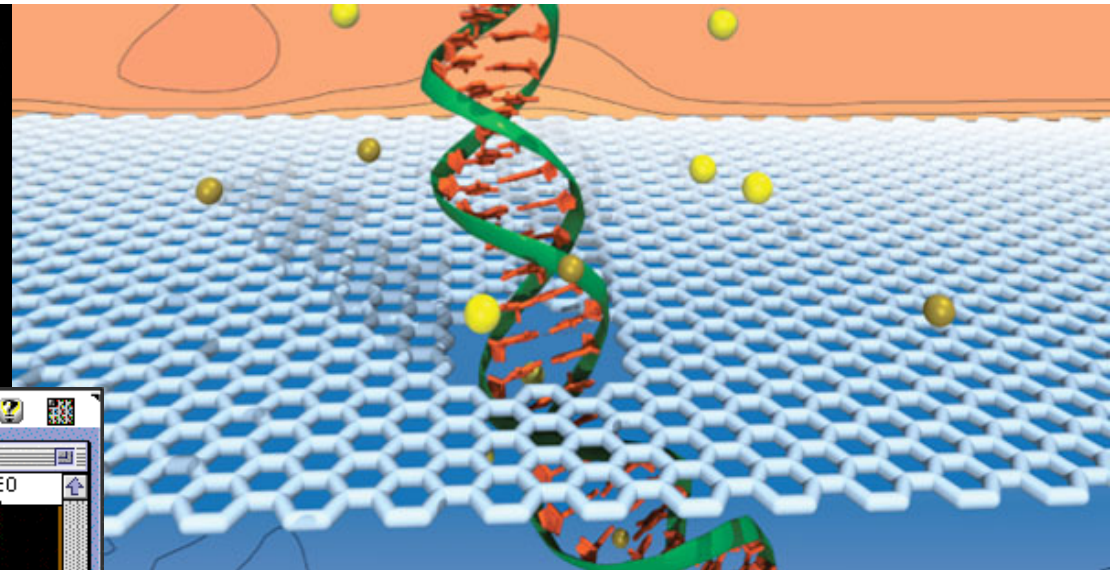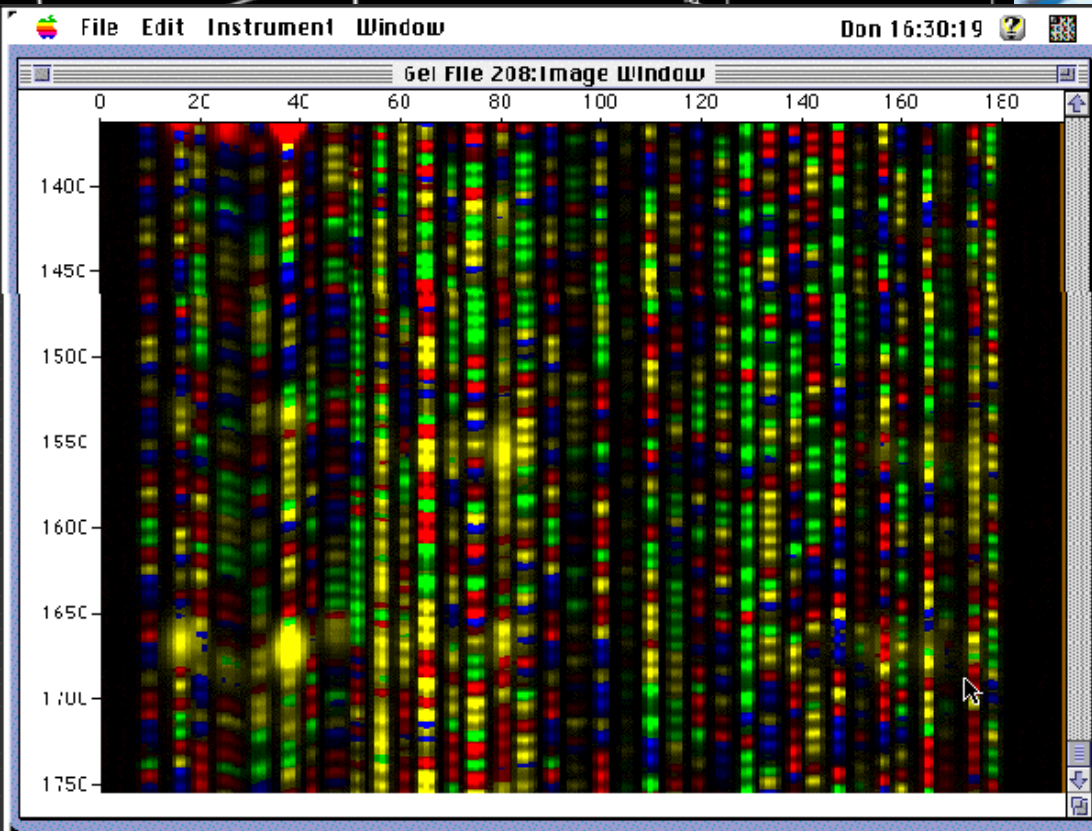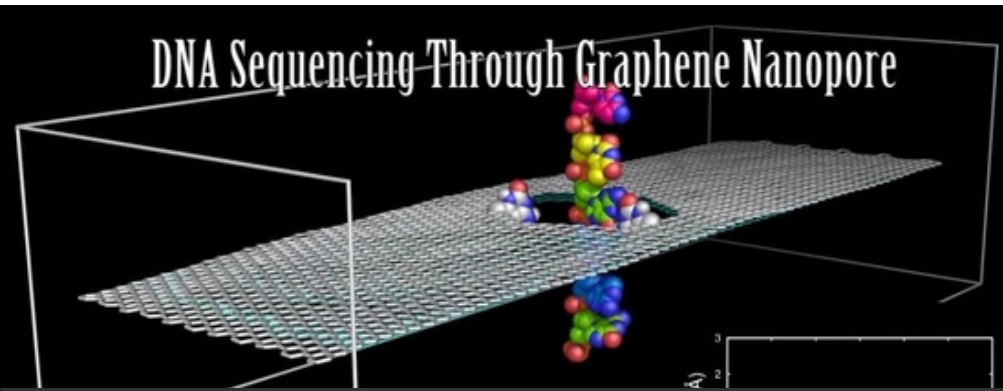
Private Detective: *"Sherlock Holmes"!*

"Forensics Pioneer"
a) Detective Work
b) Fingerprints
c) Ciphers & Codes
d) Footprints
e) Handwriting

Author: *Sir Arthur Conan Doyle:* 1859 - 1930
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Fast DNA Sequencing:*Graphene Nanopore*

DNA Sequencing Through Graphene Nanopore

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Cyber-Bio: *Security Threat Scenarios*

- **Banks/Finance:** **e**Fraud, DDOS, Insider Threats
- **Government/Parliament:** "Fake IDs" & File Theft
- **Defence/Military:** Cyber-Espionage & Attacks
- **Travel/Tourism:** Beach Resorts & Travel Hubs
- **Culture/Sports:** Major Events & Competitions
- **Energy/Utilities:** Nuclear Theft, Explosions
- **Retail/Malls/Campus:** Armed Attacks & Siege
- **Healthcare/Pharma:** "Fake Drugs & Records"

...ALL Generic *Cyber-Bio Threats* apply to ALL Business Sectors & Critical Infrastructure!

Security 2018-2025: Techno, Tools & Trends

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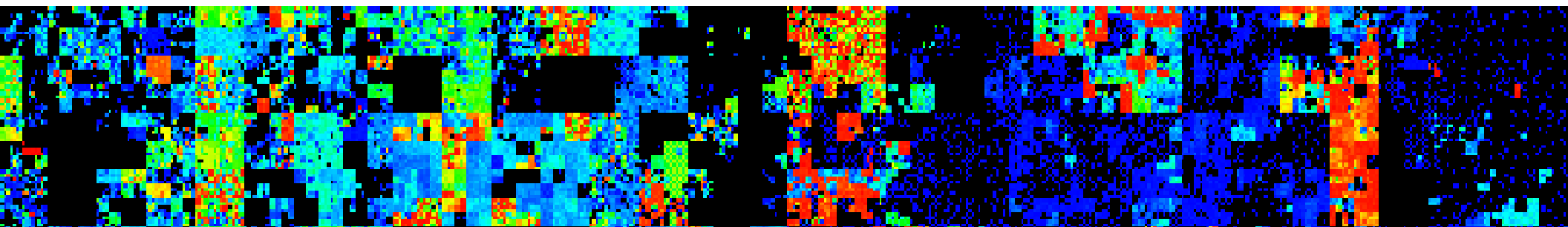
Security 2018-2025: Techno, Tools & Trends

4 –Scenario 2019: Internet of Things - IoT
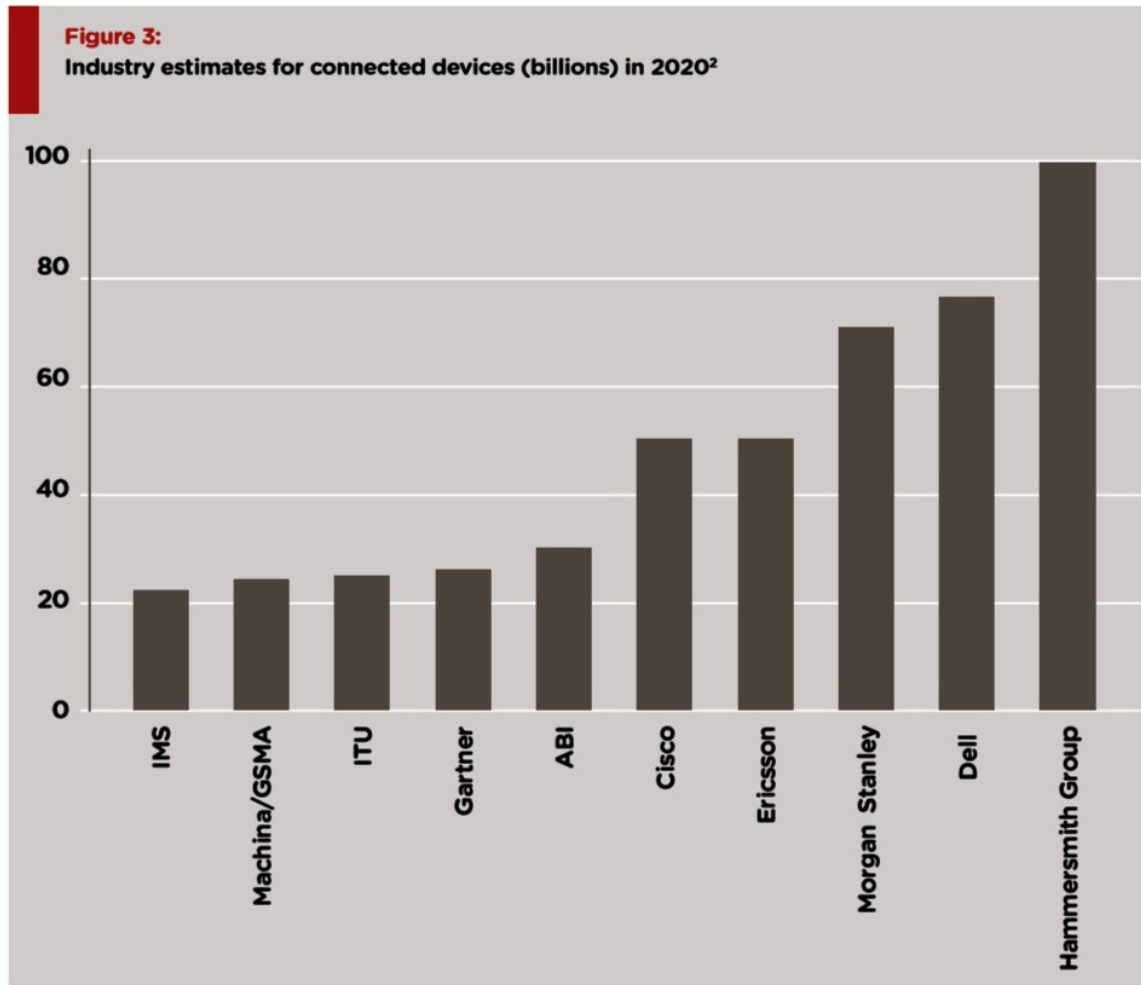# "Self-Adaptive Security"
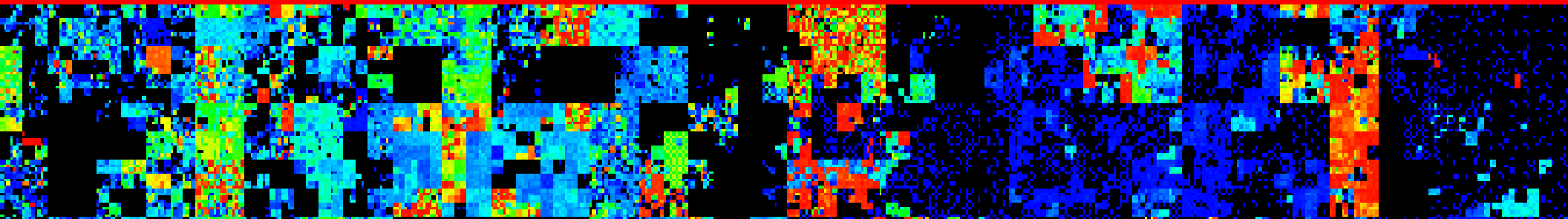
Scenario 2019: "Internet of Things - IoT"
*** Adaptive Security***

- Major Trends and Developments: **Scenario 2020**
  - **ALL Major Cyber Vendors** market AI/ML Solutions
  - Updated **ISO/NIST** Standards with Adaptive Security
  - Embedded "Cyber" in ALL New **Smart IoT** Devices
  - Board Level **C$O in C-Suites** with CEO, CFO & COO
  - International Protocols on **Cyber Warfare** (UN/NATO)

  …..**CyberSecurity** now focused on **Self-Adaptive** Modelling of "Normal" Net/User Behaviour & Detection of **Real-Time Anomalies & Threats**!

2019 Estimates for "IoT" Connectivity

Figure 3:
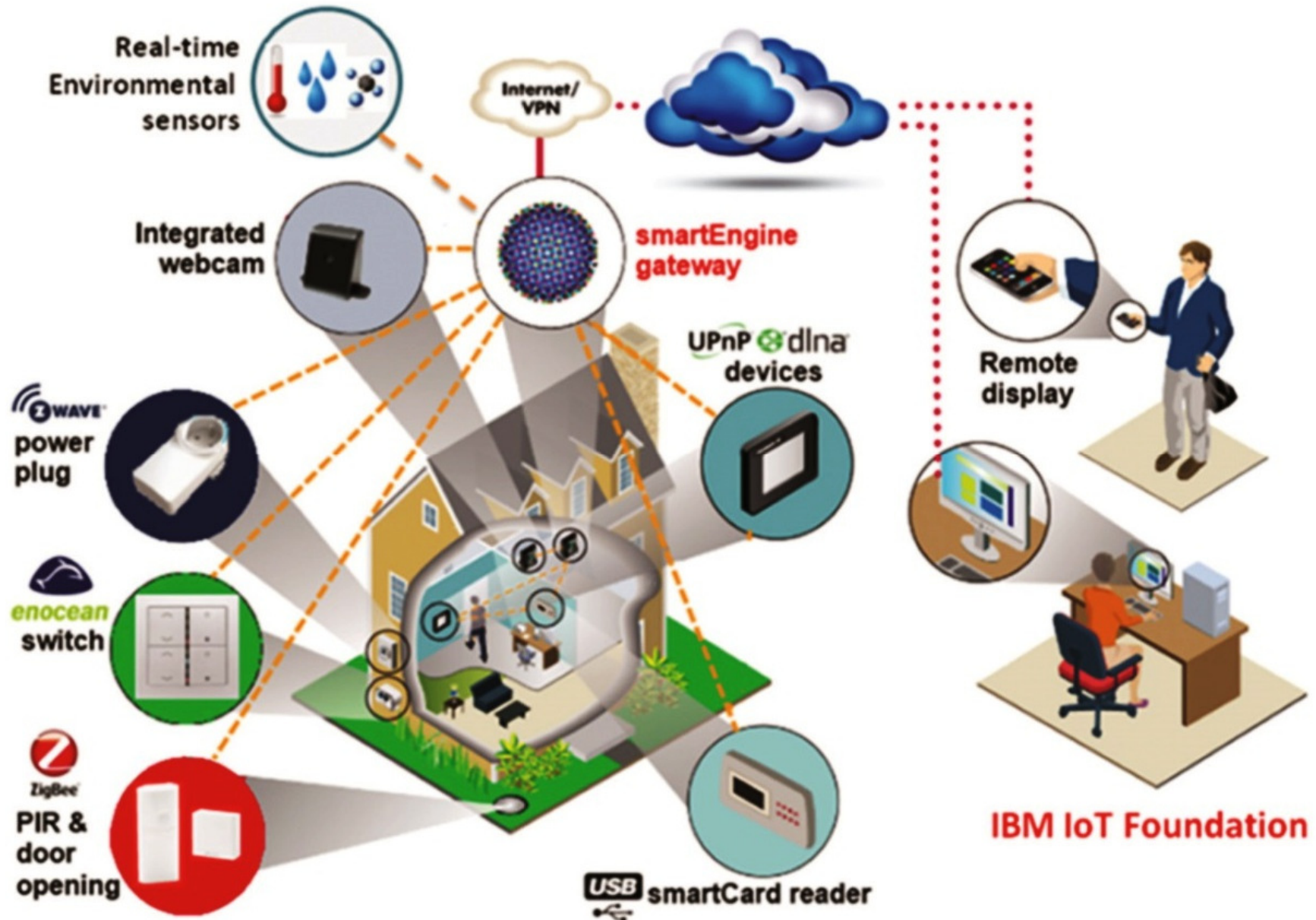Industry estimates for connected devices (billions) in 2020[2]

