Key Analytical Points from the Workshop on Scientific Applications For the Internet of Things (IOT)

Colloquium in Trieste, Italy at:

The Abdus Salam
International Centre
for Theoretical Physics

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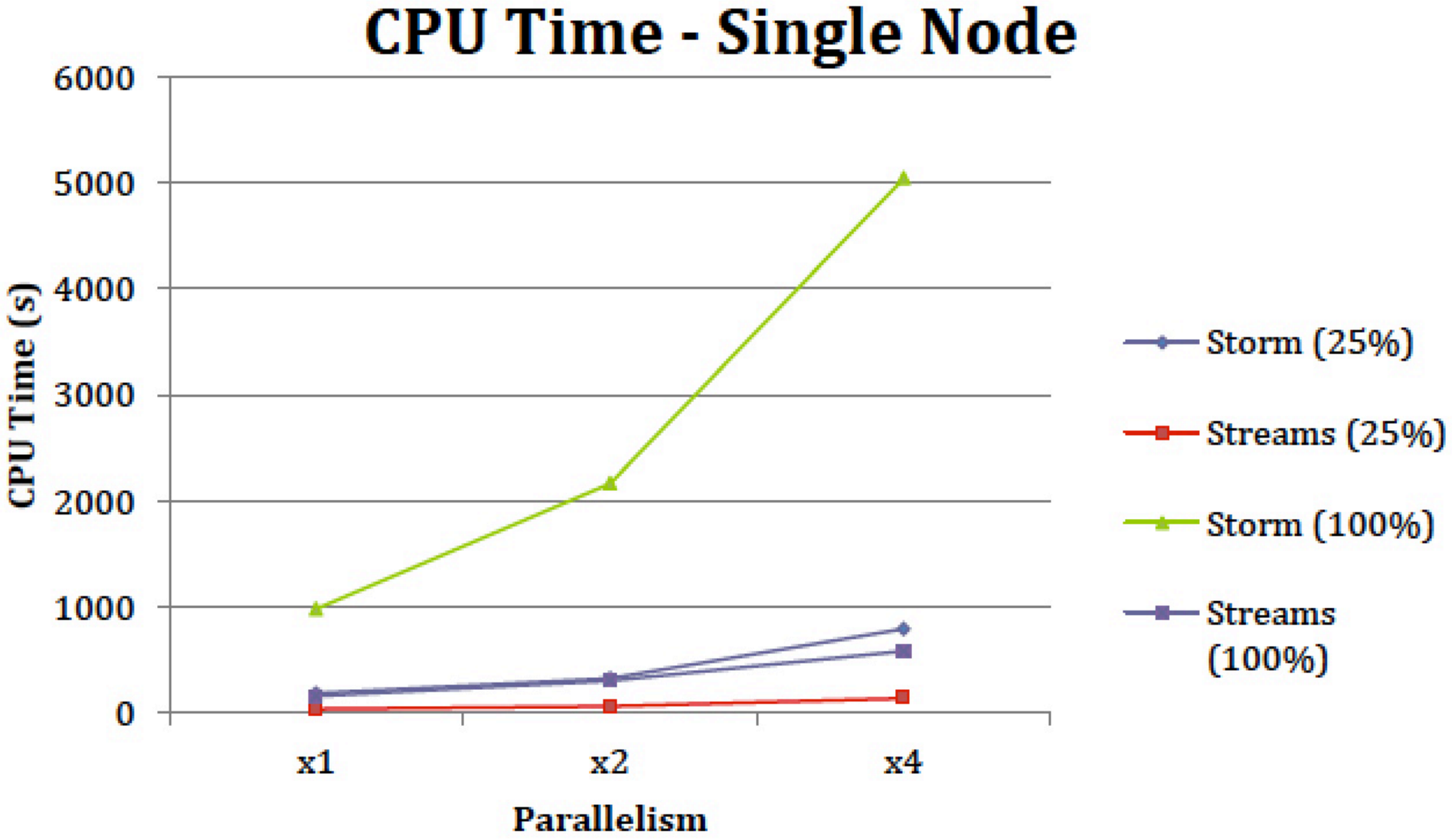
Storm Core vs. Storm Trident vs. Spark Streaming

	Core Storm	Storm Trident	Spark Streaming
Community	> 100 contributors	> 100 contributors	> 280 contributors
Adoption	***	*	*
Language Options	Java, Clojure, Scala, Python, Ruby, ...	Java, Clojure, Scala	Java, Scala Python (coming)
Processing Models	Event-Streaming	Micro-Batching	Micro-Batching Batch (Spark Core)
Processing DSL	No	Yes	Yes
Stateful Ops	No	Yes	Yes
Distributed RPC	Yes	Yes	No
Delivery Guarantees	At most once / At least once	Exactly Once	Exactly Once
Latency	sub-second	seconds	seconds
Platform	Storm Cluster, YARN	Storm Cluster, YARN	YARN, Mesos Standalone, DataStax EE

Source: Trivadis

Acknowledgments: Please refer to source, adaptation, and acknowledgments page:



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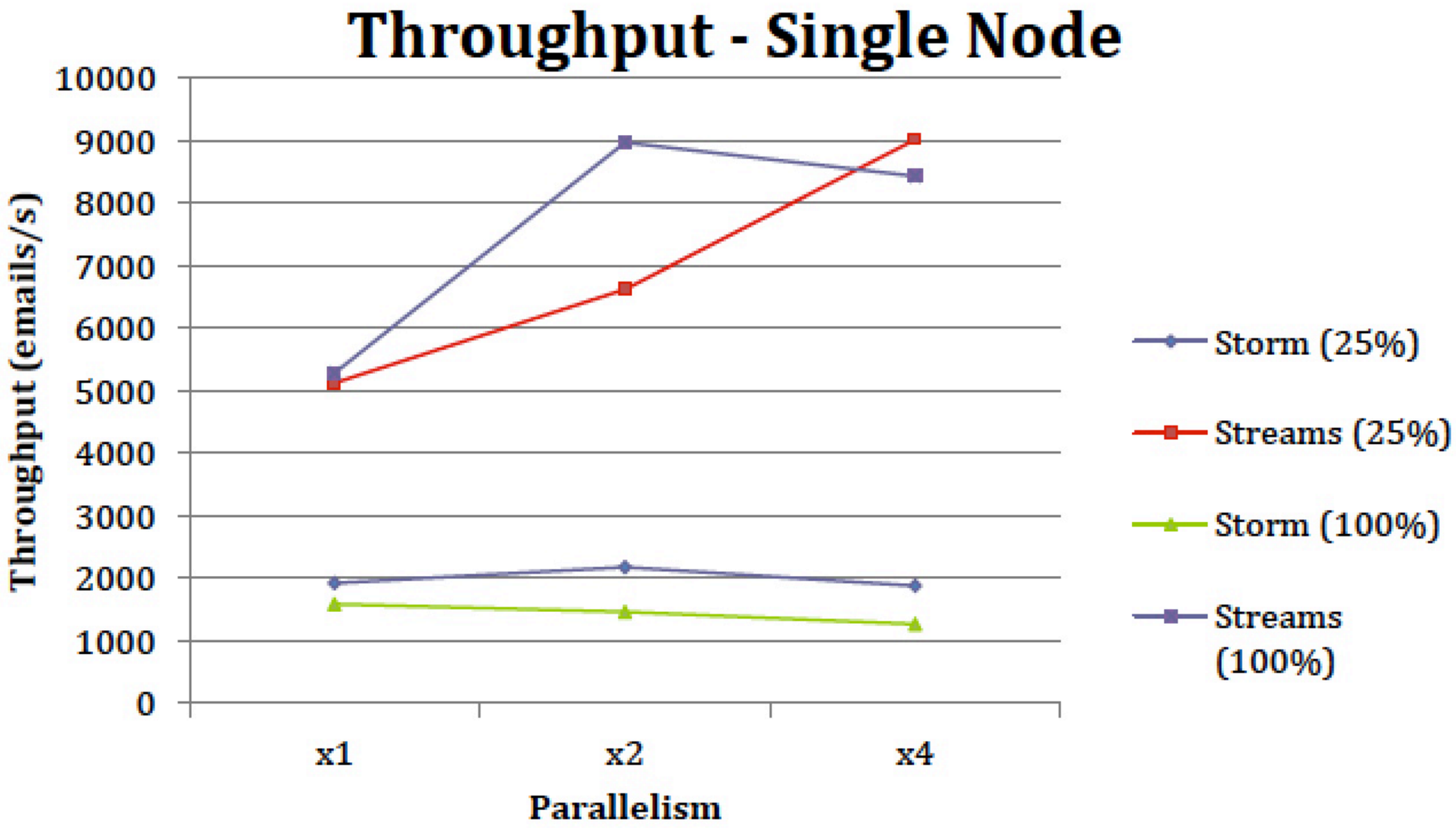