1 'Internet of Things Connections Counter', Cisco Systems, 2014
2 http://www.businessinsider.com/75-billion-devices-will-be-connected-to-the-internet-by-2020-2013-10; https://www.
   abiresearch.com/market-research/product/1016390-over-30-billion-wireless-connected-devices/; 'Forecast: The Internet of
   Things, Worldwide 2013', Gartner, 2013; 'The State of Broadband 2012: Achieving digital inclusion for all', Broadband commission,
   2012; 'The Internet of Things: How the next evolution of the Internet is changing everything', Cisco Systems, 2011; 'Towards
   50 Billion Connected Devices', Ericsson Research, 2010; 'The Internet of Things: Networked objects and smart devices', The
   Hammersmith Group, 2010; http://www.marketplace.org/topics/tech/indie-economics/2020-there-will-be-10-web-connected-
   devices-human; 'The Connected Life: A USD 4.5 trillion global impact in 2020', GSMA and Machina Research, 2012; http://www.
   itpro.co.uk/626209/web-connected-devices-to-reach-22-billion-by-2020
3 'The Internet of Things is Now', Morgan Stanley, 2014

"IoT" Connectivity in the Home: IBM

Real-time Environmental sensors

Internet/VPN

smartEngine gateway

Integrated webcam

UPnP & dlna devices

Remote display

Zwave power plug

enocean switch

ZigBee PIR & door opening

USB smartCard reader

IBM IoT Foundation

RESEARCH PAPER

on

The Compromised Devices

of the Carna Botnet

(used for "Internet Census 2012")

by Parth Shukla,

Information Security Analyst,

Australian Computer Emergency Response Team (AusCERT),

University of Queensland.
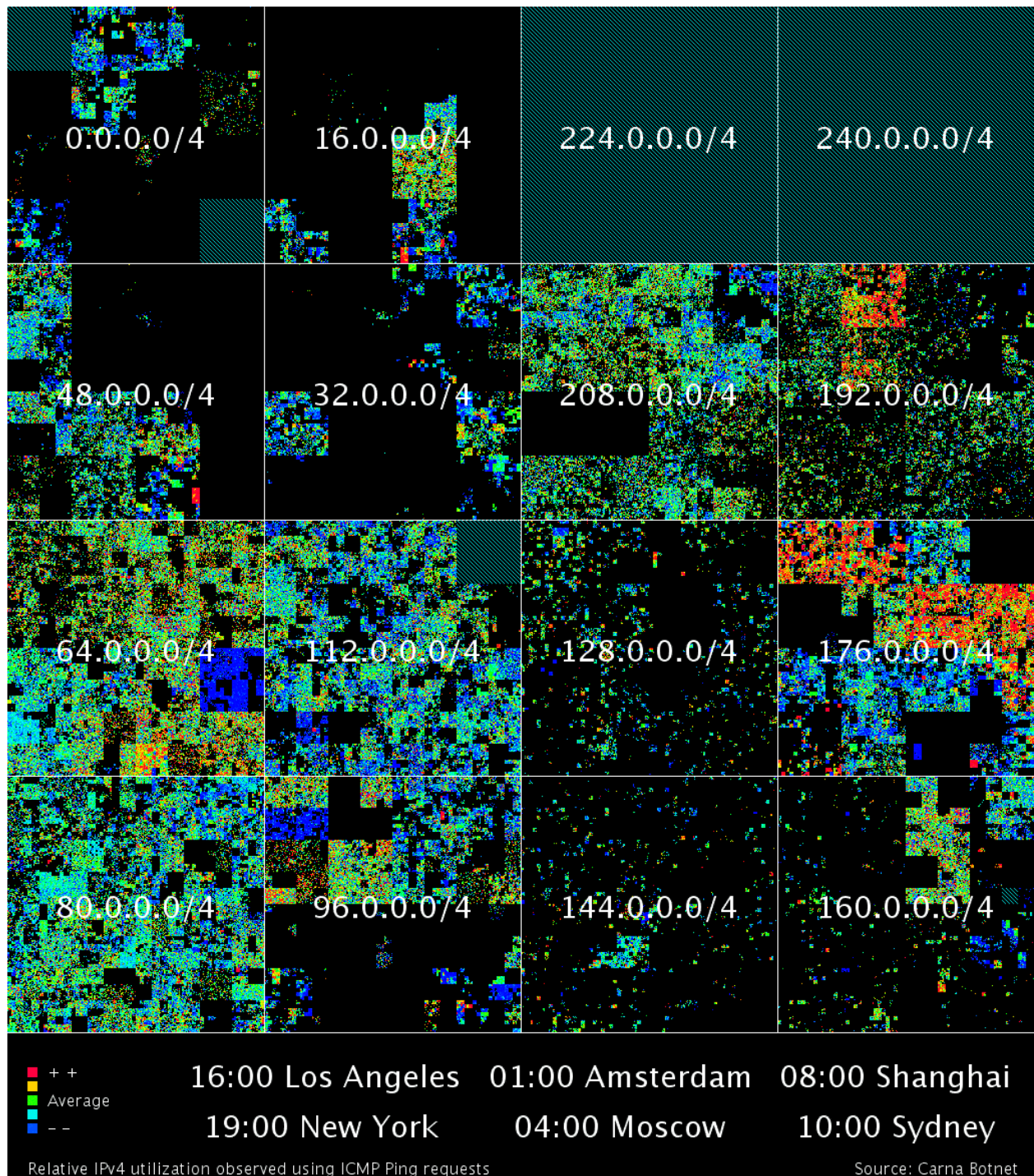
Email: pparth@auscert.org.au

Twitter: http://twitter.com/pparth

Version 1

20 August 2013 – Released to AusCERT members

25 August 2013 – Released to the Public

0.0.0.0/4   16.0.0.0/4   224.0.0.0/4   240.0.0.0/4

48.0.0.0/4   32.0.0.0/4   208.0.0.0/4   192.0.0.0/4

64.0.0.0/4   112.0.0.0/4   128.0.0.0/4   176.0.0.0/4

80.0.0.0/4   96.0.0.0/4   144.0.0.0/4   160.0.0.0/4

++
Average
- -

16:00 Los Angeles   01:00 Amsterdam   08:00 Shanghai
19:00 New York   04:00 Moscow   10:00 Sydney

Relative IPv4 utilization observed using ICMP Ping requests   Source: Carna Botnet

Carna Botnet exposed Legacy Vulnerabilities in *"IoT" Devices*

Vulnerable Legacy Devices: "IoT"

Worldwide Manufacturers Original

zhongxing telecom
6505
1%

dreammultimediatv gmbh
5951
0%

blink electronic limited
4528
0%

american time and signal
4452
0%

arcadyan technology
6043
0%

gk computer
5081
0%

digitalks
4644
0%

shanghai dareglobal technologies
4358
0%

konka group co
6703
1%

synerjet international
7505
1%

hame technology co limited
7427
1%

shanghai dare technologies co
8500
1%

unionman technology co
9281
1%

aztech electronics pte
14201
1%

sony computer entertainment
17042
1%

shenzhen coship electronics co
19212
1%

dlink
20140
2%

asustek computer
30928
2%

alpha networks
33807
3%

zhejiang dahua technology co
32744
3%

yuxing electronics company limited
37020
3%

airties wireless networks
43564
3%

sunniwell cyber tech co
93341
7%

Other Manufacturers
113236
9%

unknown
266252
21%

zte
174864
14%

smd informatica sa
109406
9%

tvt co
98494
8%

shenzhen gongjin electronics co
99963
8%

IoT Cybersecurity: *7-Level Architecture*

FlipsCloud
Quantum Level Encryption

Cyber Security - 7 Security Layers Structure

- Network Firewall ⑦
- Anti-Vius ⑥
- Authentication Authorization ⑤
- Encryption ④
- Key Management ③
- Trust Boot /Zone ②
- Random Number Generator ①

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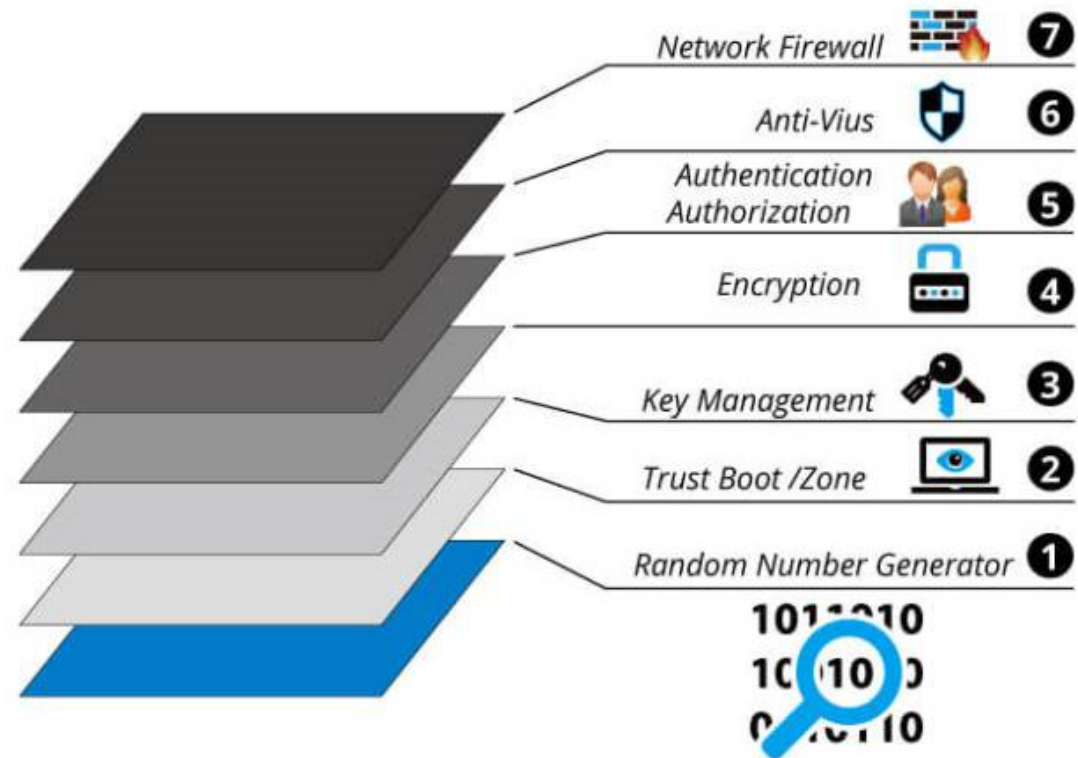
EU/IERC – Research Cluster Reports:
"Smart Systems" & the Internet of Things

The Internet of Things 2012 New Horizons

CASAGRAS2
an EU Framework 7 Project
IERC
European Research Cluster on the Internet of Things

River Publishers Series in Communications

Internet of Things — Converging Technologies for Smart Environments and Integrated Ecosystems

Editors
Ovidiu Vermesan
Peter Friess

River Publishers

River Publishers Series in Communications

Building the Hyperconnected Society
IoT Research and Innovation Value Chains, Ecosystems and Markets

Editors
Ovidiu Vermesan
Peter Friess

River Publishers

BlockChains & *CryptoCurrencies*

BLOCK CHAIN

BlockChains & *CryptoCurrencies*

Market Capitalisation of 1000+ CryptoCurrencies:
*** $200 Billion+ ***

BlockChains & *CryptoCurrencies*

- **BlockChains:** Distributed "Spreadsheets " with Encrypted Verification of "Financial Contracts"
  - Apps in MOST Economic Sectors for Peer-to-Peer On-Line Trading with NO Central Authority...
  - Apps from Banks, Governments, & Retail Sectors

- **CryptoCurrencies:** Virtual Currencies include BitCoin, Ethereum, LiteCoin, Ripple & Zcash
  - Now more than 1000 Virtual CryptoCurrencies!....
  - BitCoin is still most widely traded Virtual Currency

... BlockChain Apps may improve CyberSecurity for On-Line Trading & Financial Contracts!...

Security 2018-2025: Techno, Tools & Trends

1 – "CyberSecurity @ Board Level" "YOUR Cyber Mission"	2 –CyberCrime:CyberTerror:CyberWar "OUR Cyber Society"	3 –Scenario 2018: Cyber & Physical Tools "Integrated Security"
4 –Scenario 2019: Internet of Things-IoT "Self-Adaptive"	5 –Scenario 2020: Machine Learning "Self-Learning"	6 –Scenario 2025: Artificial Intelligence "Cyber-Intelligent"
7 – Scenario 2040: Artificial Silicon Life! "Neural Security"	8 – Cyber VISION to Security NOW! "New Cyber Toolkit"	9 – YOUR Action Plan for 21stC Cyber!... "CyberSecurity Plan"

CyberSECURITY
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Security 2018-2025: Techno, Tools & Trends

5 –Scenario 2020: Machine Learning
"Self-Learning Security"
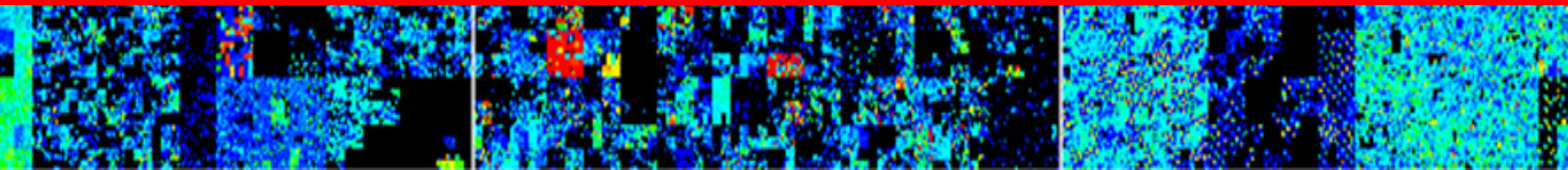
AI & Machine Learning as *Cyber Tools*

- **Artificial Intelligence (AI) :** Developed during 1960s/70s : Neural Networks, Expert Systems, Self-Organising Automata, Adaptive Stochastic Learning, Algorithms, Robotics, Autonomous Systems, Augmented Reality

- **Behavioural Modelling:** AI/ML can be applied to real-time modelling of ALL Network Traffic, Log & Audit Files, Net Nodes, Servers and all "Smart IoT" Devices

- **Zero-Day Attacks:** AI Modelling & Machine Learning can mitigate risks of new malware that have no prior "signature".

- **Advanced Persistent Threats (APTs):** Adaptive Learning Algorithms can detect the step-by-step penetration of APT malware (Phishing, Trojans, Adware, Botnets...)

- **Insider Threats & Attacks:** Enterprise AI Traffic Modelling can quickly expose the malicious activities of malicious "insiders"!

"Surfing the Evolutionary Cyber Waves"
- *More than 45 Years of AI & CyberSecurity! -*

- 1970 – BT Research Labs – IBM 360 –Digital PCM
- 1976 – AI Thesis – Stochastic Learning Automata
- 1982 – AI & Expert Systems: UK Govt Programme
- 1991 – EARN/TERENA: European Networks Board
- 1992 – International Net Conference: RAS, Moscow
- 1994 – EMEA – Internet, Security & eCommerce
- 2007 – Georgian Parliament Security Projects
- 2009 – Armenia eGovernance & CyberSecurity
- 2010 – Georgian Cybersecurity Audit & Roadmap

......Global Marketplace for "Cyber" AI/ML Apps will mainstream during the Next 7 Years: 2018 – 2015 !

BT Research Labs: Digital Systems-1970

FIG 5
EVALUATION OF R.A.L FOR
P.C.M. SYSTEM WITH D.

```
LIST

OFFSET      9:05    GEIS D 09/07/70

10 BEGIN
15 REAL PO,A,B,C,D,F,L,N,P,R,S,T,U,Y,Z,S
20 INTEGER I,J,M;
40 ARRAY V[-64:64], W[-64:64], INT[-64:6
52 REAL PROCEDURE NORM(Z);VALUE Z;
54 REAL Z;
55 IF Z>7.5 THEN NORM:=0 ELSE IF Z<-7.5
56 IF Z=0 THEN NORM:=0.5 ELSE
57 BEGIN REAL T,Y,P;
58 P:=Z; Z:=ABS(Z);
59 Y:=0.5*Z*Z;
62 IF Z<1.28 THEN
64 T:=0.5-Z*(0.398942280444-0.3999034385
66 -29.8213557808/(Y+2.62433121679+48.69
68 5.92885724438)))))
69 ELSE BEGIN Y:=0.398942280385*EXP(-Y);
70 T:=IF Y/Z=0 THEN 0 ELSE
72 Y/(Z-0.000000038052+1.00000615302/(Z+
74 15381364/(Z-0.151679116635+5.29330324
76 15.1508972451/(Z+0.742380924027+30.78
78 (Z+3.99019417011)))))
79 )
80 END;
81 NORM:=IF P<0 THEN 1-T ELSE T;
82 END;
87 V[0]:=0;
90 FOR I:=1 STEP 1 UNTIL 64 DO BEGIN
92 READATA(INPUT,V[I]);DATA INPUT:=
94 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,1
100 22,24,26,28,30,32,36,40,44,48,52,56,
110 112,120,128,144,160,176,192,208,224,
120 384,416,448,480,512,576,640,704,768,
121 END;
125 FOR I:=1 STEP 1 UNTIL 64 DO V[-I]:=-
130 FOR I:=-64 STEP 1 UNTIL 64 DO V[I]:=
140 FOR I:=1 STEP 1 UNTIL 64 DO W[I]:=(V
145 FOR I:=-64 STEP 1 UNTIL -1 DO W[I]:=
155 D:=0.5/1024;
160 FOR I:=-64 STEP 1 UNTIL 64 DO V[I]:=
170 PRINT("OFFSET","N-VALUE-DB","S-TMAX-
180 FOR N:=-83 STEP 10 UNTIL -63 DO BEGIN
190 FOR S:=-93 STEP 10 UNTIL -63 DO BEGIN
200 B:=PO:=MENU:=0;
220 SDN:=10↑(N/20);
230 SDS:=10↑(S/20);
240 U:=SQRT(SDN:2+SDS:2);
245 F:=V[0]:2/(2*U*U);
250 ERR[0]:=IF F>39 THEN 0 ELSE EXP(-F);
260 FOR I:=1 STEP 1 UNTIL 64 DO BEGIN
300 INT[I]:=NORM(V[I-1]/U)-NORM(V[I]/U);
```

Research Group: R9.3.1
Research Memo: 160/10

Evaluation of Distortion and Loss for Digital *"PCM"* Transmission Systems in the presence of Gaussian Noise.

Author: David E. Probert   Date: July, 1970

- Post Office Research Labs – Dollis Hill, London –

APPENDIX 2

The analysis of m for a symmetrical P.C.M. with Noise

μ_{11}/σ_v^2 gradient of regression line

$\Sigma f_i(U_i - \overline{U})(v_i - \overline{v})/\sigma_v^2$ but $\overline{v} = \overline{U} = 0$ for symmetrical system.

$$\sum_{i=1}^{i=64} U_i \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-n^2/2} \int_{v_{i-1}-N}^{v_i-N} \frac{v}{\sigma_v \sqrt{2\pi}} e^{-v^2/2\sigma_v^2} \, dv \, dn \, \cdots \Big/ \sigma_v^2$$

..... + term from v_{64} to ∞.

normalise by putting $Z = v/\sigma_v$.

$$\sum_{i=1}^{i=64} U_i \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-n^2/2} \int_{\frac{v_{i-1}-n\sigma_n}{\sigma_v}}^{\frac{v_i-n\sigma_n}{\sigma_v}} \frac{Z}{\sqrt{2\pi}} e^{-Z^2/2} \, dz \, dn \Big/ \sigma_v^2$$

term in dotted lines:-

$$\frac{1}{2\pi} \int_{-\infty}^{\infty} e^{-n^2/2} \left[EXP - \frac{1}{2\sigma_v^2} \left((v_{i-1} - n\sigma_n)^2 \right) - EXP - \frac{1}{2\sigma_v^2} \left(v_i - n\sigma_n \right)^2 \right] dn$$

This will be symmetrical for analysis in v_i and v_{i-1}.

g term in v_{i-1}:-

$$\int_{-\infty}^{\infty} EXP - \left[n^2\sigma_v^2 + (v_{i-1})^2 - 2n\sigma_n v_{i-1} + n^2\sigma_n^2 \right] / 2\sigma_v^2$$

$$\int_{-\infty}^{\infty} EXP - (\sigma_v^2 + \sigma_n^2)/2 \sigma_v^2 \left[n^2 - 2n\sigma_n v_{i-1}/\sigma_v^2 + \sigma_n^2 \right] EXP \left[- \frac{(v_{i-1})^2}{2\sigma_v^2} \right] dn$$

exp is constant and now by completing the square:-

$$EXP - (\sigma_v^2 + \sigma_n^2)/2\sigma_v^2 \left[\left(n - \sigma_n v_{i-1}/\sigma_v^2 + \sigma_n^2 \right)^2 - \sigma_n^2 (v_{i-1})^2 / (\sigma_v^2 + \sigma_n^2)^2 \right] dn$$
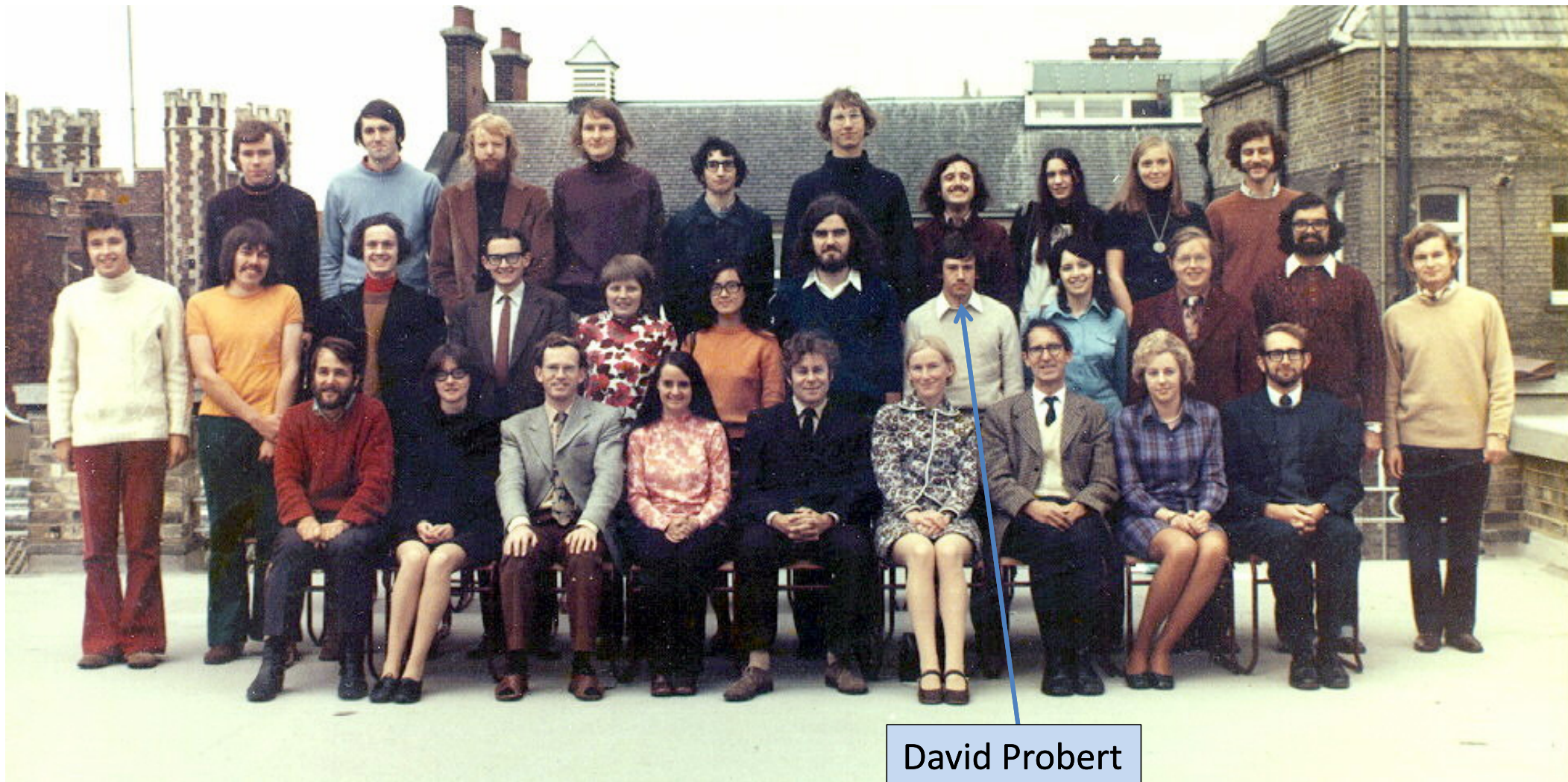
12

- Dept of Mathematics & Statistics -
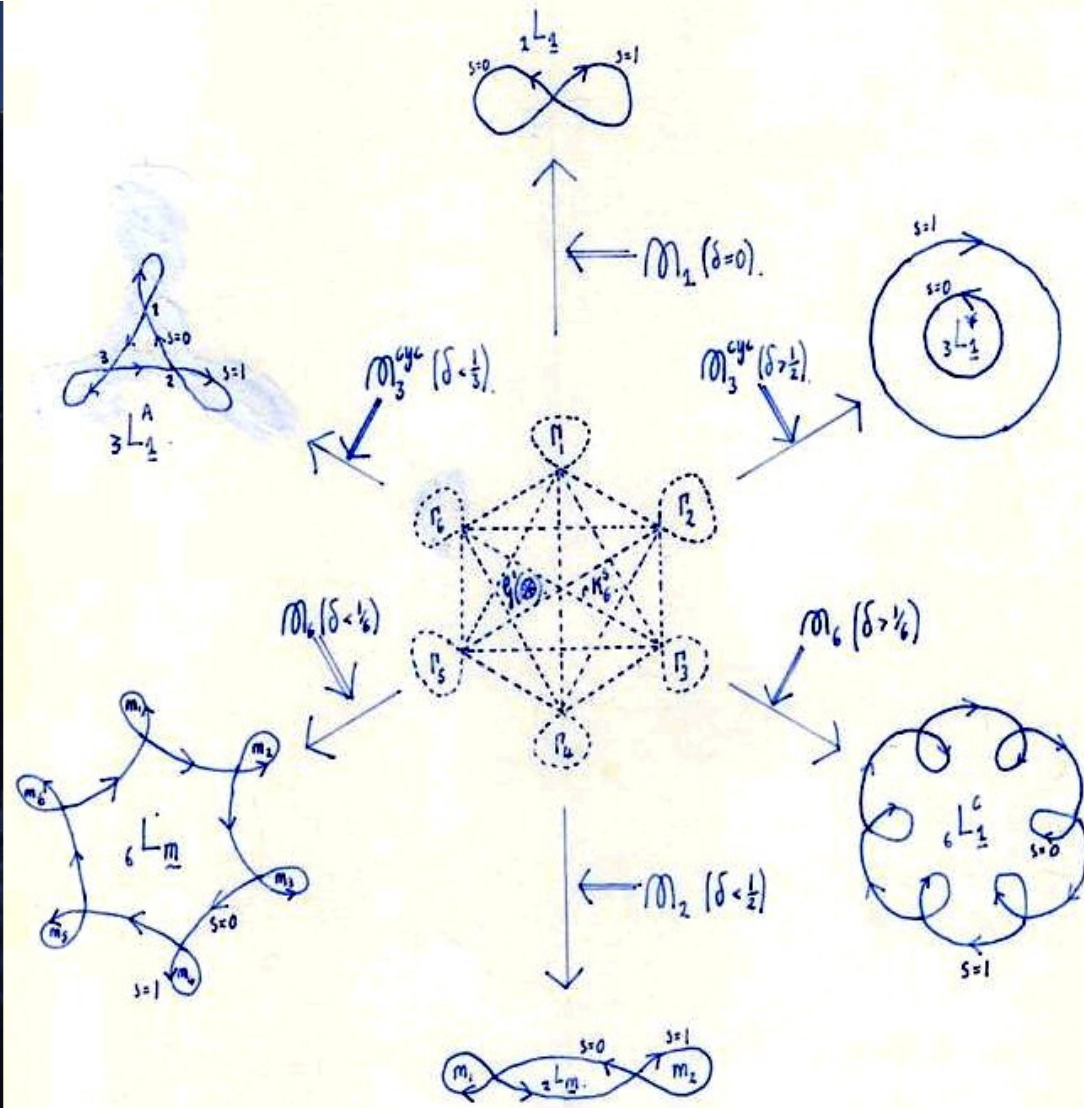## Cambridge University : 1973 - 1976

David Probert

Evolution of Stochastic Automata: *Cambridge, June '76*

The Evolution of Stochastic Automata
David Eric Probert - 1976
Churchill College, Cambridge

Self-Organisation & Adaptation Of Stochastic Learning Automata To Dynamic Environments

Download : www.valentina.net/Thesis/Thesis.pdf

Artificial Intelligence: "HAL 9000"
- 2001: *A Space Odyssey* (1968) -
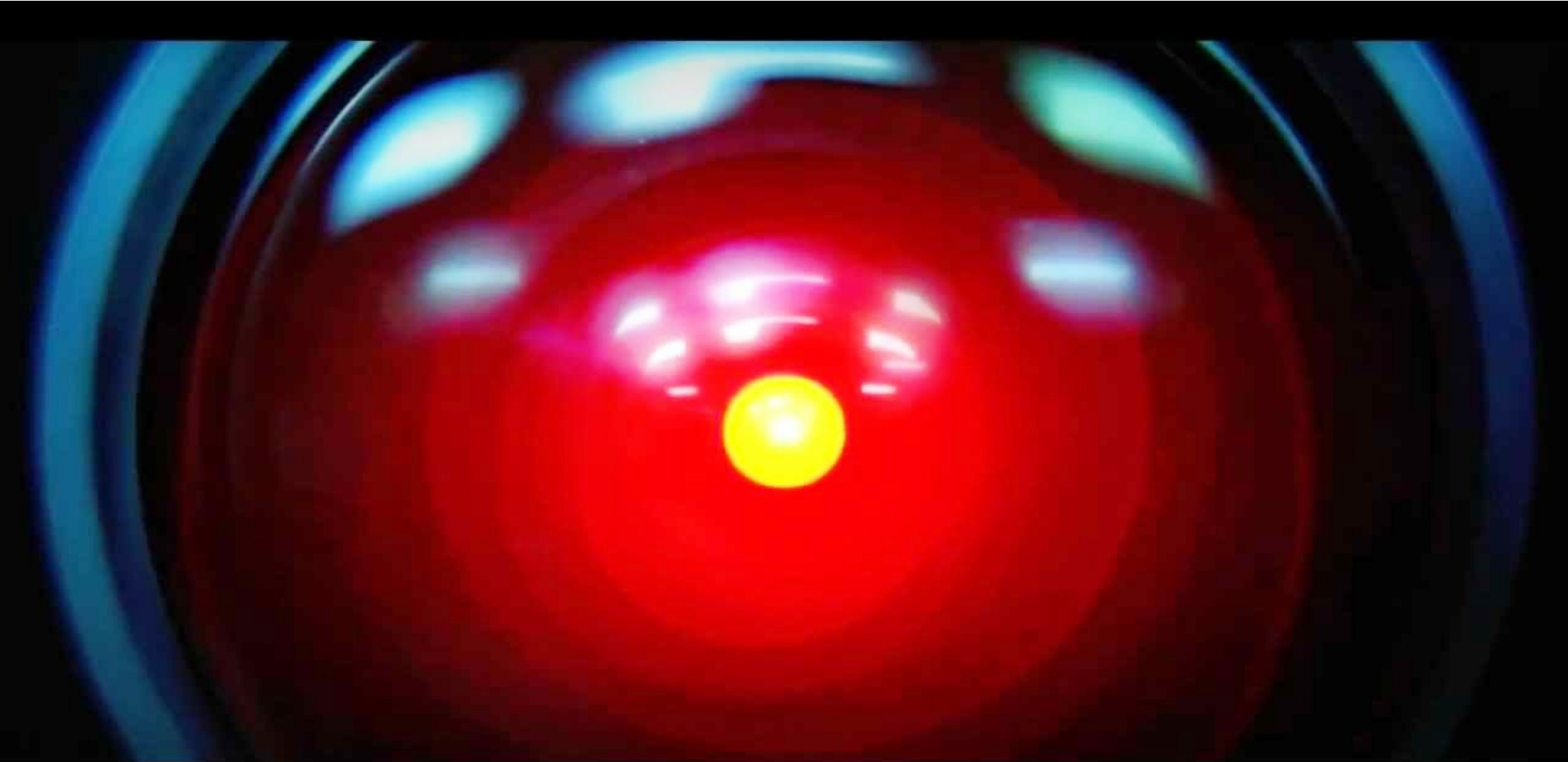
Artificial Intelligence: "HAL 9000"

A Space Odyssey - 1968 – 2018 – 2068 - Artificial Silicon Life?

Scenario 2020: "Advanced Cyber Tools"

*** Self-Learning Security ***

- Major Trends and Developments: **Scenario 2025**
  - Enterprises now deploy **AI/ML** Based **CyberSecurity Tools**
  - **"Augmented Reality"** Cyber Software & **Smart Devices**
  - **C$Os** provide Pan-Enterprise **Physical/Cyber Security**
  - **ICT Networks** migrate to **Self-Learning Neural Security**
  - Intelligent **"AI Bots"** act a *Real-Time* **"Cyber Police"** to Search & Quarantine Resources linked with suspected **CyberCriminals, Political Hacktivists** & **CyberTerror Cells**!

  ....Business & Government **Cyber** Networks & Assets now Secured **24/7** through **"Intelligent AI/ML Bots"**

Worldwide Real-Time Financial Trading
@*Light Speed* – 24/7 – *Global Networks*

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Darktrace: AI/ML CyberSecurity
- The Enterprise Immune System -

www.darktrace.com

THE ENTERPRISE IMMUNE SYSTEM

POWERED BY MATH & MACHINE LEARNING PROVEN TO WORK

DARKTRACE

DarkTrace: CyberSecurity Solution that **"Learns"** ALL Net Traffic, Assets & User Behaviour...
...Real-time Alerts provided & **Assets Quarantined** whenever **"Non-Normal"** Events Detected!

Darktrace: AI/ML CyberSecurity
- The Enterprise Immune System -

www.darktrace.com

DarkTrace: **CyberSecurity Solution** that **"Learns"** ALL Net Traffic, Assets & User Behaviour...
...Real-time Alerts provided & **Assets Quarantined** whenever **"Non-Normal"** Events Detected!