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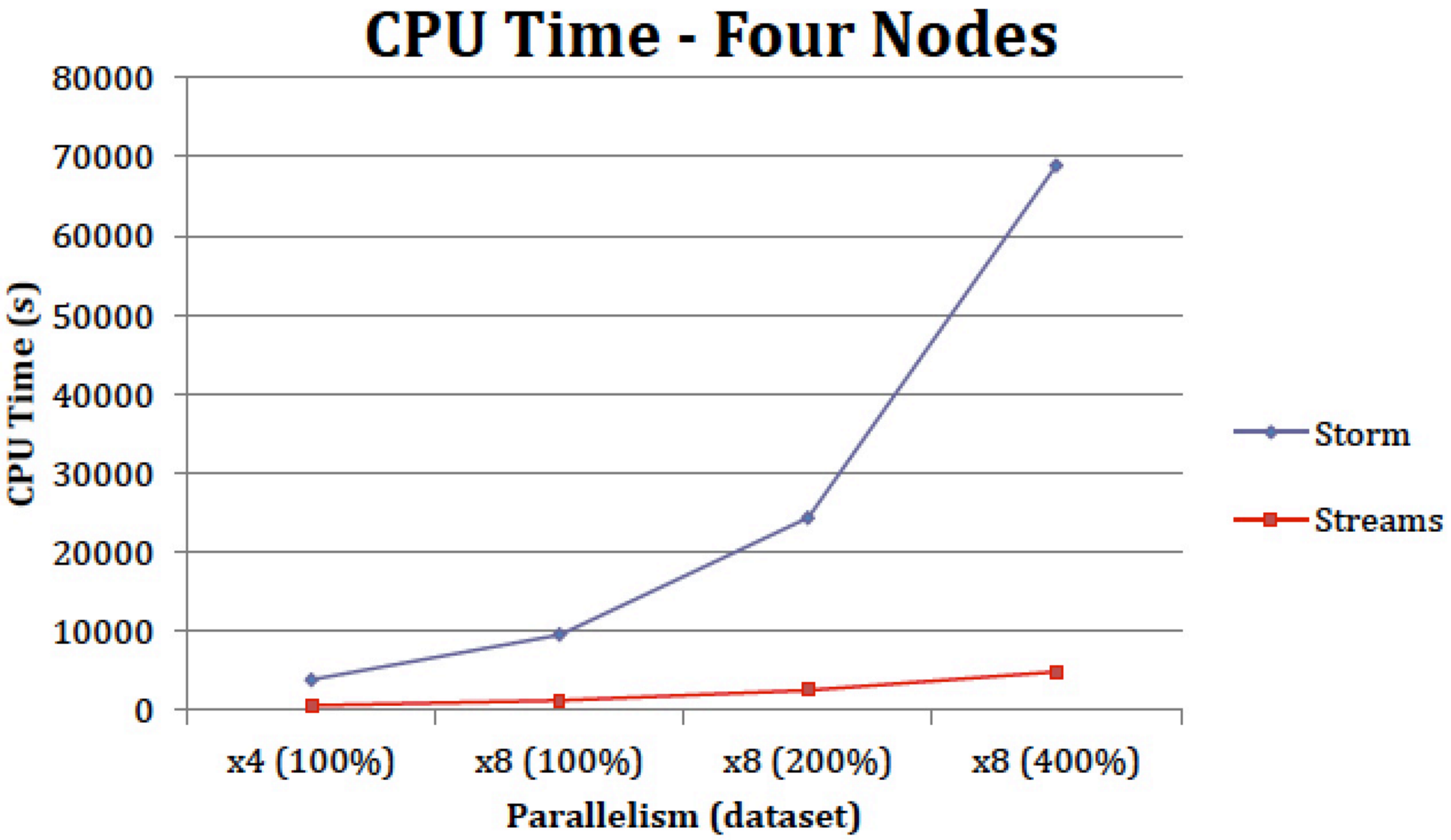

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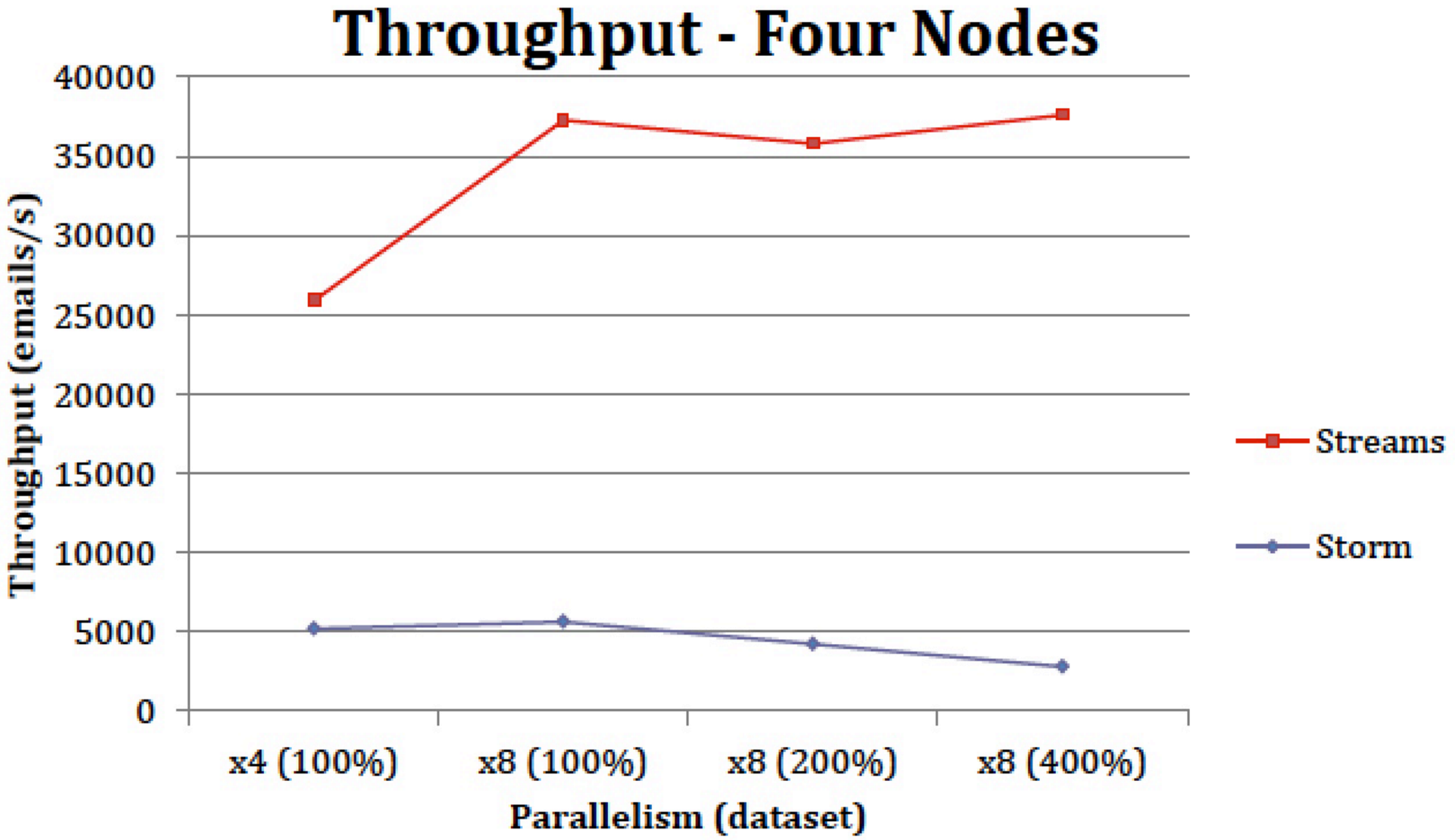

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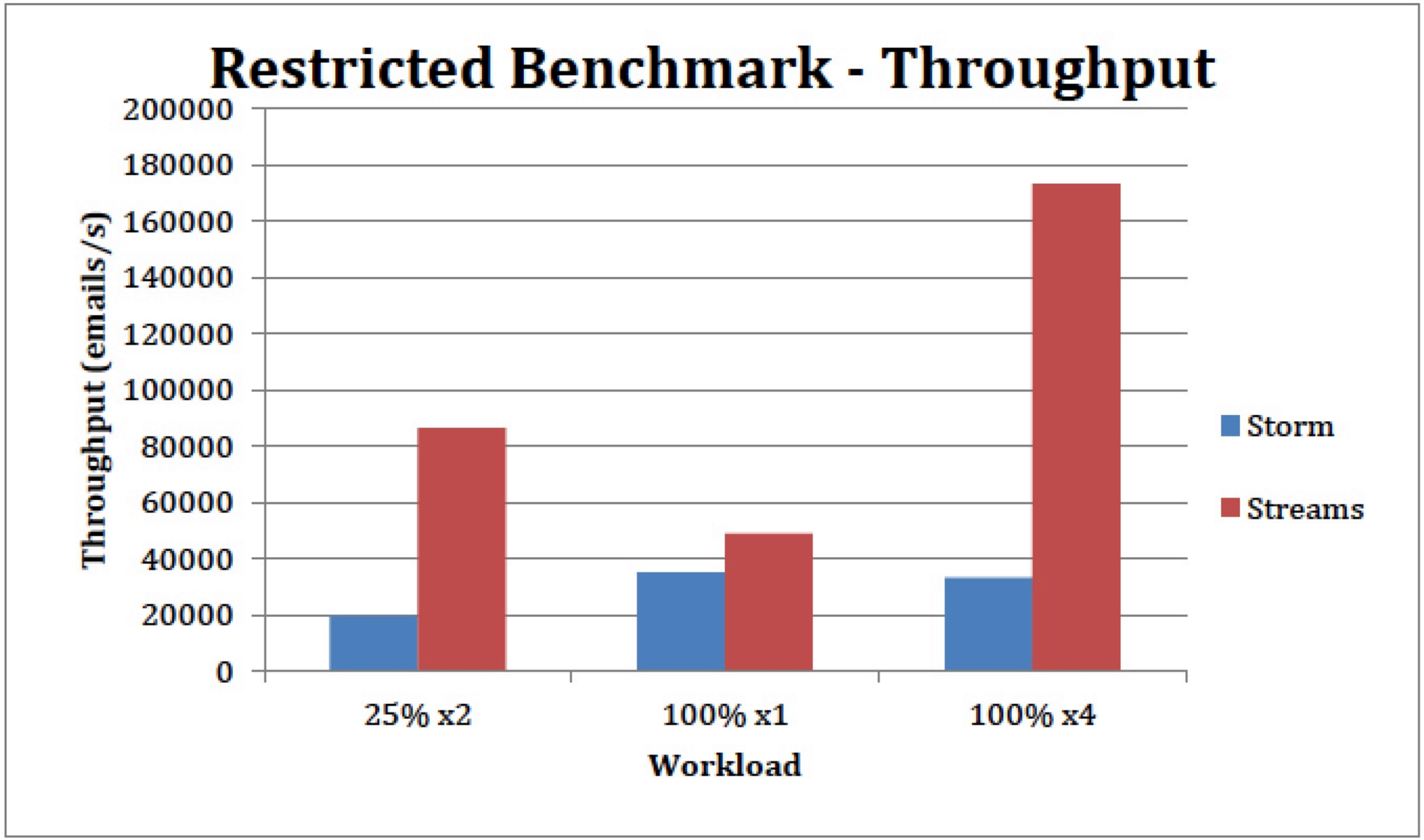

Figure 11: Restricted Benchmark Throughput

Source: IBM

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

Security

- What changes in the IoT:
  - Resource poverty: relatively low processing power and energy stores
  - Asynchrony: your devices are switched off most of the time
  - Clock sync is not a given and is important
  - Mobility, the importance of location
  - Poor access to the hardware
  - Byzantine is the norm – things fail, but frequently not cleanly.
  - Cascading failure is the norm
  - Boundaryless security
    - Self protection
    - Intrusion detection
    - Many more points for information leakage
  - New DoS attacks
    - e.g. sleep deprivation
  - Actuators

Source: Steve Hailes, UCL

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

Key Analytical Points from the Workshop on the Internet of Things (IOT)

Security processes 1

- If we want to secure a system, then we need to follow a number of principles:
  - Prevention is *never* 100% effective – so:
    - Need defence in depth – several different mechanisms
    - Mechanisms for detecting and responding to attacks, preferably in real time, are essential:
      - Detect – get to know you're being attacked.
      - Localise – determine what's being attacked.
      - Identify – determine who the attacker is.
      - Assess – why are they doing this?
      - Respond – depends on all of above.
      - Recover – Have a plan better than 'go find a new job'

Source: Steve Hailes, UCL

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Key Analytical Points from the Workshop on the Internet of Things (IOT)

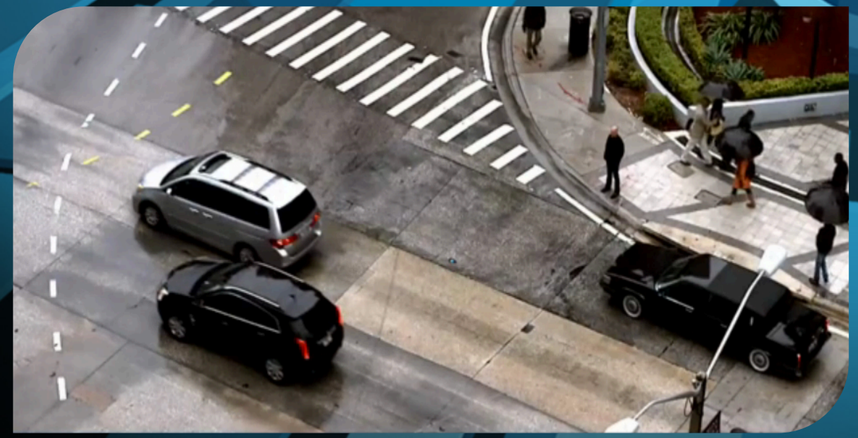
Edge Processing = Data Acquisition + Data Analytics

- The opportunity is in Sense-and Respond systems at the edge to optimize operations and avoid the need for black-start/quick-start.
- Success in Africa and for Smarter Cities/Smarter Planet necessitates integrating lessons from the Microgrid Stability Paradox so as to effectuate higher penetration of renewables while enhancing stability and resiliency.

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

1. Deficiencies of Event/SCADA Data (Big Data) -> Continuous Streaming Data (Bigger Data)

- Event and SCADA data are essentially too little and too late for effective operation of the modern Grid. Continuous streaming high quality data (Bigger Data) is required for a stable and resilient Grid.



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2. Deficiencies of an Arbitrary Bus Reference -> Calculated Center of Inertia

- (Base vector + Drift) ⇔ Context-Referenced Phase Angle Data
- Calculated Center of Inertia

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

3. High Penetration of Renewables -> From Transmission to Distribution

- The high penetration of renewables results in less stable operation of the distribution system. Acquisition of quality real-time data, enriched by analytics, will be used to enable operations with higher levels of renewables.

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

4. Consumer/PUC Reluctance to absorb cost of black-start/ quick-start -> Better Sense and Respond

- The costs of adding black-start/quick-start capability is prohibitively expensive. The providing of real-time monitoring, analytics, and controls for better “Sense-and-Respond” reduces the need for these very expensive facilities.

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

5. Desire for better Defense-in-Depth Methodology (Citizen Science/Crowd-Sourced Data)

- Augmenting real-time power system Data with Citizen Science/Crowd-Sourced Data facilitates the movement from Big Data to even Bigger Data.

Acknowledgments: Please refer to source, adaptation, and acknowledgments page.

6. Microgrid (e.g. DOD, Data Centers)
-> High use of Renewables represents a Paradox

- Microgrids are expected to provide a higher level of availability that the Grid. Yet, the microgrids' high use of renewables introduces heightened instability. The effective operationalization of microgrids necessitates 1 to 5.