Typical "Machine Learning" Algorithm
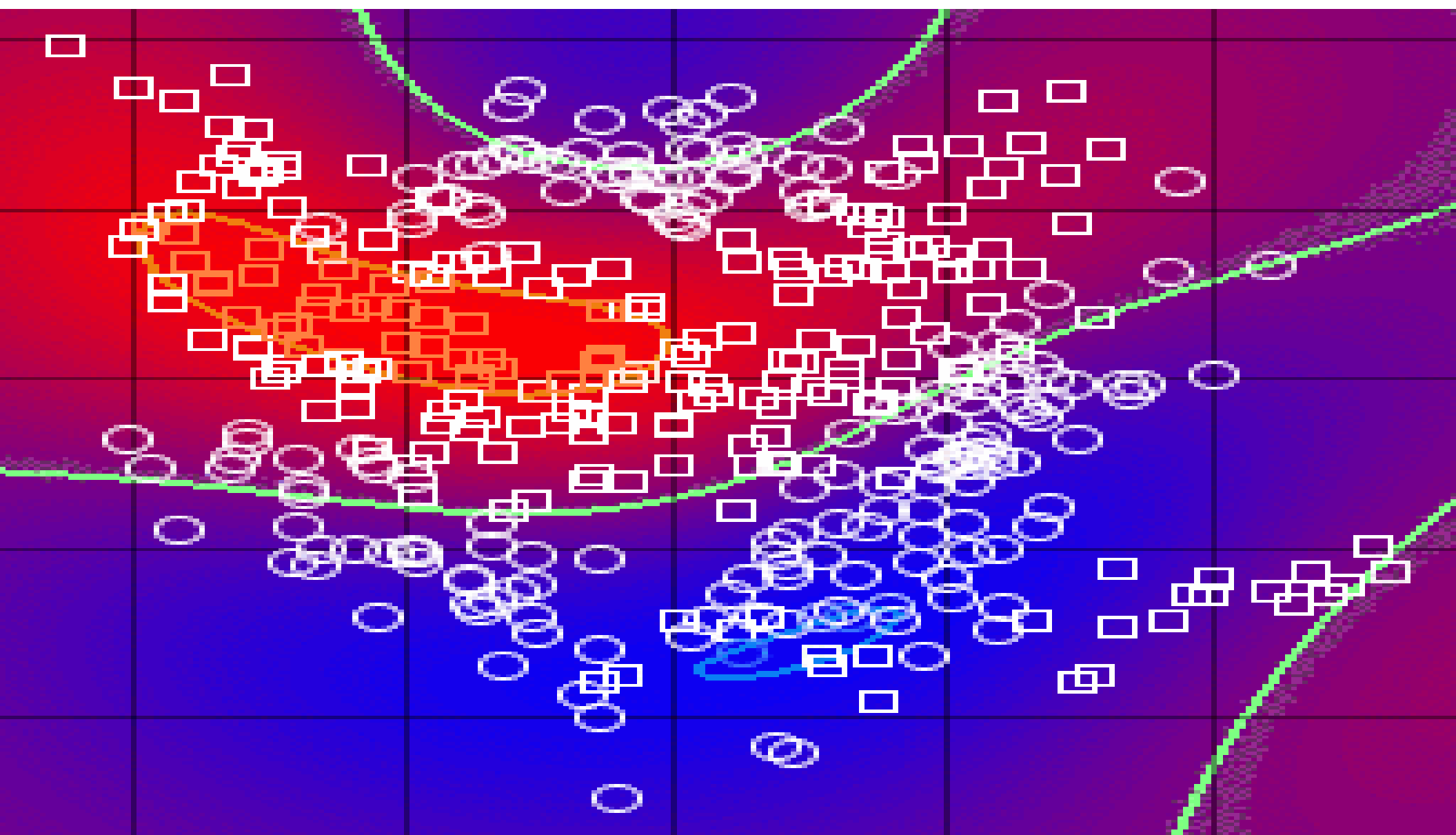
Google I/O: AI/ML Futures – 17th May 2017
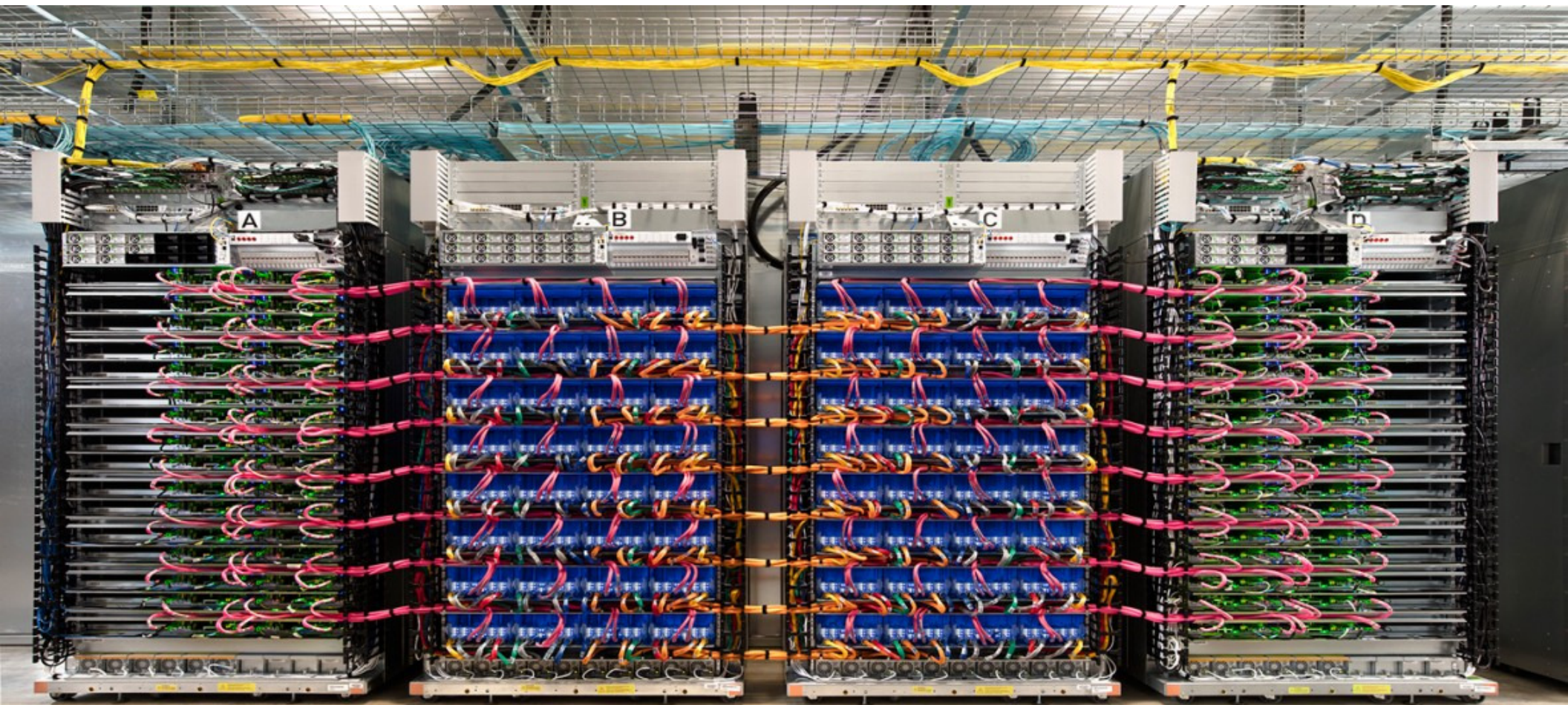
Ultra High Speed – Tensor Processing Unit: TPU
*** AL/ML/Big Data Apps - 180 TeraFlops ***

"Integrated Intelligent CyberSecurity"
using Google TPU within 5 Years running
Ultra-Fast Real-Time AI/ML/Big Data!

Google I/O: AI/ML Futures – 17th May 2017

Google Machine Learning Research Centre: Zurich - 2016

SparkCognition: AI & Machine Learning
DeepArmour – SparkPredict - SparkSecure

Link: SparkCognition.com – Austin. Texas, USA
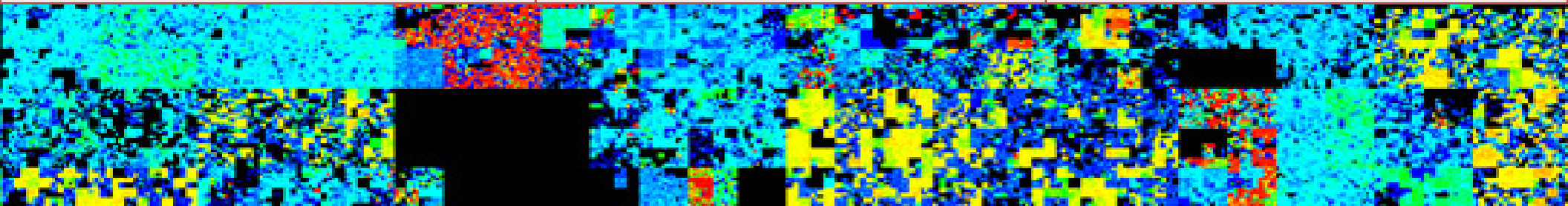**36th International East West Security Conference**

- 21stC Security Futures: 2018 – 2025 -
*** "Technology, Tools & Trends" ***
Seville, Spain – 20th–21st November 2017
© Dr David E. Probert : www.VAZA.com ©

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SparkCognition: AI & Machine Learning
DeepArmour – SparkPredict - SparkSecure

DEEPARMOR

Signature-free, Machine Learning Anti Malware

sparkcognition

Link: SparkCognition.com – Austin. Texas, USA

36th International East West Security Conference

- 21stC Security Futures: 2018 – 2025 -
*** "Technology, Tools & Trends" ***
Seville, Spain – 20th–21st November 2017
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SparkCognition: AI & Machine Learning
DeepArmour – SparkPredict - SparkSecure

SparkCognition Cognitive Analytics – Beyond Machine Learning

Powerful advancements in state of the art

Natural language processing
- Enables recall of answers, in context
- Analysis of human readable text for clues, insights and evidence

Deep Learning and Reasoning algorithms
- Improves accuracy
- Learns complex patterns
- Scales efficiently: High speed, large data implementations
- Make decisions in the absence of training data

Automated Model Building and Infinite Learning
- Watches data and derives rules
- Incorporates human feedback to strengthen or dismiss conclusions
- Automatically learns from feedback and greater volumes of data
- More data = more accuracy, capability & insight.

Powerful Visualization with Evidential Insights
- Provides transparency and evidence about what the cognitive system is learning and proposing
- Presents data elegantly – Analyst friendly interface, easy feedback
- Elevates evidence / reasoning for machine decisions

Link: SparkCognition.com – Austin. Texas, USA
36th International East West Security Conference

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Security 2018-2025: Techno, Tools & Trends

1 – "CyberSecurity @ Board Level" **"YOUR Cyber Mission"**	**2 – CyberCrime:CyberTerror:CyberWar** **"OUR Cyber Society"**	**3 – Scenario 2018: Cyber & Physical Tools** **"Integrated Security"**
4 – Scenario 2019: Internet of Things: IoT **"Self-Adaptive"**	**5 – Scenario 2020: Machine Learning** **"Self-Learning"**	**6 – Scenario 2025: Artificial Intellgence** **"Cyber-Intelligent"**
7 – Scenario 2040: Artificial Silicon Life" **"Neural Security"**	**8 – Cyber VISION to Security NOW!** **"New Cyber Toolkit"**	**9 – YOUR Action Plan for 21stC Cyber!..** **"CyberSecurity Plan"**

CyberSECURITY
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Security 2018-2025: Techno, Tools & Trends

6 –Scenario 2025: Artificial Intelligence
"Cyber-Intelligent Security"
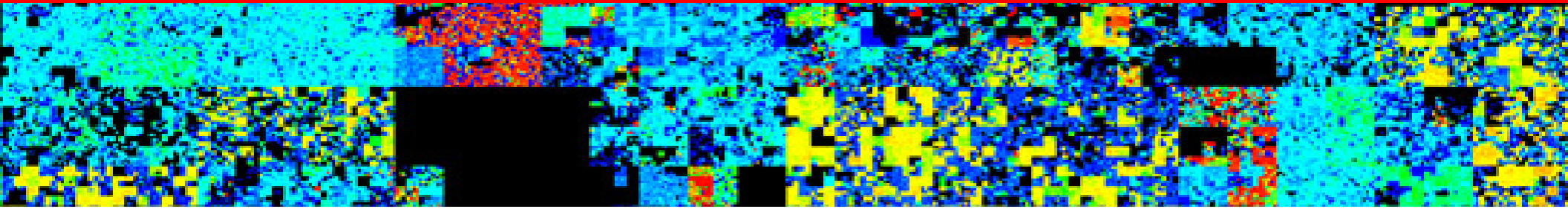
Scenario 2025: *"Intelligent Security"*

- Transition & Full Deployment of Enterprise-Wide AI/ML-based **Intelligent** "CyberSecurity" Tools

- Real-Time **Behavioural Modelling** of ALL aspects of Net Traffic, System/Event Logs, Net Nodes, Servers, Databases, Devices & Users

- Focus on **AI/ML Modelling** of the **"Known Good"** to augment Classic Detection using **"Known Bad",** and hence provide New Generation **"Defence In-Depth"**

- Trial Deployment of **Autonomous Real-Time** "Cyber" Alerts that integrate both Traditional & Advanced AI/ML "Cybersecurity Tools"

Hybrid 21ˢᵗC Business Organisation
- Hierarchical & Networked -

- *Transition* from 20ᵗʰC to 21ˢᵗC Business, Governance & Security requires fundamental re-structuring of operations:

  – *20ᵗʰC Industrial Organisations:* *Hierarchical* Bureaucracies - *"Pyramids"* - to manually process data/information.

  – *21ˢᵗC Intelligent Organisations:* *Networked* Peer-to-Peer Business & Agencies with data processed in Global *"BIG Cyber Clouds"*

- *Living Systems*, such as Mammals & Birds, use *Hybrid* Organisation of their extended nervous system (**Brain & Body**) to optimise real-time learning and effective self-organising environmental adaptation!

- *Intelligent Security Solutions* will also require *Hybrid* organisation to optimise real-time response to **Cyber & Physical** Attacks.

Scenario 2025 Business will evolve to Intelligent *Hybrid* Security Operations!

A 30,000 ft View of the Artificial Intelligence Industry

Visit www.artificialintelligenceevent.com for details. This infographic is for educational purposes and uses forecasts from Tractica.

ARTIFICIAL INTELLIGENCE
FOR ENTERPRISE

ARTIFICIAL INTELLIGENCE REVENUE FORECASTED AT $36.8 BILLION USD

THESE NUMBERS REPRESENT SPENDING ON AI TECHNOLOGY DEPLOYMENTS BY INDUSTRY SECTOR.

$2.9 BILLION Advertising
$2.2 BILLION Healthcare
$2.3 BILLION Finance
$3.1 BILLION Business Services
$3.4 BILLION Consumer
$1.1 BILLION Retail
$1.1 BILLION Oil, Gas, & Mining
$2.3 BILLION Defense
$2.4 BILLION Investment
$2.7 BILLION Media & Entertainment
$1.3 BILLION Education
$1.2 BILLION Legal
$1.5 BILLION Agriculture
$1.9 BILLION Manufacturing
$996 MILLION Automotive
$876 MILLION Information Technology
$819 MILLION Telecommunications
$797 MILLION Transportation
$769 MILLION Logistics
$708 MILLION Sports
$631 MILLION Aerospace
$407 MILLION Government
$441 MILLION Real Estate
$348 MILLION Life Sciences
$290 MILLION Gaming
$255 MILLION Building Automation
$168 MILLION Fashion

40% of AI Revenue Forecasts to 2025 Comes from Consumer, Business Services, Advertising, Media & Entertainment and Investment Industries

ARTIFICIAL INTELLIGENCE REVENUE BY INDUSTRY, WORLD MARKETS: 2025

INDUSTRY	2025
Consumer	$3.4 billion
Business Services	$3.1 billion
Advertising	$2.9 billion
Media & Entertainment	$2.7 billion
Investment	$2.4 billion
Defense	$2.3 billion
Finance	$2.3 billion
Healthcare	$2.2 billion
Manufacturing	$1.9 billion
Agriculture	$1.5 billion
Education	$1.3 billion
Legal	$1.2 billion
Oil, Gas, and Mining	$1.1 billion
Retail	$1.1 billion
Automotive	$996 million
Information Technology	$876 million
Telecommunications	$819 million
Transportation	$797 million
Logistics	$769 million
Sports	$708 million
Aerospace	$631 million
Real Estate	$441 million
Government	$407 million
Life Sciences	$348 million
Gaming	$290 million
Building Automation	$255 million
Fashion	$168 million
Total	**$36.8 billion**

* WorldWide AI MarketPlace *
(1) Investments & Acquisitions: 2012 - 2017

CISCO	prospera · Paxata · Moogsoft · exabeam · BITSTEW SYSTEMS	MindMeld
facebook		JIBBIGO · face.com · wit.ai · Ozlo · Masquerade · Zurich Eye
GE	tamr · stem · SmartAssist AI FOR CUSTOMER SUPPORT · SIGHT MACHINE Manufacturing Analytics · Predixion · PingThings · MedAware · MAANA · HealthReveal · FOGHORN · BITSTEW SYSTEMS · AYASDI · ARTERYS	BITSTEW SYSTEMS · Wise.io
Google	ZEPHYR HEALTH · Unbabel · tamr · SHAPE · Recorded Future · Predilytics · Orbital Insight · MODSY · MindMeld · Mighty Ai · LATTICE · Lemonade · fullstory · FRAMED · flatiron · digit · Comfy · clarifai · ANOMALI · Mobvoi	DNNresearch · DEEPMIND · jetpac · emu · Dark Blue Labs · Vision Factory · Granata decision systems · TIMEFUL · Moodstocks · api.ai · kaggle · Halli Labs · Fabby

36th International East West Security Conference

* WorldWide AI MarketPlace *
(2) Investments & Acquisitions: 2012 - 2017

IBM
- Welltok. Optimizing Health, Maximizing Rewards.
- Cognitive Scale
- PATHWAY GENOMICS®
- CogNEA ARTIFICIAL INTELLIGENCE
- AlchemyAPI™ An IBM Company
- explorys

intel
- ZMP
- Xevo
- VECTRA
- saffron TECHNOLOGY
- RK Reflektion
- lu lumiata
- prelert
- PERRONE ROBOTICS
- Paxata
- Parallel/\
- ORCAM
- next IT
- indisys:
- FORTSCALE
- FOGHORN
- InteliWISE
- ELEMENT AI
- Mighty Ai
- MAANA
- EMOTIENT
- MindMeld
- DataRobot
- COSY
- CLOUD MADE
- Chronocam
- api.ai
- indisys: Intelligent Dialogue Systems
- saffron TECHNOLOGY
- itseez
- Movidius
- nervana SYSTEMS

Microsoft
- TACT
- Plape
- Paxata
- onfido
- INSIDE SALES .COM
- ELEMENT AI
- CrowdFlower
- Cognitive Scale
- Comfy
- bonsai
- agolo
- NETBREEZE understanding your audience
- equivio zoom in. find out
- SwiftKey.
- Genee
- Maluuba

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CyberSecurity www.vaza.com
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Where are the largest market opportunities for AI?
Visit www.artificialintelligenceevent.com for details. This infographic is for educational purposes and uses forecasts from Tractica.

ARTIFICIAL INTELLIGENCE FOR ENTERPRISE

Businesses Use Artificial Intelligence to Improve Strategy Performance as Well as Processing Big Data

TOP 3 USE CASES FOR ARTIFICIAL INTELLIGENCE:

1 Algorithmic trading strategy performance improvement

Algorithmic trading, also known as algo-trading, has been around for years – used by traders to minimise cost and time spent on manual slices. Its positive impact on market and the risk of an order executive make it a popular practice used by institutional traders in order to support large orders – which is seen in the forecasted $2.4billion invested into it. The most common application of algo-trading is to enhance trading strategies including arbitrage, intermarket spreading, market making, and speculation.

2 Static image recognition, classification, and tagging

With the growing popularity of open-source content, the new speed of internet and the unmatched space of cloud-based systems, platforms processing a large number and a high frequency of images saw immediate benefit to the introduction of image recognition through machine learning – correlating with a forecast of $2.3billion investment by 2025. Just recently, Facebook's own Marc Zuckerberg, who outlined the social network's artificial intelligence (AI) plans to "build systems that are better than people in perception."*

3 Efficient, scalable processing of patient data

Although there are still some challenges in information governance, the efficient, scalable processing of patient data is one of the most critical uses of artificial intelligence, with a forecast of roughly $2.3billion in investment. For anyone who has experienced the pains of hand-written clinical notes and letters at the doctor's office can guess what an immediate benefit machine learning can lend – and can potentially be enhanced or complemented by self-reporting measures. Dr Goran Nenadic, Group Leader, The Farr Institute's Health eResearch Centre recently shared main concepts in text analytics and natural language processing, and presented the potential and challenges through several real-world use case examples at the recent AI for Healthcare and Life Sciences meeting in London.

$2.4 BILLION Algorithmic trading strategy performance improvement

$2.3 BILLION Static image recognition, classification and tagging

$2.3 BILLION Efficient, scalable processing of patient data

$1.1 BILLION Text query of images

$1.1 BILLION Automated geophysical feature detection

$1.0 BILLION Object identification, detection, classification, tracking from geospatial images

$1.2 BILLION Content distribution on social media

$1.4 BILLION Predictive maintenance

$665 MILLION Prevention against cybersecurity threats
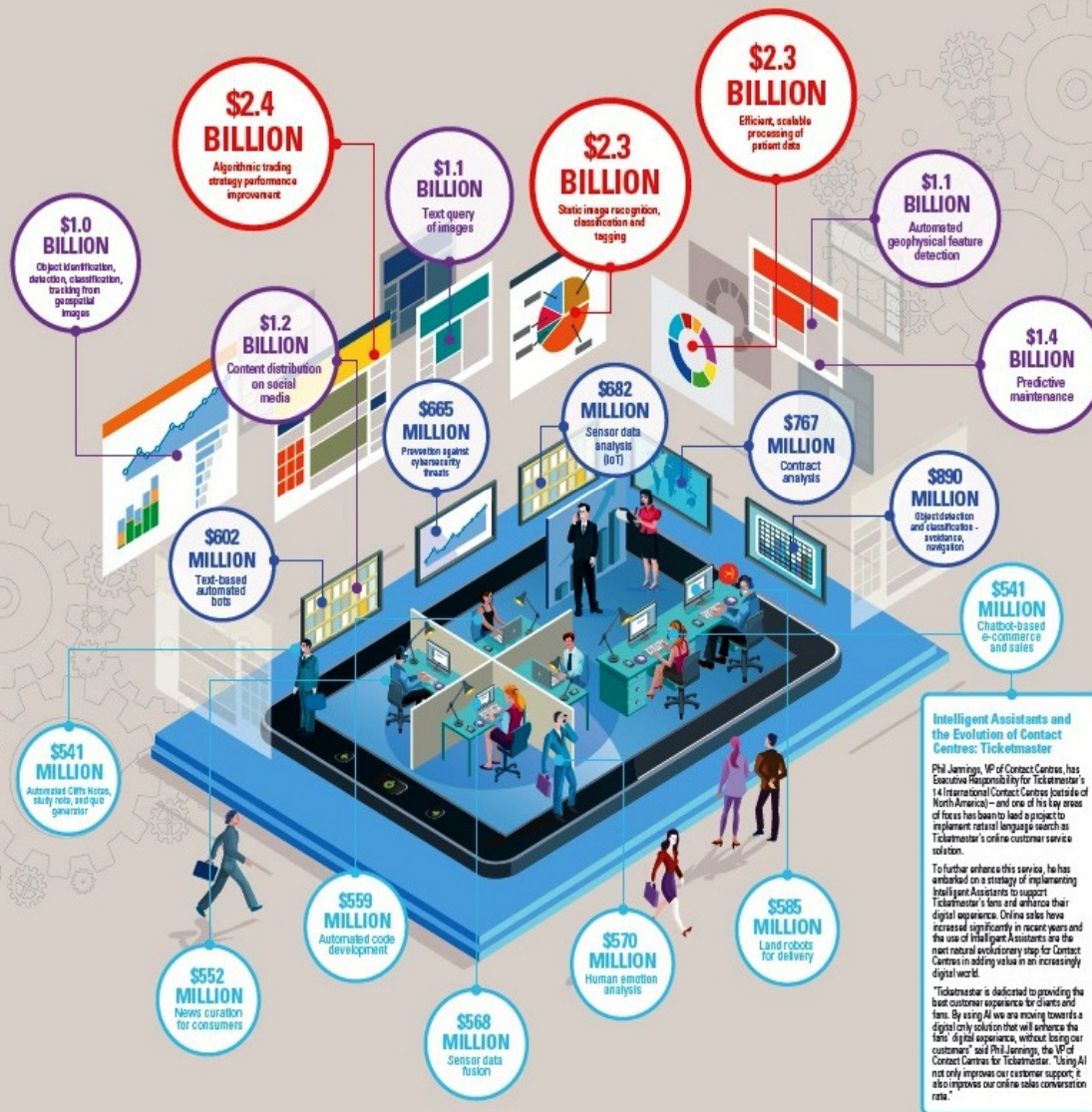
$682 MILLION Sensor data analysis (IoT)

$767 MILLION Contract analysis

$890 MILLION Object detection and classification - avoidance, navigation

$602 MILLION Text-based automated bots

$541 MILLION Chatbot-based e-commerce and sales

$541 MILLION Automated Cliffs Notes, study note, and quiz generator

$552 MILLION News curation for consumers

$559 MILLION Automated code development

$570 MILLION Human emotion analysis

$568 MILLION Sensor data fusion

$585 MILLION Land robots for delivery

Intelligent Assistants and the Evolution of Contact Centres: Ticketmaster

Phil Jennings, VP of Contact Centres, has Executive Responsibility for Ticketmaster's 14 International Contact Centres (outside of North America) – and one of his key areas of focus has been to lead a project to implement natural language search as Ticketmaster's online customer service solution.

To further enhance this service, he has embarked on a strategy of implementing Intelligent Assistants to support Ticketmaster's fans and enhance their digital experience. Online sales have increased significantly in recent years and the use of Intelligent Assistants are the next natural evolutionary step for Contact Centres in adding value in an increasingly digital world.

"Ticketmaster is dedicated to providing the best customer experience for clients and fans. By using AI we are moving towards a digital only solution that will enhance the fans' digital experience, without losing our customers" said Phil Jennings, the VP of Contact Centres for Ticketmaster. "Using AI not only improves our customer support; it also improves our online sales conversion rate."

ARTIFICIAL INTELLIGENCE REVENUE, TOP 20 USE CASES, WORLD MARKETS: 2025

USE CASE	2025
Algorithmic trading strategy performance improvement	$2.4 billion
Static image recognition, classification, and tagging	$2.3 billion
Efficient, scalable processing of patient data	$2.3 billion
Predictive maintenance	$1.4 billion
Content distribution on social media	$1.2 billion
Text query of images	$1.1 billion
Automated geophysical feature detection	$1.1 billion
Object identification, detection, classification, tracking from geospatial images	$1.0 billion
Object detection and classification - avoidance, navigation	$890 million
Contract analysis	$767 million
Sensor data analysis (IoT)	$682 million
Prevention against cybersecurity threats	$665 million
Text-based automated bots	$602 million
Land robots for delivery	$585 million
Human emotion analysis	$570 million
Sensor data fusion	$568 million
Automated code development	$559 million
News curation for consumers	$552 million
Chatbot-based e-commerce and sales	$541 million
Automated Cliffs Notes, study note, and quiz generator	$518 million

Scenario 2025: "Intelligent Defence Bots"

1982 < -Review Past 34 years-> **2016** <- Explore Future 34 years-> **2050**

TRON (1982): Sci-Fi Security Perspective!

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Scenario 2025: "Intelligent Defence Bots"

1982 < -Review Past 34 years-> **2016** <- Explore Future 34 years-> **2050**

TRON (1982): Sci-Fi Security Perspective!

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Mapping 21stC Social Media Networks: *LinkedIn (Probert)*

Mapping 21stC Social Media Networks: *LinkedIn (Probert)*
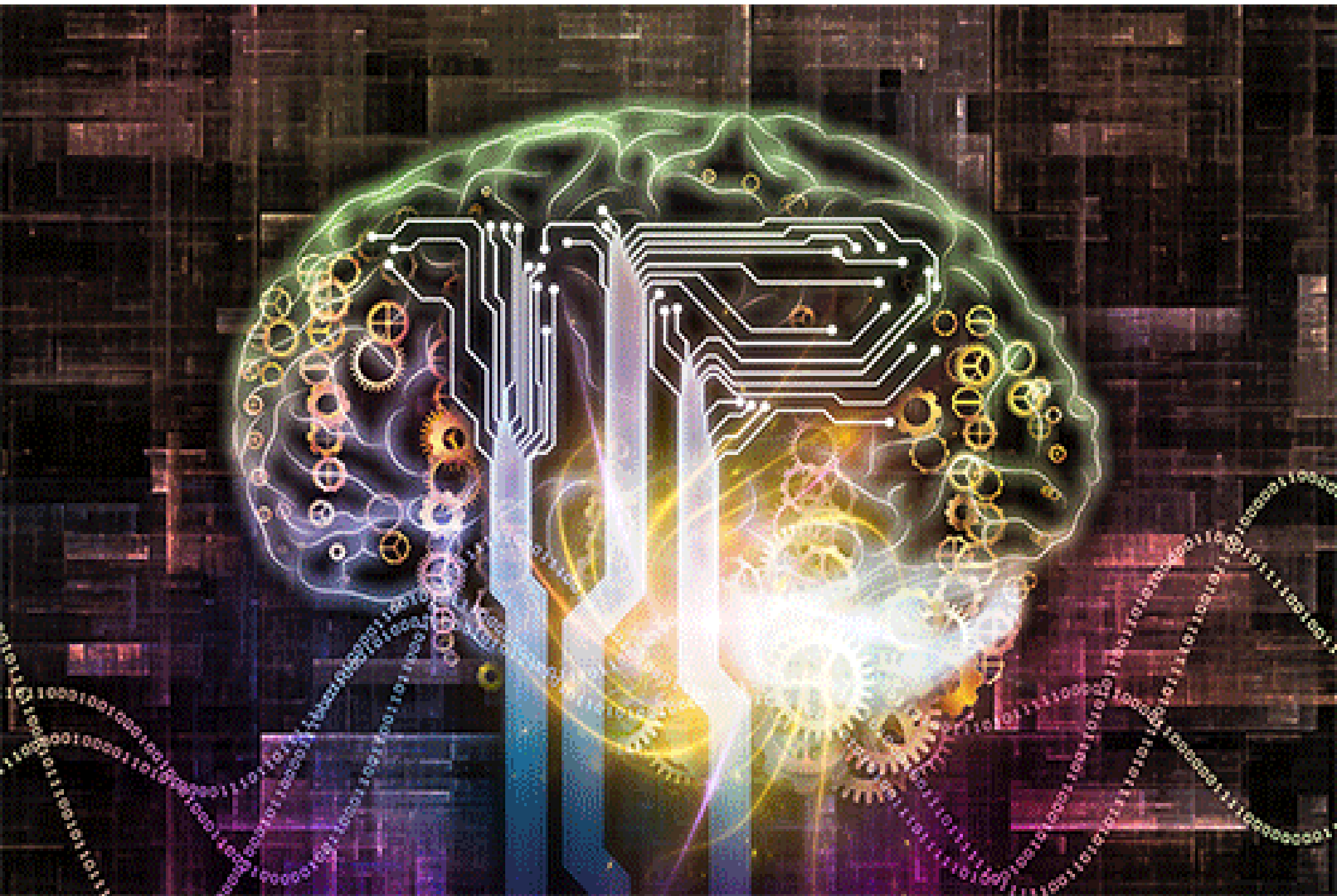
Deep Learning & Neural Networks
Advanced CyberSecurity Solutions

ARTIFICIAL INTELLIGENCE
Early artificial intelligence stirs excitement.

MACHINE LEARNING
Machine learning begins to flourish.

DEEP LEARNING
Deep learning breakthroughs drive AI boom.

1950's   1960's   1970's   1980's   1990's   2000's   2010's

Deep Learning & Neural Networks
Advanced CyberSecurity Solutions

HOW A DEEP NEURAL NETWORK SEES

Image

"Audi A7"
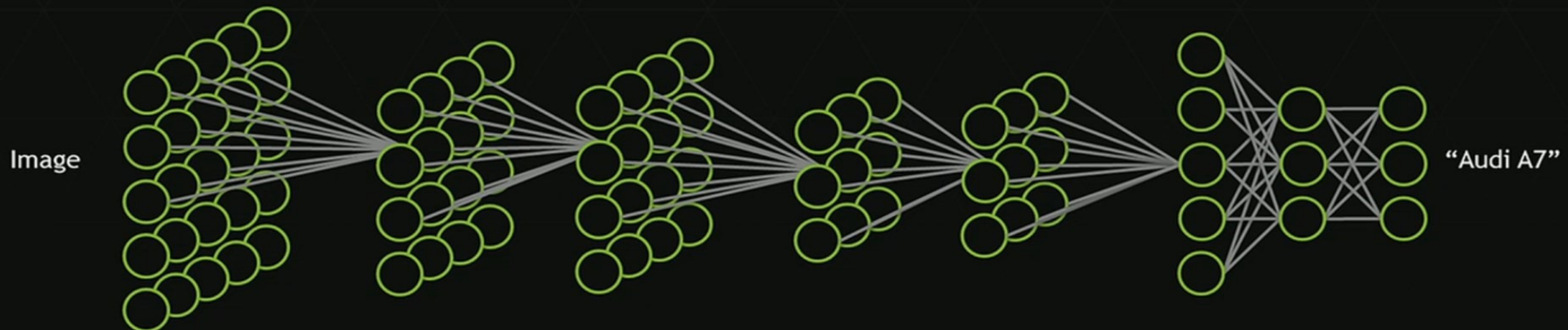
Image source: "Unsupervised Learning of Hierarchical Representations with Convolutional Deep Belief Networks" ICML 2009 & Comm. ACM 2011.
Honglak Lee, Roger Grosse, Rajesh Ranganath, and Andrew Ng.