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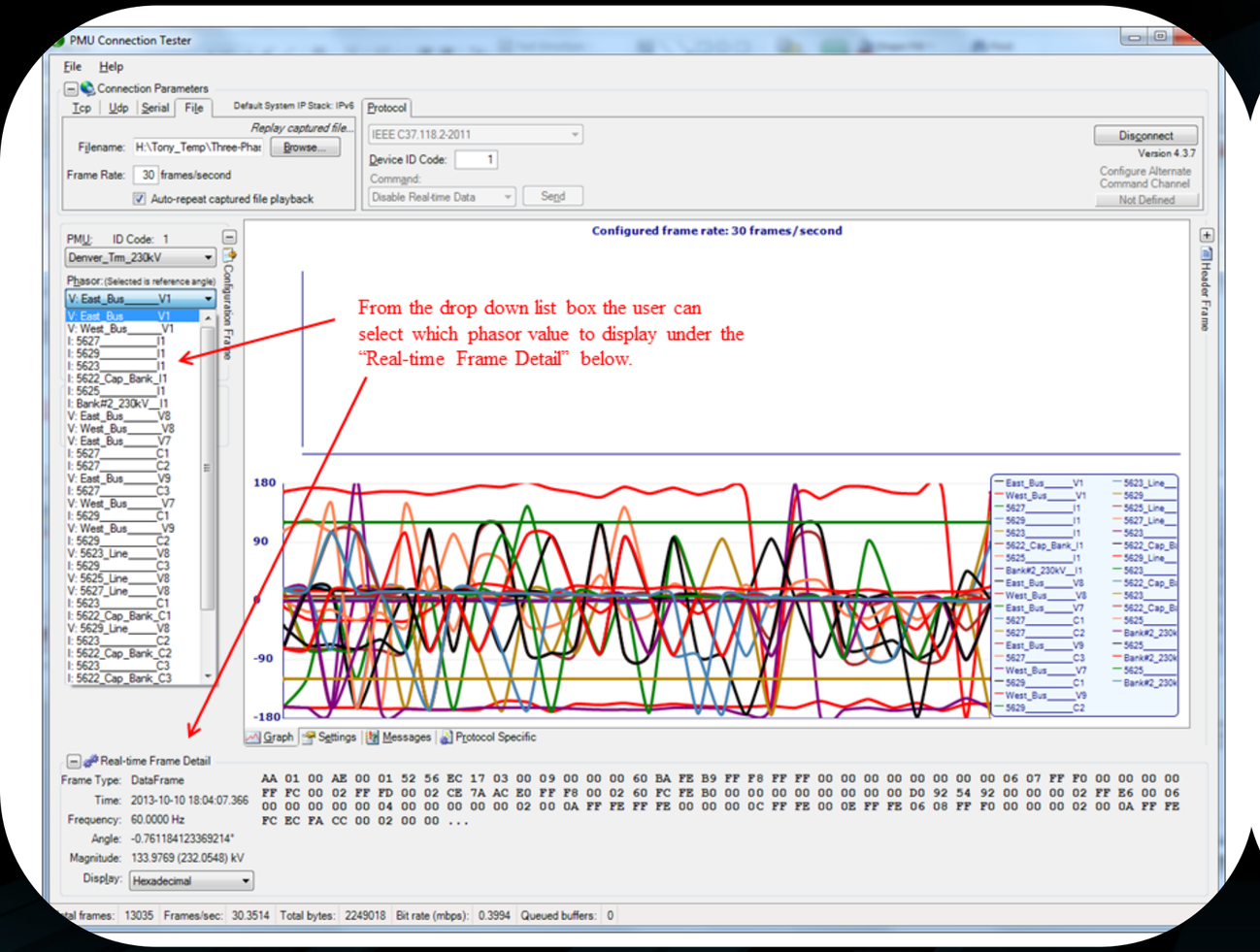
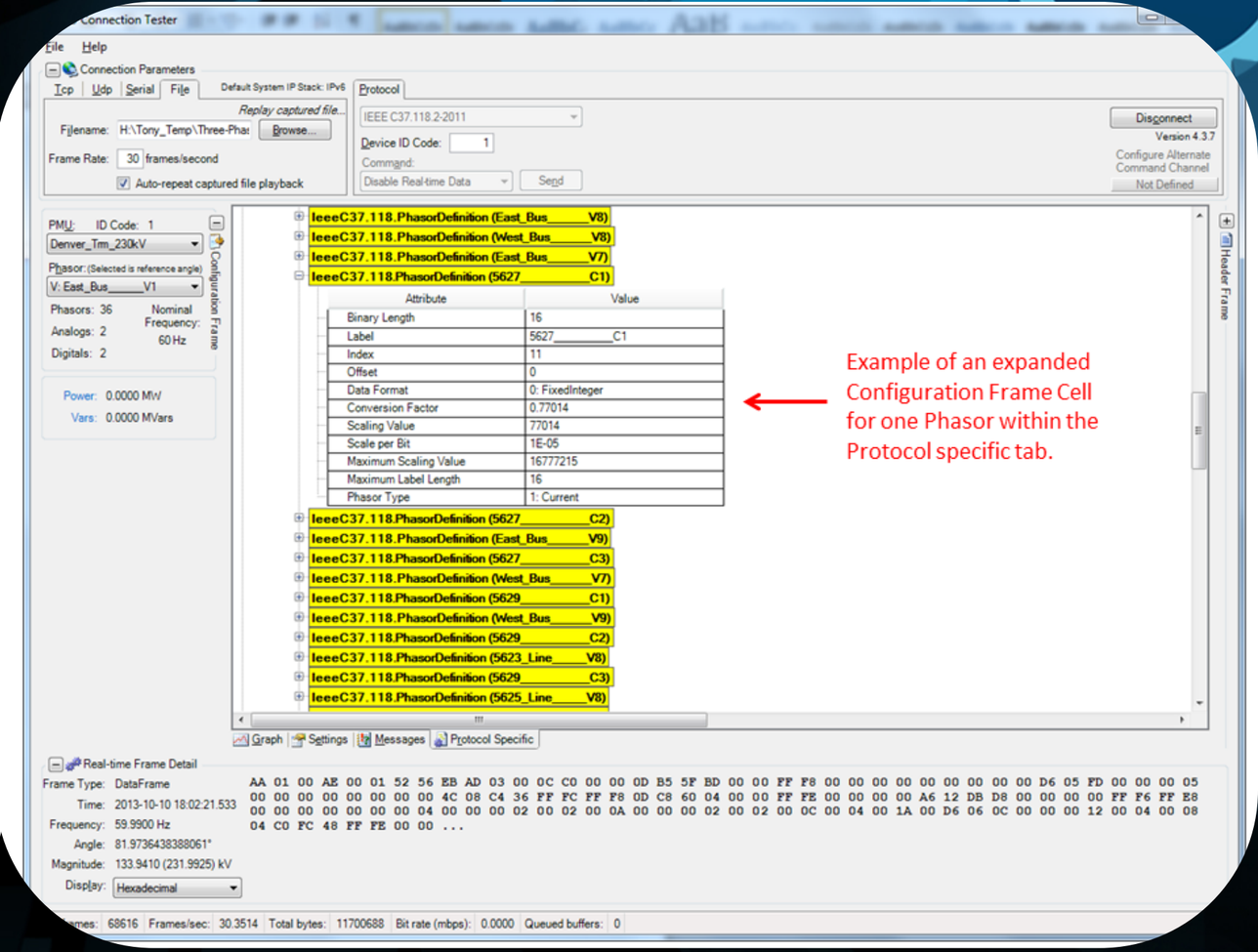
8. Isomorphic Experience -> Lower Ambiguity -> More Robust Decision Engineering





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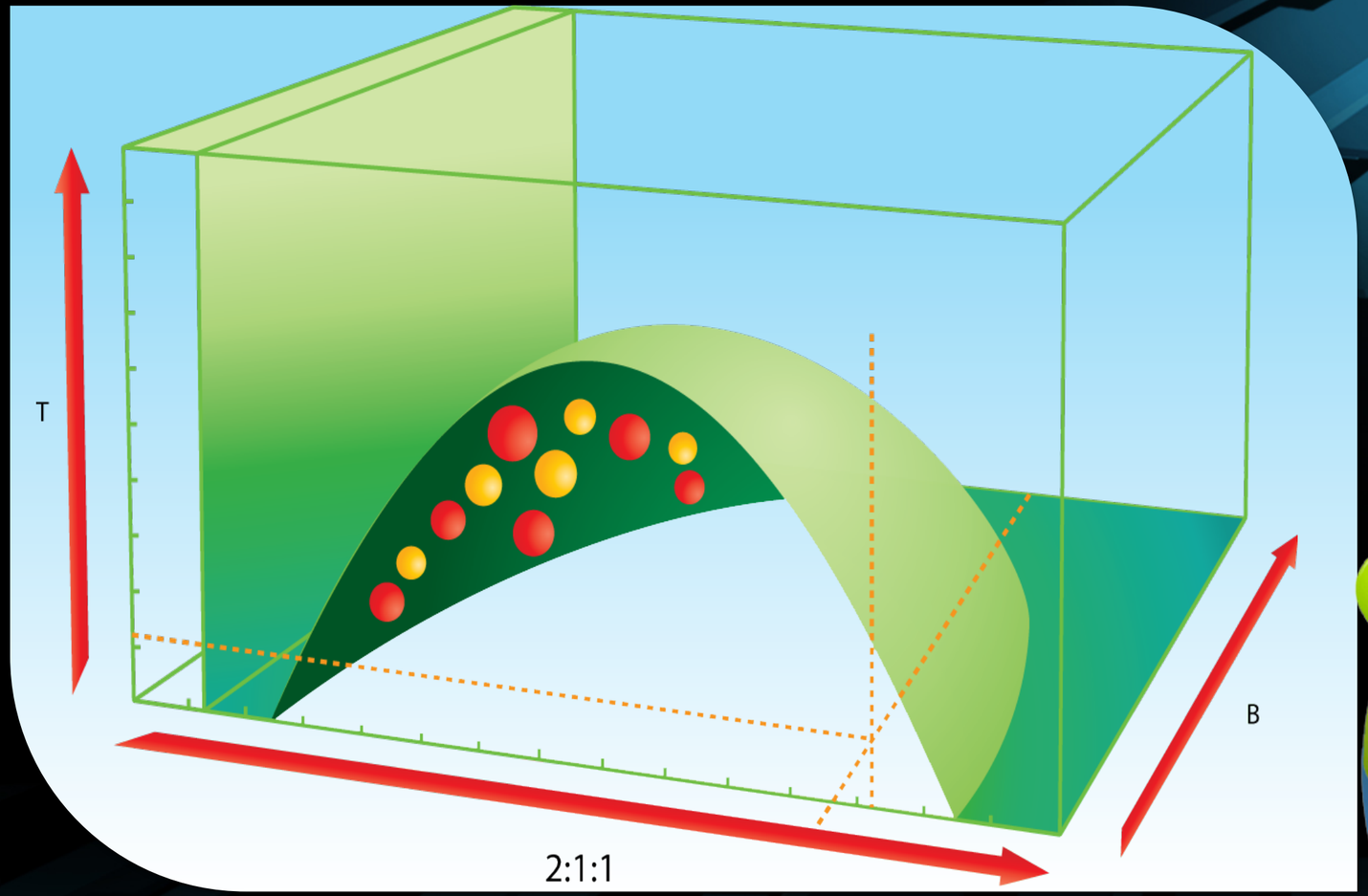

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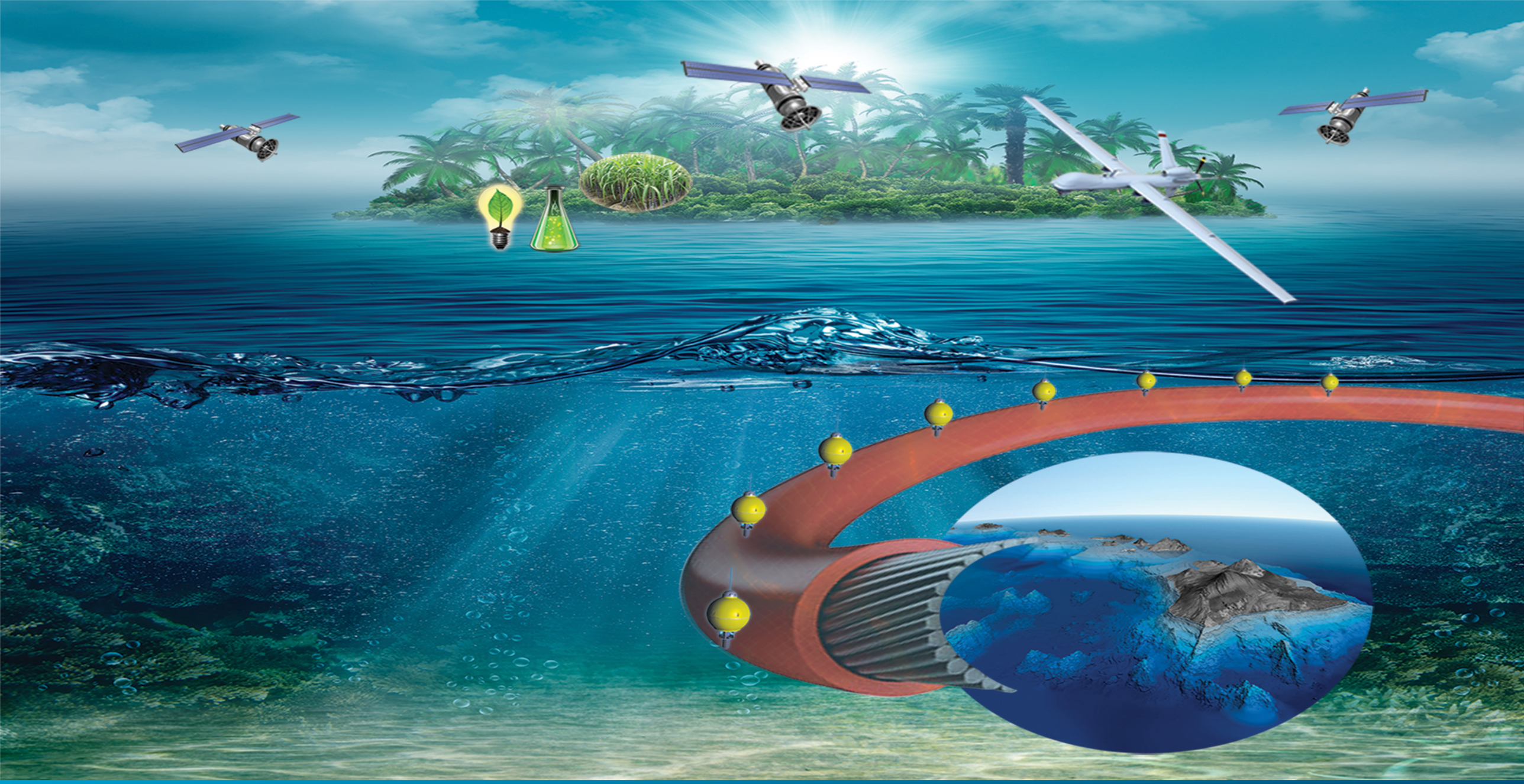

Key Analytical Points from the Workshop on the Internet of Things (IOT)

A warning (1)….

If you believe that encryption is the answer to your security problem, then you probably asked the wrong question.

- What on earth does ‘security’ mean anyway?
  - It’s a state of being – everything is OK
- Security is about securing a **system**
- Security is a **process** NOT a product
- A sole focus on technology is blinkered and founded in ignorance

Source: Steve Hailes, UCL

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Key Analytical Points from the Workshop on the Internet of Things (IOT)

Study Space: Haiti

A2O Finding: Commodities, such as Internet Access (for aid, weather, news), are more important to Tent City Refugees than water and medicines, amidst a paradigm of counterfeits (no electrolytes, sawdust). Context Matters.

Big Insight: Counterfeiters are the promulgators of – unexpectedly – 1/3 of the world's spam and malware.

NASA Resource Utilized: Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) data (e.g. backscatter) from NASA's C-20A Gulfstream III.

Takeaway: Wifi and they will come.

Key Analytical Points from the Workshop on the Internet of Things (IOT)

Study Space: Pacific Ocean

A2O Finding: HPC and High Order High Fidelity Modeling for robust Tsunami Warning (non-spoofing, via 5V Tests). Apropos Compute Matters.

Big Insight: Hybridizing near-shore and far-shore modeling provides fidelity lessons learned for texture, shape, and color histograms.

NASA Resource Utilized: NASA World Wind's Blue Marble for true colors and Landsat 7 for high resolution imagery.

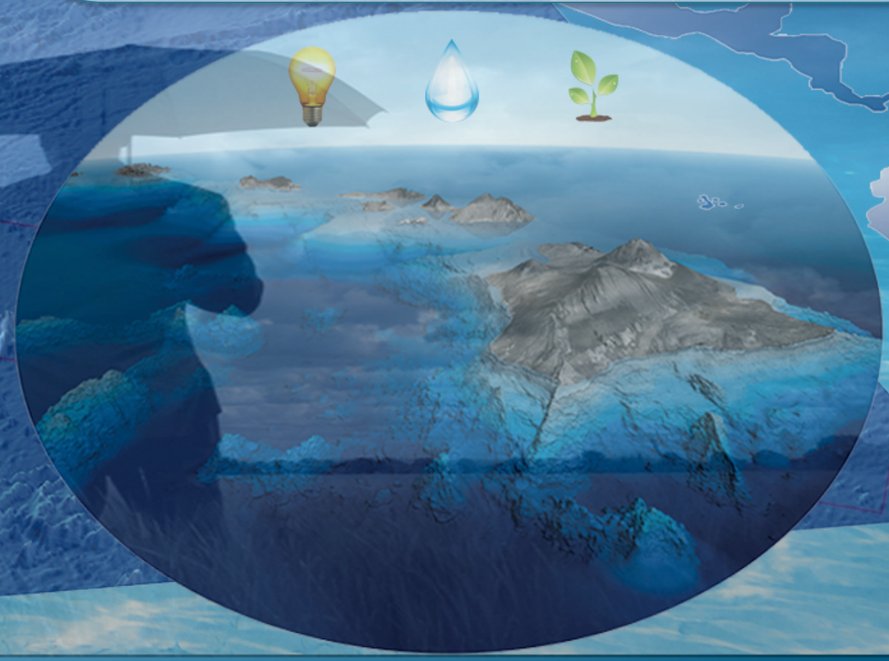
Takeaway: Slowly but surely.