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Advanced CyberSecurity Solutions
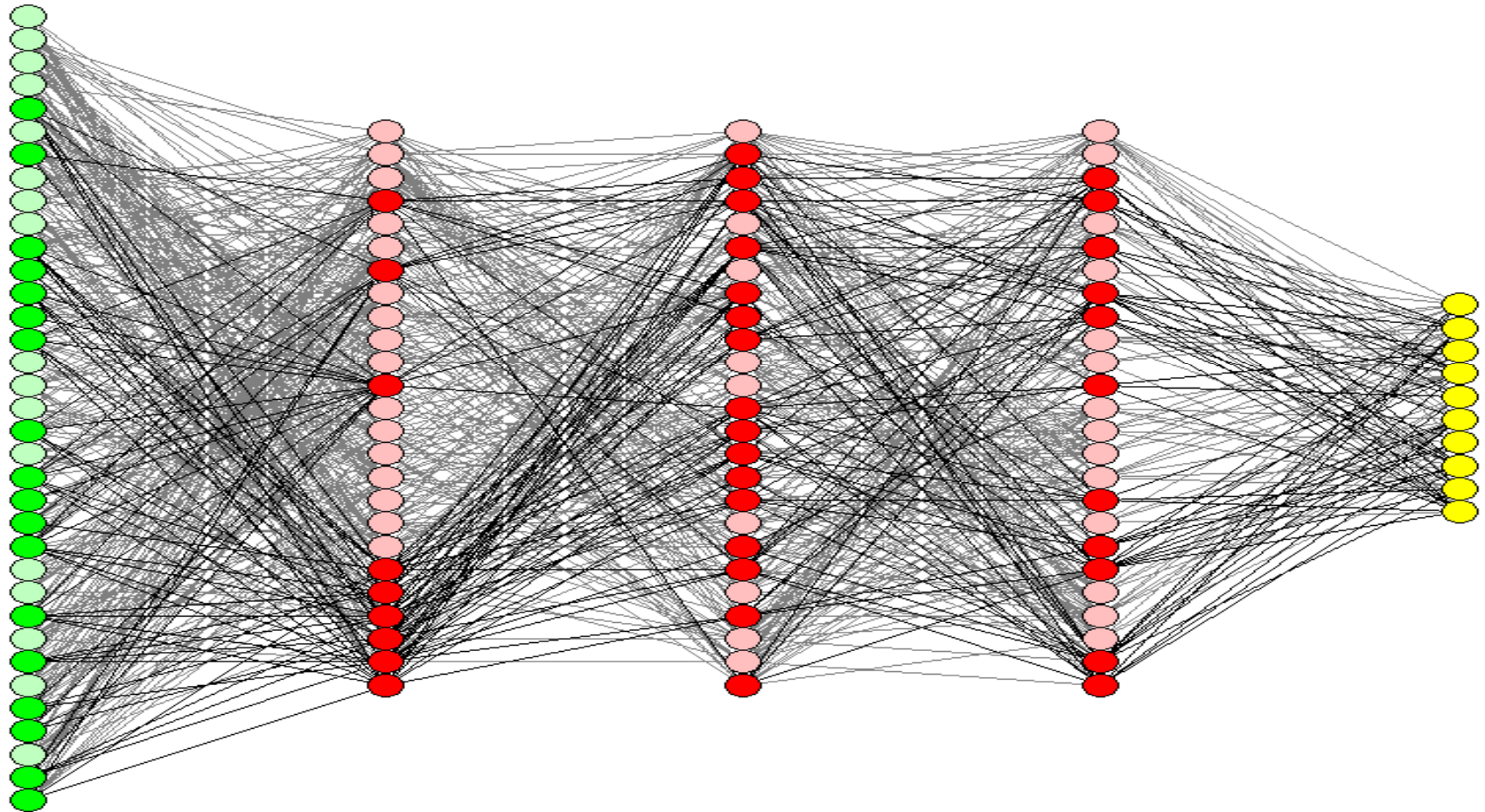
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How Artificial Intelligence Will Secure the 21st Century

Machine Learning and Mathematics Introduce a Brave New World of Predictive Cybersecurity That Rewrites the Rules of Protection

www.cylance.com/content/dam/cylance/pdfs/white_papers/**AI_and_Machine_Learning.pdf**

CYLANCE™
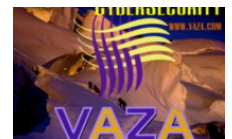
Deep**Instinct:** **Real-Time APT Protection**

Provides **Deep Learning CyberSecurity** for **APT Protection** of **Mobile** & **End-Points**!

DeepInstinct: Real-Time APT Protection

DATA TRAINING

Each object is broken-down into its smallest parts. Process is agnostic to the data's origin
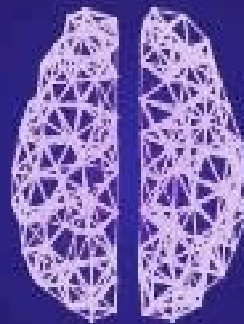
DEEP LEARNING

Proprietary, deep learning algorithms. Continuous learning

PREDICTIVE CAPABILITIES

Lightweight, real-time cyber intelligence distributed across the organization's infrastructure

Provides **Deep Learning CyberSecurity** for **APT Protection** of **Mobile** & **End-Points**!

DeepInstinct: Real-Time APT Protection

Our Value: Zero-Day and APT Prevention

Real-time APT detection and prevention
Deep Instinct enables real-time detection AND prevention capabilities of first-seen malicious activities on all organizational assets.

Deep Instinct's accurate prediction capability is enabled by its proprietary Deep Learning algorithms.
Prediction of future cyber threats

Infrastructure agnostic
- **Mobile:** Immediate on-device decision
- **Endpoints:** Pre-execution action. Faster than real-time!

Light prediction model enables direct action on the device without any external dependency.
Connectionless

www.deepinstinct.com
Fast and easy deployment
Light agents enabling a smooth deployment with no impact on the entire organization's assets.

deepinstinct

Provides **Deep Learning CyberSecurity** for **APT Protection** of **Mobile** & **End-Points**!

*** **APT** = Advanced Persistent Threat ***
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SingularityNet: Platform for AI Economy
- *Distributed BlockChain Payment Net* -

Launch: *Oct 2017* - **Web:** singularityNet.io - **Founder**: *Dr Ben Goertzel*

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7 – Scenario 2040: Artificial Silicon Life! **"Neural Security"**	8 – Cyber VISION to Security NOW! **"New Cyber Toolkit"**	9 – YOUR Action Plan for 21stC Cyber!.. **"CyberSecurity Plan"**

Security 2018-2025: Techno, Tools & Trends

7 – Scenario 2040: Artificial Silicon Life!
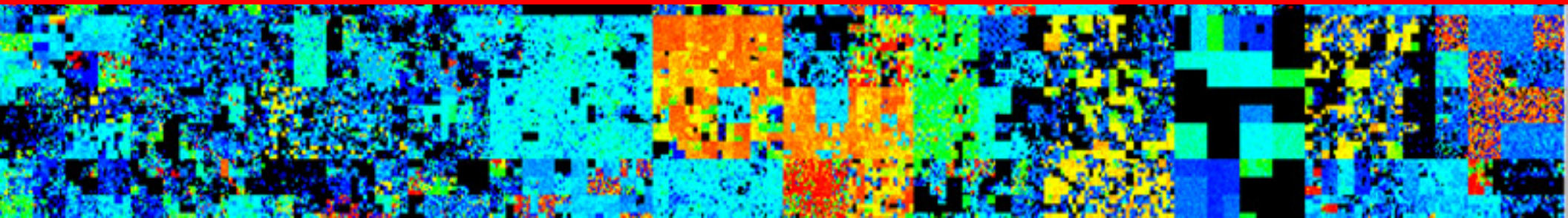
"Neural Security"
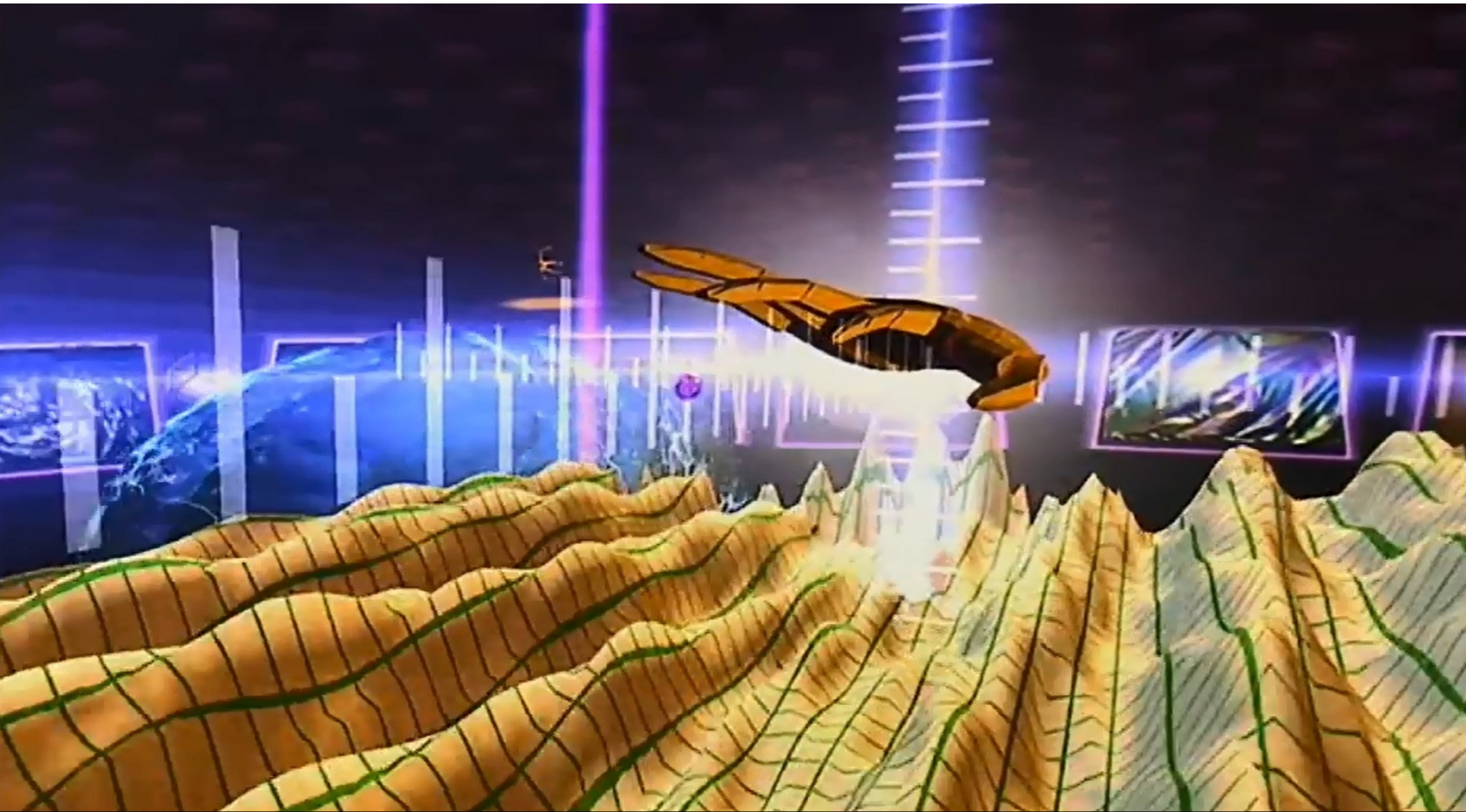
Scenario 2040: "Neural Security & Society"

1992 < -Review Past 24 years-> 2016 <- Explore Future 24 years-> 2040

Scenario **2040**: "**Neural Security & Society**"

ACCESS GRANTED

1992 < -Review Past 24 years-> **2016** <- Explore Future 24 years-> **2040**

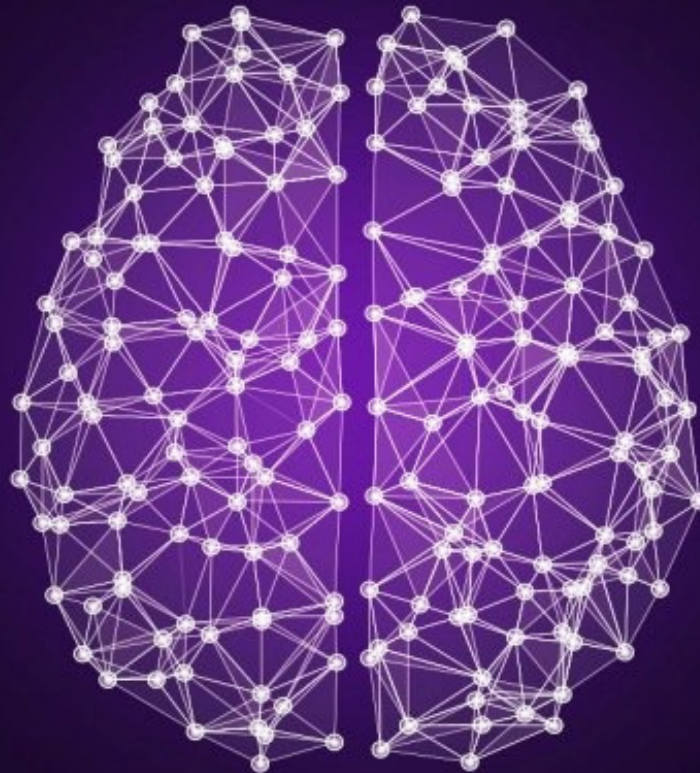Lawnmower Man (1992) ...a Neural Future!

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CyberSecurity

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Scenario 2040: *"Neural Security"*

- Full Implementation of Intelligent & Adaptive Cybersecurity across the *Extended Enterprise*

- *Autonomous "Alerts"* and Real-Time AI/ML-based Cyber Event, Traffic & User Modelling

- New Scaled Architectures and Operational Standards for *"Smart Systems"* – Smart Devices, Business, Cities, Government, Economy & Society

- Cybersecurity Operations transition to become Ultra-Intelligent – *"Neural Security"* – through Embedded "AI-Security Bots" for Real-Time Defence

Scenario **2040**: *"Neural Security"*

EEG powered by BCILAB | SIFT

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Scenario 2040: Cyber Defense – NATO & Canada

The Future Security Environment 2013-2040

National Défense
Defence nationale

Canada

Artificial Intelligence in Cyber Defense

Enn Tyugu
R&D Branch
Cooperative Cyber Defense Center of Excellence (CCD COE)
and Estonian Academy of Sciences
Tallinn, Estonia
tyugu@ieee.org

Abstract- The speed of processes and the amount of data to be used in defending the cyber space cannot be handled by humans without considerable automation. However, it is difficult to develop software with conventional fixed algorithms (hard-wired logic on decision making level) for effectively defending against the dynamically evolving attacks in networks. This situation can be handled by applying methods of artificial intelligence that provide flexibility and learning capability to software. This paper presents a brief survey of artificial intelligence applications in cyber defense (CD), and analyzes the prospects of enhancing the cyber defense capabilities by means of increasing the intelligence of the defense systems. After surveying the papers available about artificial intelligence applications in CD, we can conclude that useful applications already exist. They belong, first of all, to applications of artificial neural nets in perimeter defense and some other CD areas. From the other side – it has become obvious that many CD problems can be solved successfully only when methods of artificial intelligence are being used. For example, wide knowledge usage is necessary in decision making, and intelligent decision support is one of yet unsolved problems in CD.

Keywords: applied artificial intelligence; intelligent cyber defense methods; neural nets in cyber defense; expert systems in cyber defense.
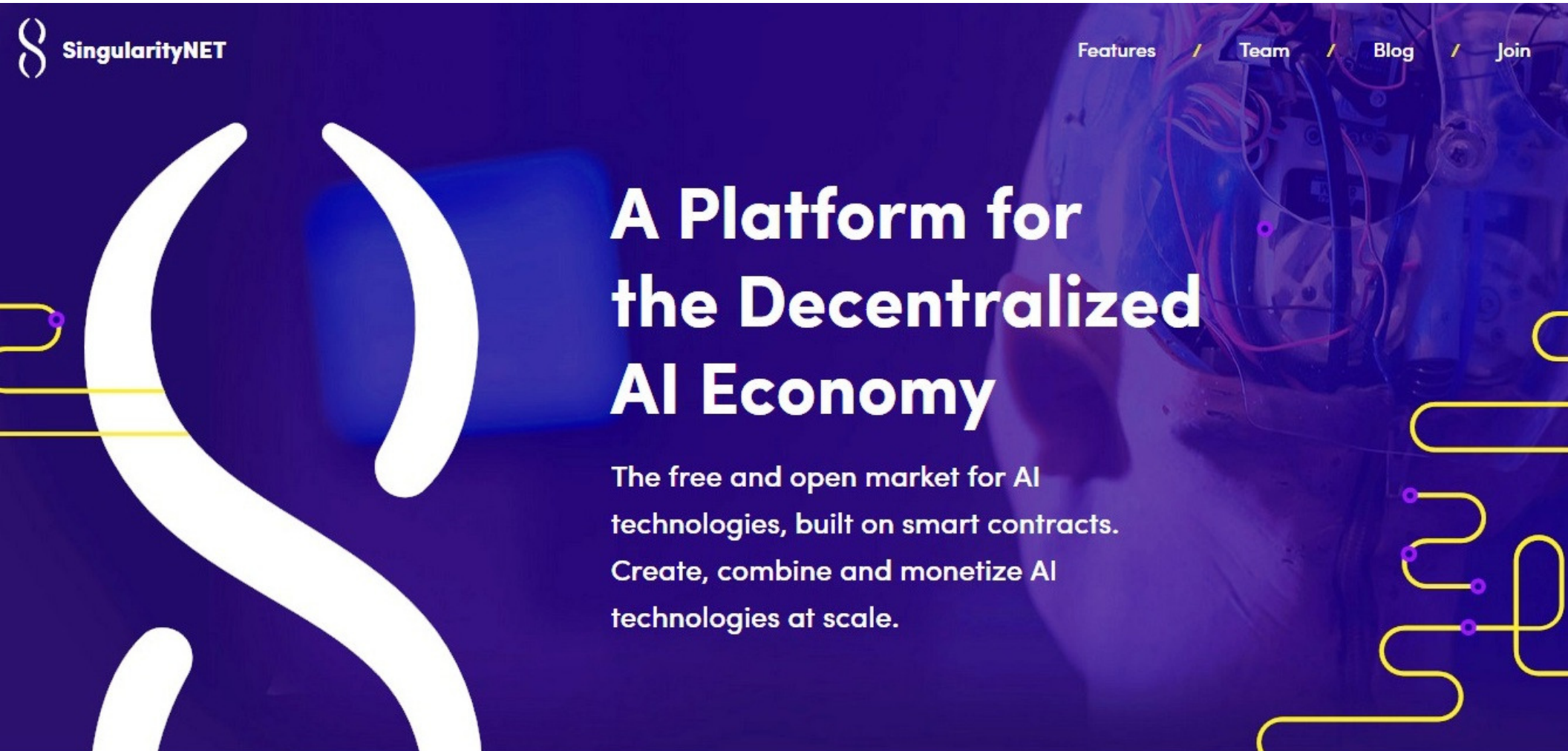