Key Analytical Points from the Workshop on the Internet of Things (IOT)

Alaskan Earthquakes:

- 1946 Alaska Earthquake (7.4) and Tsunami.
- 2014 Alaska Earthquake (7.9).

- 19 today.
- 463 this month.
- 5,313 this year, thus far.



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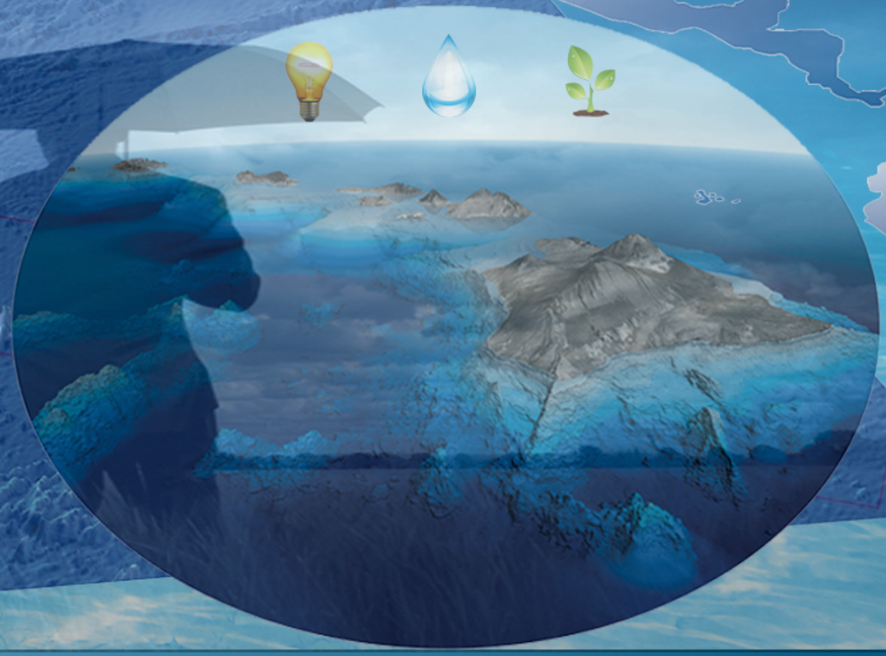

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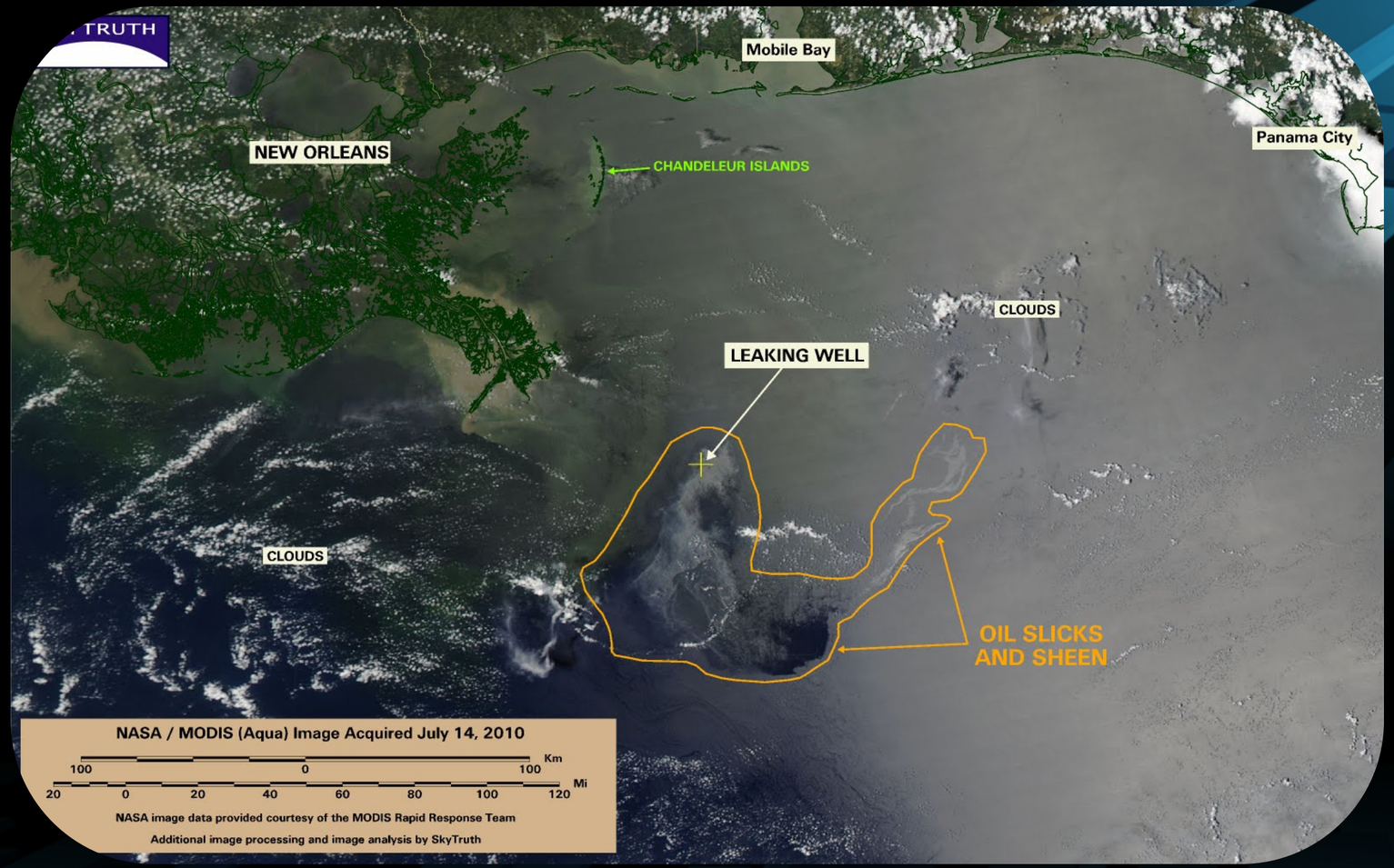
Study Space: Gulf of Mexico

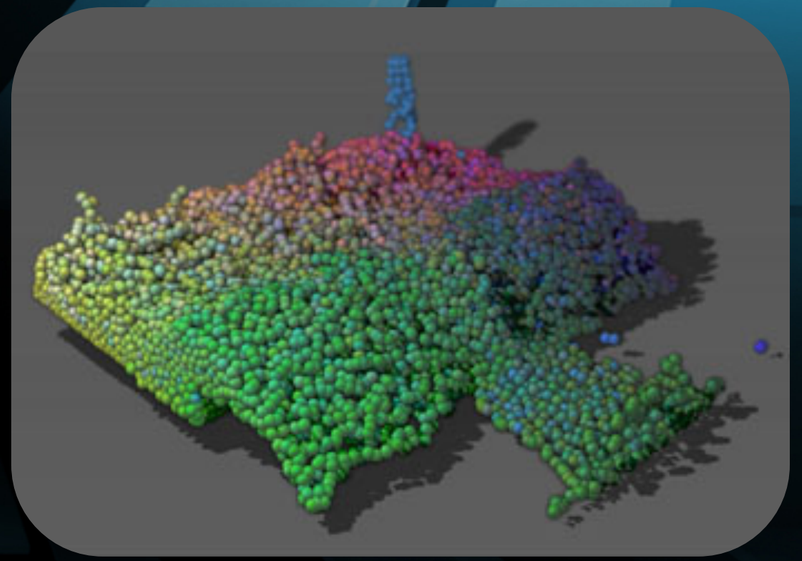
A2O Finding: HPC and High Order High Fidelity Modeling for the Oil Slick Spread (Deepwater Horizon Oil Spill). Apropos Compute Matters.

Big Insight: Smooth Particulate Hydrodynamic (SPH) Modeling for non-approximation.

NASA Resource Utilized: Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) imagery (e.g. light) from the Terra satellite.

Takeaway: Measure twice cut once.





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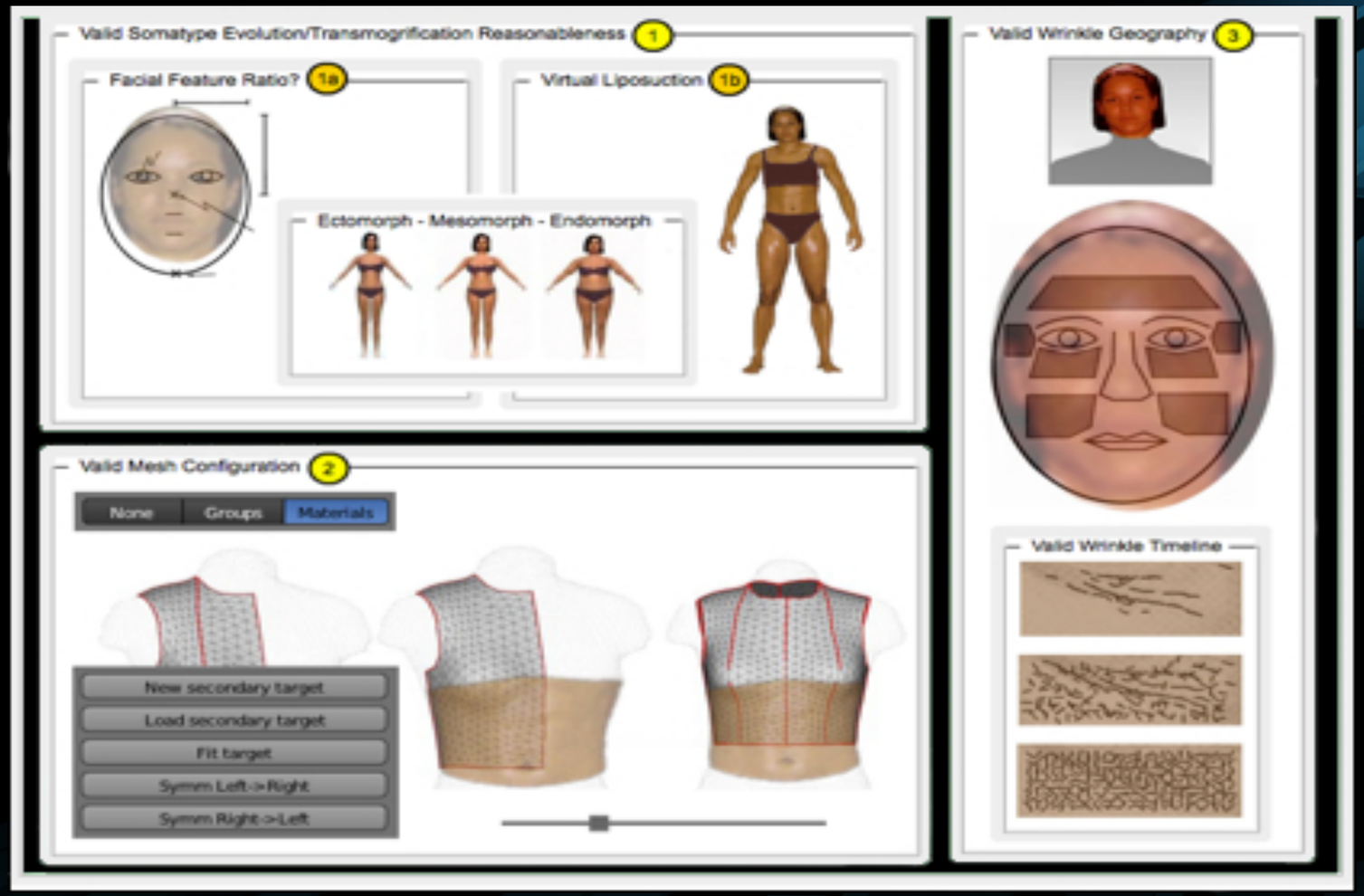
Study Space: Cyberspace

A2O Finding: Workflow process matters for removing hay from the haystack. Qualifying Sequence Neutrality.

Big Insight: The analysis begins with detecting specular highlights, then mesh distortion, then wrinkle geography.

NASA Resource Utilized: Tool for Analysis of Surface Cracks (TASC) + Hyperspectral Recognition of processing tomato early blight based on Genetic Algorithms (GA) and Support Vector Machines (SVM)

Takeaway: Penny-wise, but pound foolish.



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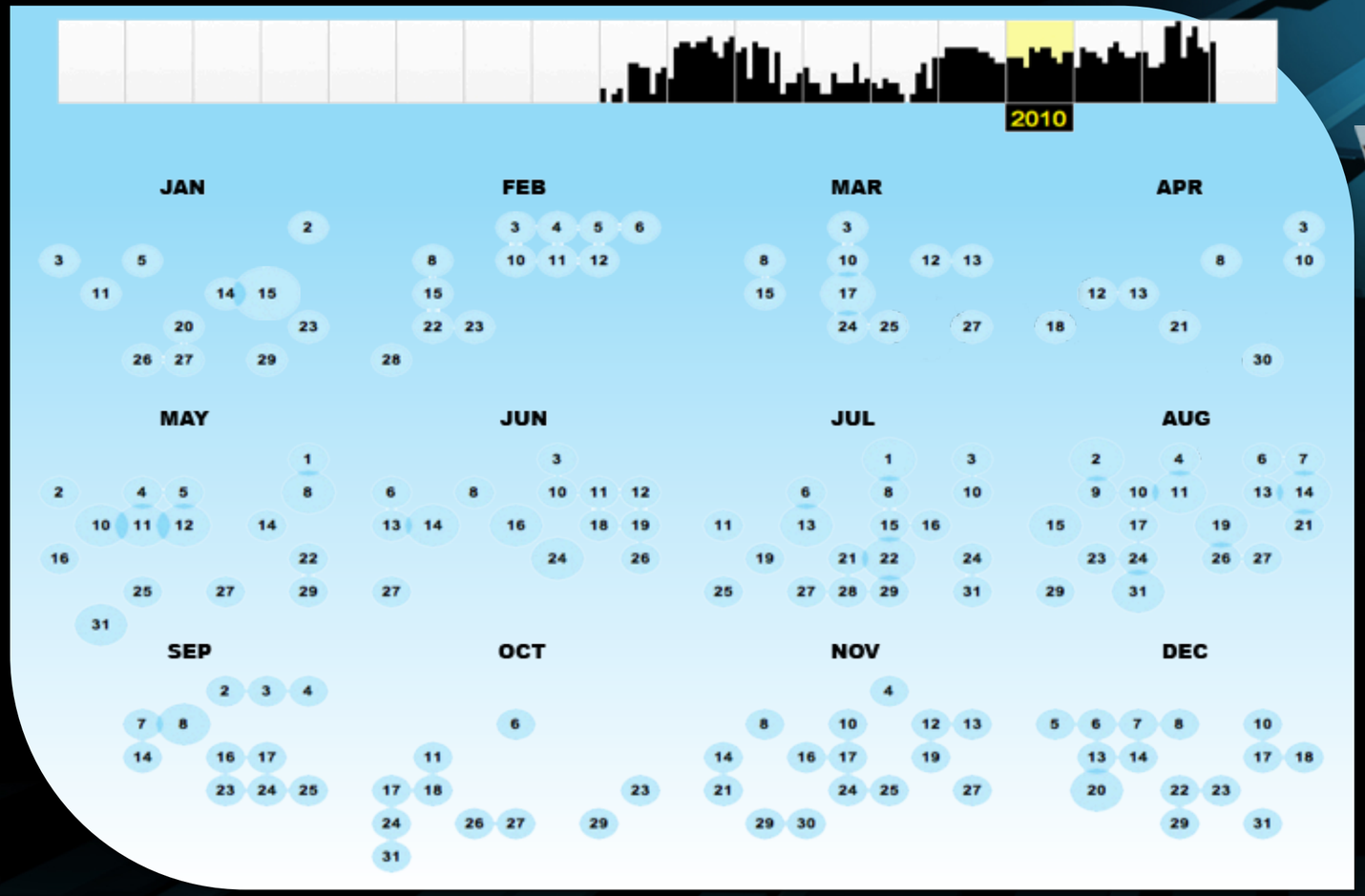