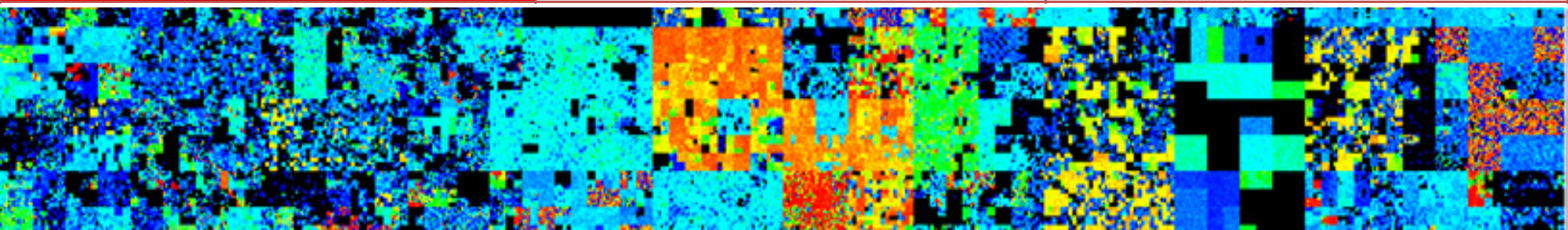
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Security Futures: *Towards "Neural Society"*

- **Real-Time Security Operations:**
  - Secure and monitor every cyber asset and critical physical asset through IP Networking, RFID Tagging & communication of status to operations centre

- **Augmented & Immersive Reality:**
  - Multimedia virtual world overlays on data from the real physical world, through head-up displays & other forms of embedded sensors & displays

- **Bio Neural Metaphors:**
  - Further developments of self-organising and autonomous systems for monitoring and responding to cyber alerts & attacks in real-time

- **3D Adaptive Simulation & Modelling:**
  - Adaptive 3D computer modelling of physical buildings, campuses & cities, as well as dynamic models of extended enterprises networks. The aim is to visualise, model & respond to security alerts with greater speed & precision

- **"Smart Security" Architectures:**
  - Effective integrated security requires management through hybrid hierarchical and "peer-to-peer" organisational architectures. Living organic systems also exploit hybrid architectures for optimal command & control

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Scenario 2040: Cyber Defence:
UK Ministry of Defence - MOD

Ministry of Defence

Strategic Trends Programme
Global Strategic Trends - Out to 2040

Fourth Edition

DCDC

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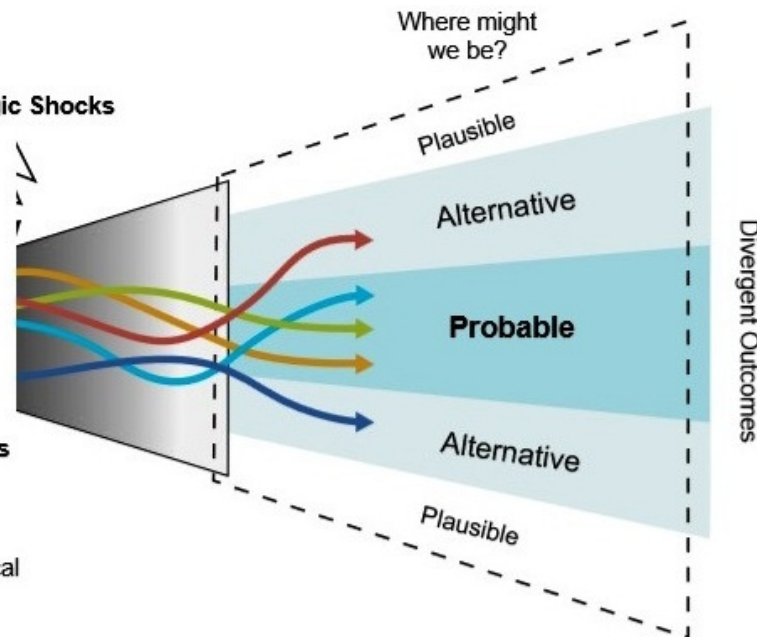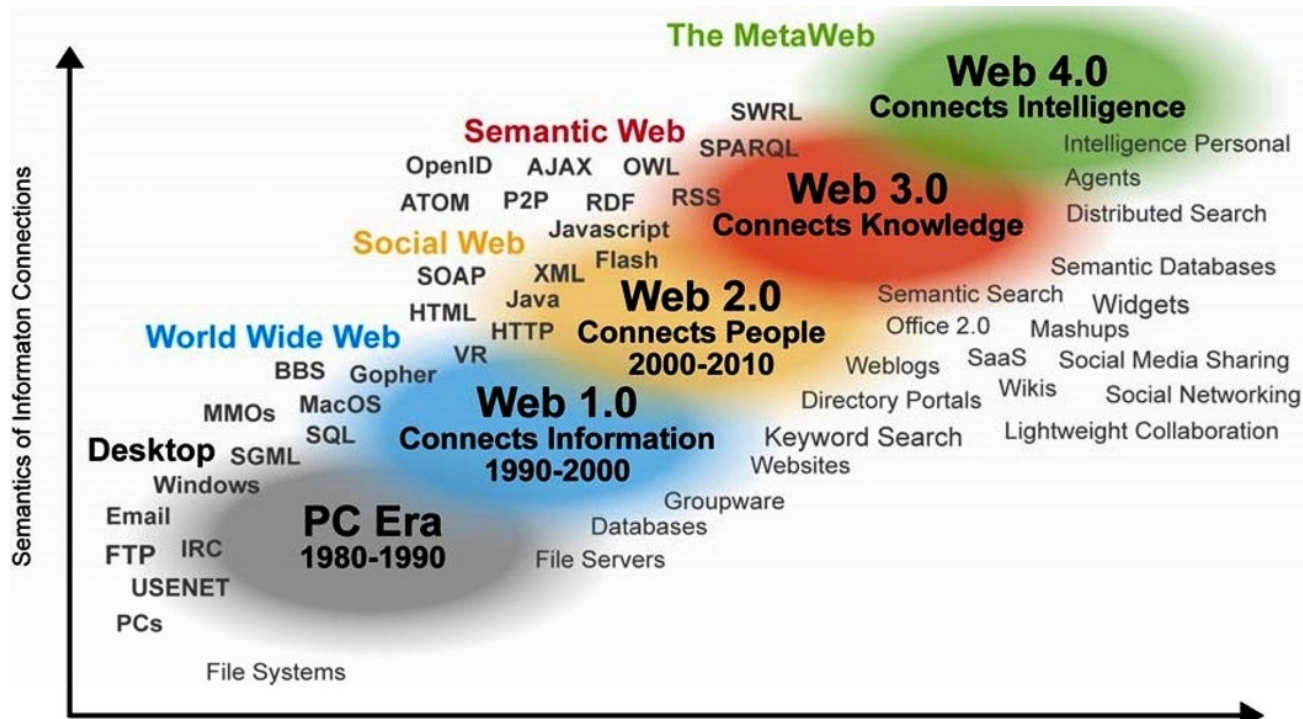
Interfacing "Human" and "CyberWorlds"

- **Neural AI/ML CyberSecurity** Solutions will require enhanced Intelligent Human/Machine Interfaces!

- Human Communications run **@ Sound Speed....** whilst Cyber Worlds run *1 Million* **X** faster **@ Speed of Light!..**

- **Virtual, Mixed & Augmented Reality(AR)** Devices & Software(SW) will "Bridge" Human & Cyber Worlds!

....Expect **New Generation AR Devices** & SW Interfaces for Security Management during the next **7 Years!....**

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Scenarios: 2019-2049: *Blade Runner*
Sci-Fi Security for "Artificial Silicon Life"?!

BLADE RUNNER 2049

Neural Security for 21st Century Cyber-Physical Worlds!

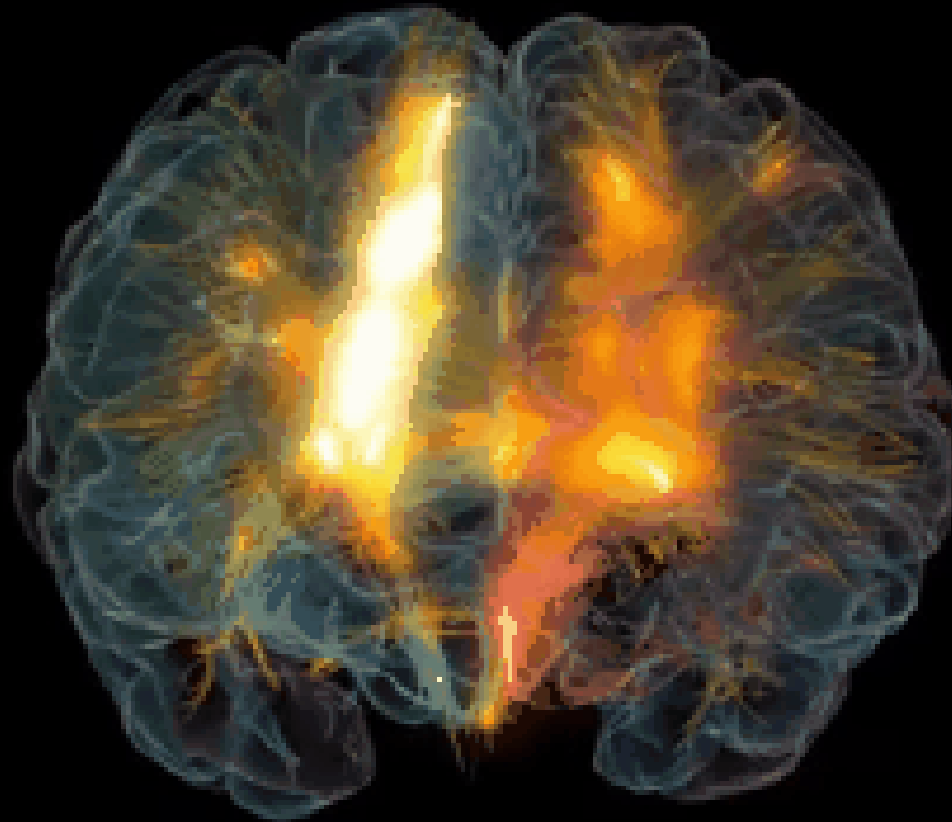**36th International East West Security Conference**

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Neural Security for 21st Century Cyber-Physical Worlds!

1984: *"Birth"* of Intelligent Networks ... & *"Death"* of Personal Privacy ?...

1984
A Novel by GEORGE ORWELL

WAR IS PEACE

FREEDOM IS SLAVERY

IGNORANCE IS STRENGTH

BIG BROTHER IS WATCHING YOU !

ANTI SEX LEAGUE

CyberVision: 1984:*Past* – 2017:*Present* – 2050:*Future?*

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8 – Cyber VISION to Security NOW!

"New Cyber Toolkit"

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"From 7 Year CyberVision to Reality!"

- 7 Year Evolution of Business **"$ecurity Culture"**
- **Cyber RoadMap** managed by Board-Level C$O
- Integrated Security with **Intelligent AI Alerts!**
- Professional **Cyber Training** for EVERY Business
- **"Sell"** Security Policy & Culture to ALL **"Staff"**
- **Trial and Deploy** Adaptive AI Security Solutions

…..**CyberSecurity** now requires **$$$** Investment in Teams & Technology to **Mitigate Major Risks!...**

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7 Year CyberVision: "The New Toolkit"

- During the last 7 Years CyberThreats targeted:
  - Critical National Infrastructure (CNI): Energy, Banks, Transport, Government, Healthcare, Education...
  - Major Events: Sports, Elections & Culture Festivals...
  - Criminal eCommerce: "The Dark Web" & "SilkRoad"!
- The "New Cyber Toolkit" provides "Real-Time" Defence against "Zero-Day" & "Insider" Attacks!
- Exponential Increase in Device Connections (IoT) requires Cyber Defence through AI/ML "Bots" running 24/7 on ALL Networked System Assets!

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CyberSecurity: "21stC Neural Defence"

- "Bad Guys" are already deploying Advanced CyberTools within Organised Crime Syndicates!

…**2018** (Integrated), **2019** (Adaptive), **2020** (Learning)

…**2025** (Intelligent Security) & **2040** (Neural Security)

Image: **David Shankbone**: Occupy Wall Street – Sept 2011

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CyberSecurity: "21stC Neural Defence"

- "Bad Guys" are already deploying Advanced CyberTools within Organised Crime Syndicates!

- Legacy IoT Devices in *EVERY Sector* may be "hacked" & exploited with ease by Global Criminal "BotNets"!

- CyberDefence for Business & Government requires Managed 7 Year Transition to *"Speed of Light"* *"Neural Defence"* and *"Augmented Reality"*!

  ...We have *discussed our* **CyberSecurity Visions** for:

  ...**2018** (Integrated), **2019** (Adaptive), **2020** (Learning)

  ...**2025** (Intelligent Security) & **2040** (Neural Security)

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UK CyberSecurity Strategy: 2016 - 2021

HM Government

NATIONAL CYBER SECURITY STRATEGY 2016-2021

Defend – Deter - Develop

3. STRATEGIC CONTEXT

4. OUR NATIONAL RESPONSE

5. DEFEND

6. DETER

8. INTERNATIONAL ACTION

CONCLUSION: CYBER SECURITY BEYOND 2021

5 Year Programme Launched by UK Chancellor Philip Hammond: **Tuesday 1st November 2016**

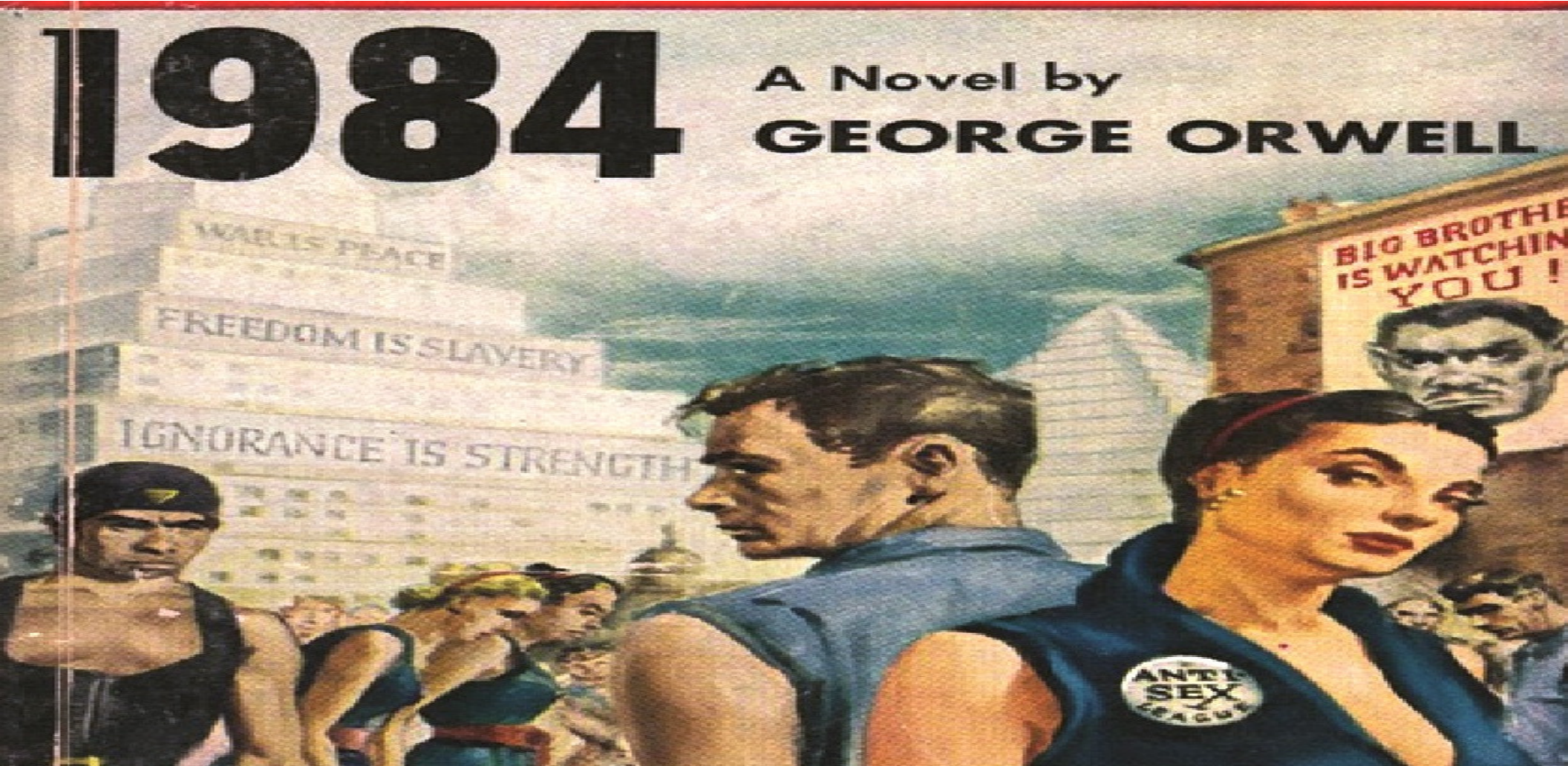**36th International East West Security Conference**

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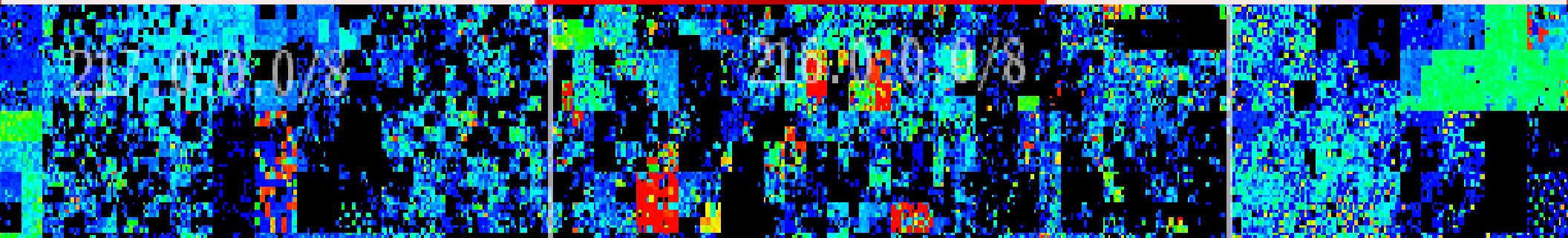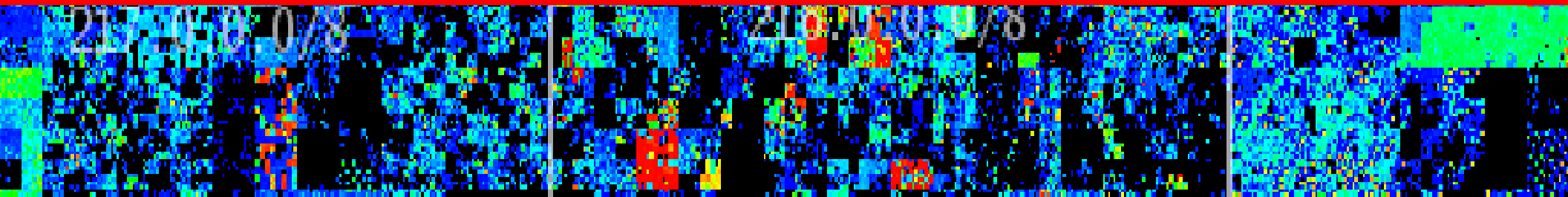| 1 – "CyberSecurity @ Board Level" **"YOUR Cyber Mission"**	2 – CyberCrime:CyberTerror:CyberWar **"OUR Cyber Society"**	3 – Scenario 2018: Cyber & Physical Tools **"Integrated Security"**
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9 – YOUR Action Plan for 21stC Cyber!..

"CyberSecurity Plan"

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YOUR TOP 10 Actions & RoadMap

1) Assign CSO – Chief Security Officer with Strategic Security Action Plan
2) Professional CyberSecurity Training to International Certification - CISSP
3) Implement International Security Standards (ISO/IEC- Biometrics)
4) Open Discussions with "Cyber" Vendors and Trial AI/ML Tools
5) Profile YOUR Security Staff and Contractors for Possible Risks

6) ICT: Hire Qualified Cybersecurity Systems Technology, Software & Operations Team
7) Review Security Risks & Connectivity of ALL Enterprise IP Legacy Assets & Devices (IoT)
8) Design Practical Multi-Year Roadmap for Strategic Operational Security Integration
9) Professional Association Membership for Team Networking & Skill Building - IPSA
10) Cyber Legal Protection – Check *Your* Legacy Contracts for "Cyber Theft" Trading Risks

Now *YOUR* Business will be Fully Fit to Defend against ***"Smart" Cyber-Physical*** Attacks!

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MSc CyberSecurity Courses: Certified by the UK Government – **GCHQ/CESG**

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"Real-Time Security" @ "Light Speed"!

Machine Learning Cybersecurity Tools Provide Real-Time **"Light Speed"** Defence against Threats & Attacks!

"Frog Spirit shows the Ring of Dark Matter around the Sun" - 2002
- Pen & Ink Drawing by **Dr Alexander Rimski-Korsakov** -

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SEVILLIA

RIO DE GUADALQVE VIR

Traiana

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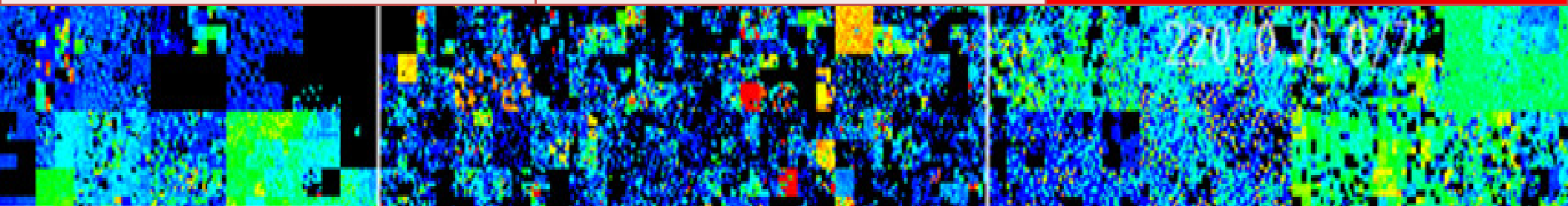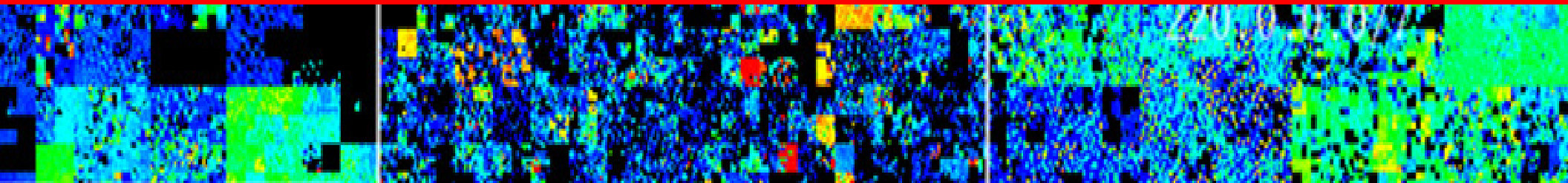**36th International East West Security Conference**

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- *"Cyber Futures & Defence"* : *On-Line!*

Security Futures: 2018-2025+
Technology, Tools & Trends

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Cyber Threats & Defence!
- "Intelligent CyberSecurity"-

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- Cyber Threats & Effective Defence! -
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Additional *Cybersecurity* Resources

"Master Class - Smart Theory & Practice"	"Master Class 2012 - Smart Design"	"21stC Armenia- 2012: Smart Economy"	"21stC Armenia - 2012: Smart Security"	"21stC Armenia: Smart Governance"
"Real-Time Armenia" - White Paper	"Real-Time Armenia" - Slides	Awesome Armenia: In Photos	Roadmap for Real-Time Armenia- Report	RoadMap for Real-Time Armenia- Slides
"Real-Time Georgia" - GITI 2008 Slides	"Real-Time Georgia" - GITI 2008 Paper	Gorgeous Georgia: In Photos	21stC Georgia: "CyberVardzia" - Paper	21stC Georgia - "CyberVardzia" - Slides
			ITU/CITEL: Cybersecurity in the Americas	ITU/CITEL: Cybersecurity Skills Building

Link: www.valentina.net/vaza/CyberDocs

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Professional Profile - *Dr David E. Probert*

- **Computer Integrated Telephony (CIT)** – Established and led British Telecom's £25M EIGER Project during the mid-1980s' to integrate computers with telephone switches (PABX's). This resulted in the successful development and launch of CIT software applications for telesales & telemarketing

- **Blueprint for Business Communities** – Visionary Programme for Digital Equipment Corporation during late-1980's that included the creation of the "knowledge lens" and "community networks". The Blueprint provided the strategic framework for Digital's Value-Added Networks Business

- **European Internet Business Group (EIBG**) – Established and led Digital Equipment Corporation's European Internet Group for 5 years. Projects included support for the national Internet infrastructure for countries across EMEA as well as major enterprise, government & educational Intranet deployments. Dr David Probert was a sponsoring member of the European Board for Academic & Research Networking (EARN/TERENA) for 7 years (1991 ➔ 1998)

- **Supersonic Car (ThrustSSC***)* – Worked with Richard Noble OBE, and the Mach One Club to set up and manage the 1st Multi-Media and e-Commerce Web-Site for the World's 1st Supersonic Car – ThrustSSC – for the World Speed Record.

- **Secure Wireless Networking** – Business Director & VP for Madge Networks to establish a portfolio of innovative fully secure wireless Wi-Fi IEEE802.11 networking products with technology partners from both UK and Taiwan.

- **Networked Enterprise Security** - Appointed as the New Products Director (CTO) to the Management Team of the Blick Group plc with overall responsibility for 55 professional engineers & a diverse portfolio of hi-tech security products.

- **Republic of Georgia** – Senior Security Adviser – Appointed by the European Union to investigate and then to make recommendations on *all* aspects of IT security, physical security and BCP/DR relating to the Georgian Parliament, and then by UN/ITU to review Cybersecurity for the Government Ministries.

- **UN/ITU** – Senior Adviser – Development of Cybersecurity Infrastructure, Standards, Policies, & Organisations in countries within both Europe & Americas

Dr David E. Probert is a Fellow of the Royal Statistical Society, IEEE Life Member and 1st Class Honours Maths Degree (Bristol University) & PhD from Cambridge University in Self-Organising Systems (Evolution of Stochastic Automata) , and his full professional biography is featured in the Marquis Directory of Who's Who in the World: 2007-2018 Editions.

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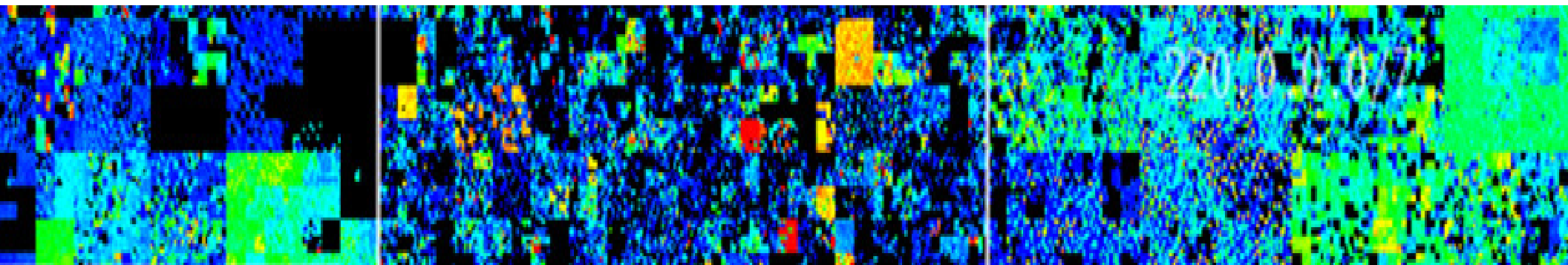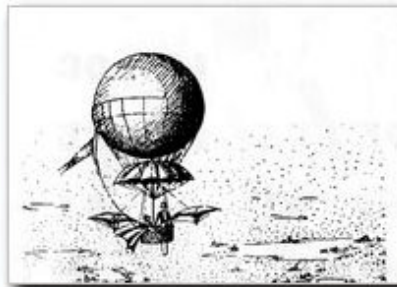
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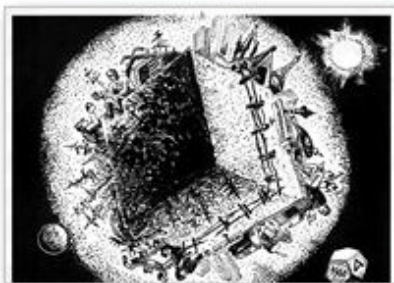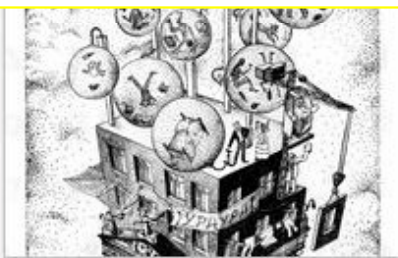
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Security Equipment for *Alpine Ascents*

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*** Security Equipment for Alpine Climbing ***
Sunrise on « Barre des Écrins » – 4102metres

Security Equipment includes: *50m Rope, Steel Crampons, Ice-Axe & Screws, Karabiners, Helmet...*

15th Sept 2015: « 7 Alpinistes killed in Avalanche »

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Towards 2025 : *"Smart Security Solutions"*

- The Application of Artificial Intelligence and Machine Learning allows us to develop *"Smart Security Solutions"* as follows:

…….."Smart Security Solutions" typically possess the following features:*

1) *Space-Time Awareness:* Location (GPS) & Real-Time Clocks
2) *Learning, Adaptation & Self-Organisation:* Real-Time Intelligence
3) *Massive Memory & Storage:* Local & Remote Cloud Storage
4) *Sustainability:* Embedded Security – *Everywhere in the Network!*
5) *Scalable Networked Architecture:* Smart Architectures will need to scale in space & time from micro cells to macro solutions
6) *Decision Focus:* "Knowledge Lens" for Data Mining & "Big Data" from Global Social Networks, Search & On-Line Trade & Commerce
7) *Systems Integration:* Cyber and Physical Solutions & Operations

………Now we'll consider how "AI & Machine Learning" principles are being engineered into 21stC Cybersecurity Solutions & Services…

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Building our 2025 Smart Security Toolkit
(1) Smart Decision Principles - "D-Genes"

- **Business Decisions** require focusing & filtering of Big Data sources in *Space-Time* to create local knowledge (Data Mining). Hence a useful metaphor is the *"Knowledge Lens"*:
  - Smart Decision *"Genes"* = Space, Time and Information Focus
  - Conceptual *"Knowledge Lens"* can filter and focus information in "Space" from searching Big Data Sets to a Small focused Short-List
  - The *"Knowledge Lens"* can focus information & present in real-time, possibly as an stream of multi-media news or market intelligence

- *"Knowledge Lens":* This concept can be a useful architectural principle in the design of *Smart Security*, Smart Business & Smart Governance

....21stC Cyber Attacks occur in Real-Time @Optical Speeds so ultra fast analysis, decisions and action is a must!

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Building our 2025 Smart Security Toolkit
(2) Smart *Learning* Principles - *"L-Genes"*

- ***Smart Learning*** requires: Self-Organisation, Adaptation, Memory and Scalable Architecture. The Decision "Genes" are relatively traditional whilst these new Learning "Genes" lie at the heart of Smart Security.

  - ***Self-Organisation*** & Adaptation are essential principles of living systems and communities which include the well known self-organisation of insect roles in communities such as ants & bees.

  - ***Cellular Automata*** demonstrate relatively complex behaviour from simple mathematical rules, as in Conway's "Game of Life"

  - ***Simple Dynamic Recursive Maps*** such as x => 4x(1-x) also result in complex chaotic behaviour as found in real world insect populations

  - ***Scalable Architecture*** is also an essential feature of plants & animal life & Mandelbrot's theory of Fractal Curves provides vivid examples.

- ***….Current Trends:*** Research into AI, Machine Learning, Self-Organisation & Adaptation remains highly active in both Universities & Commercial R&D Labs
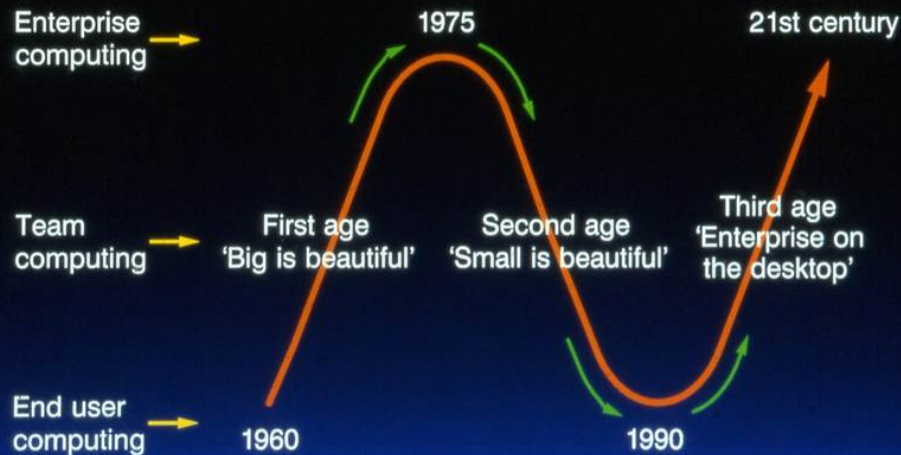
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2025 : Designing "*Smart Security*"

- **Smart Security Solutions** all use combinations of these Basic ICT Learning & Decision "genes" shared with Intelligent Living Systems:

  1) *Hybrid Organisation:* Hierarchical (Pyramid) & Organic (Networked)

  2) *Smart Decision Principles (D-Genes):* Space, Time & Decision Focus

  3) *Smart Learning Principles (L-Genes):* Memory, Scaling & Adaptation

  4) *Smart Security Solutions and Services:* Integration of Decision and Learning "Genes", within Secure & Resilient Systems Environment

     .....Using "AI & Machine Learning", 21stC Cyber Ventures are now marketing "Smart" Self-Learning Cybersecurity Tools to secure Enterprises, Government & Critical Information Infrastructure!

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Ages of Computing, Networking & Intelligence: *1960 - 21stC*

Overview: Ages of Computing

Enterprise computing →
Team computing →
End user computing →

1975

21st century

First age 'Big is beautiful'

Second age 'Small is beautiful'

Third age 'Enterprise on the desktop'

1960

1990

First Age of Computing

1960 → 1975 - Convergence

- Physical explosion of size and power - 'Hierarchical Architecture'
- 'Big is BEAUTIFUL'
- Created commodity elements: MIPS and MBITS
- Focus on DATA - a STATIC universe

Computing MIPS

Communications MBITS

Functional Convergence of Components

Second Age of Computing

1975 → 1990 - Bridge

- Emergence of Networking Architecture - 'Distributed Architecture'
- 'Small is BEAUTIFUL'
- Created Open Systems: OSI
- Focus on INFORMATION - a DYNAMIC Universe

Components → BRIDGE → Applications

Third Age of Computing

1990 → 2005 - Focusing Lens

- Biological Explosion of Intelligence - 'Organic Architecture'
- 'Enterprise on the DESKTOP'
- Focus on KNOWLEDGE - a SELF-ORGANISING Universe

Information

Knowledge for Decision and Action!
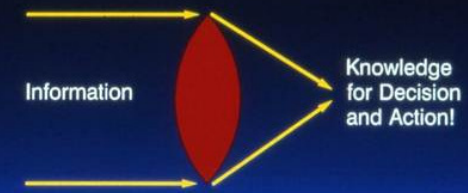
From: "Business Blueprint": Probert – July 1989

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