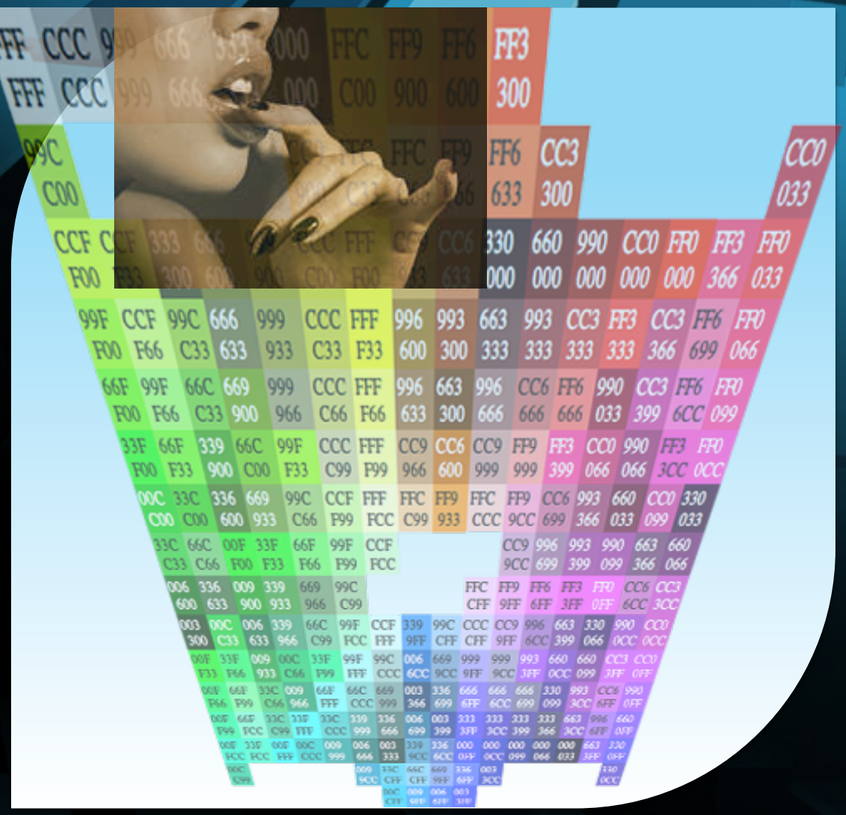

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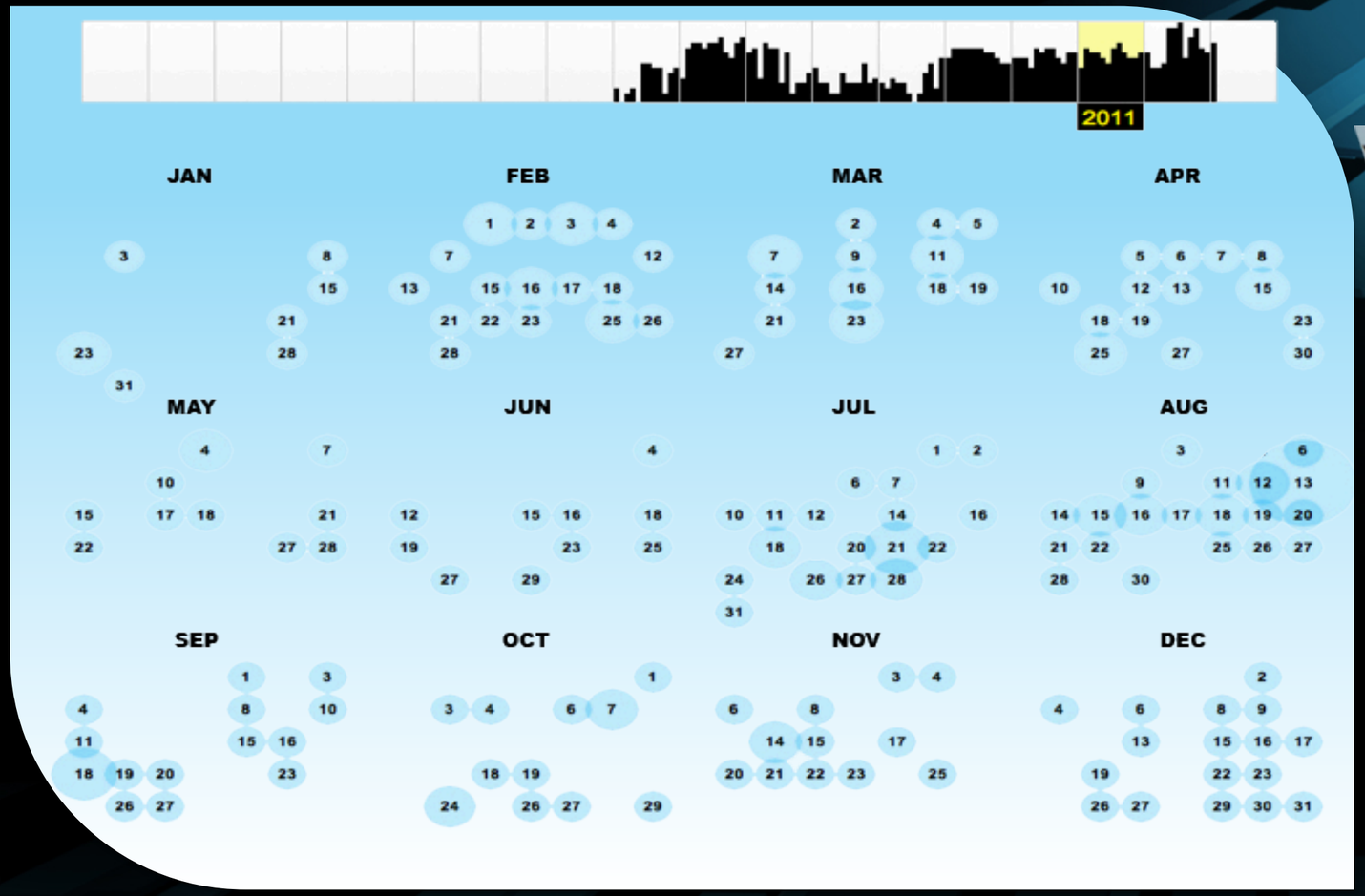

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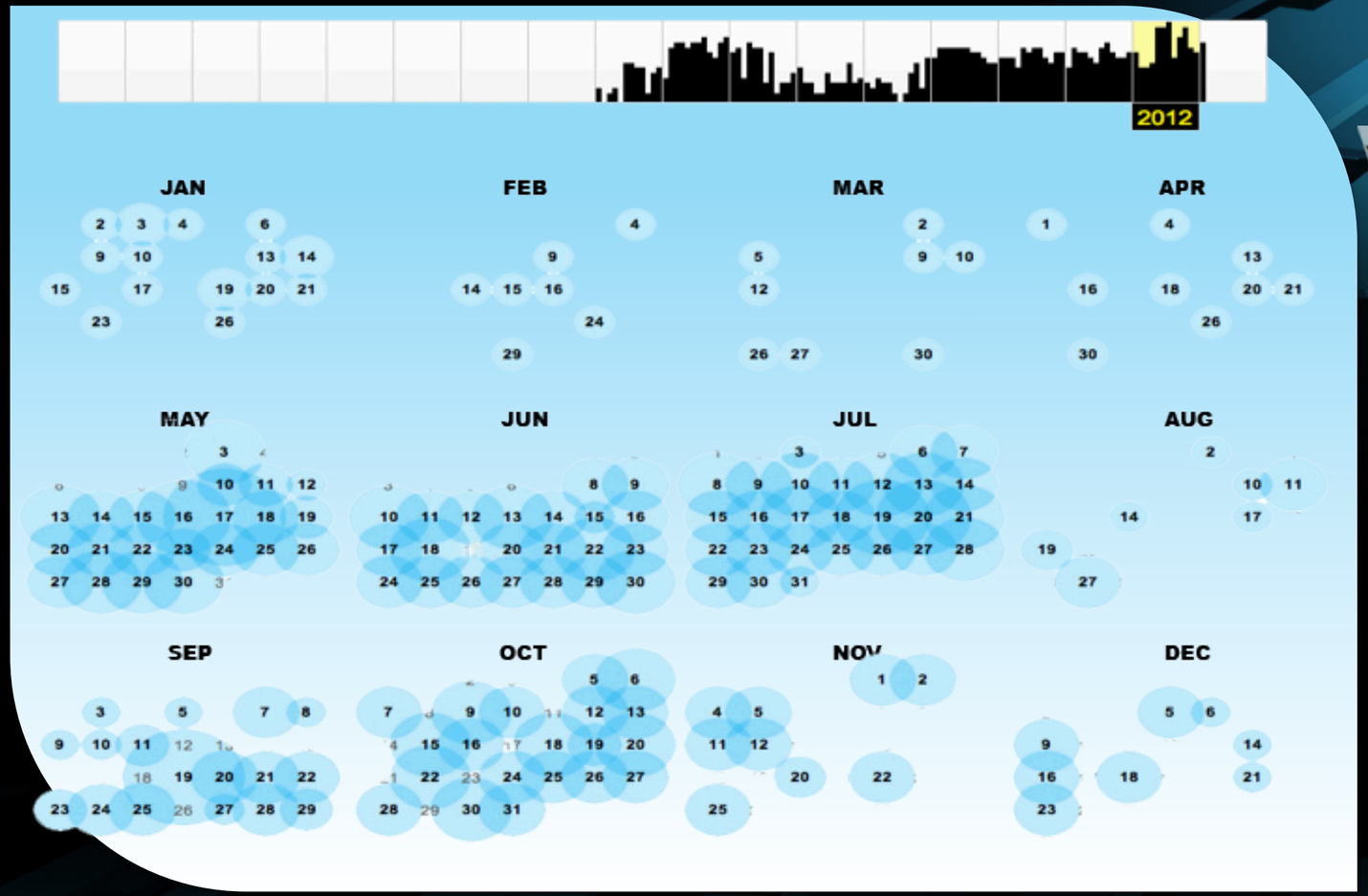

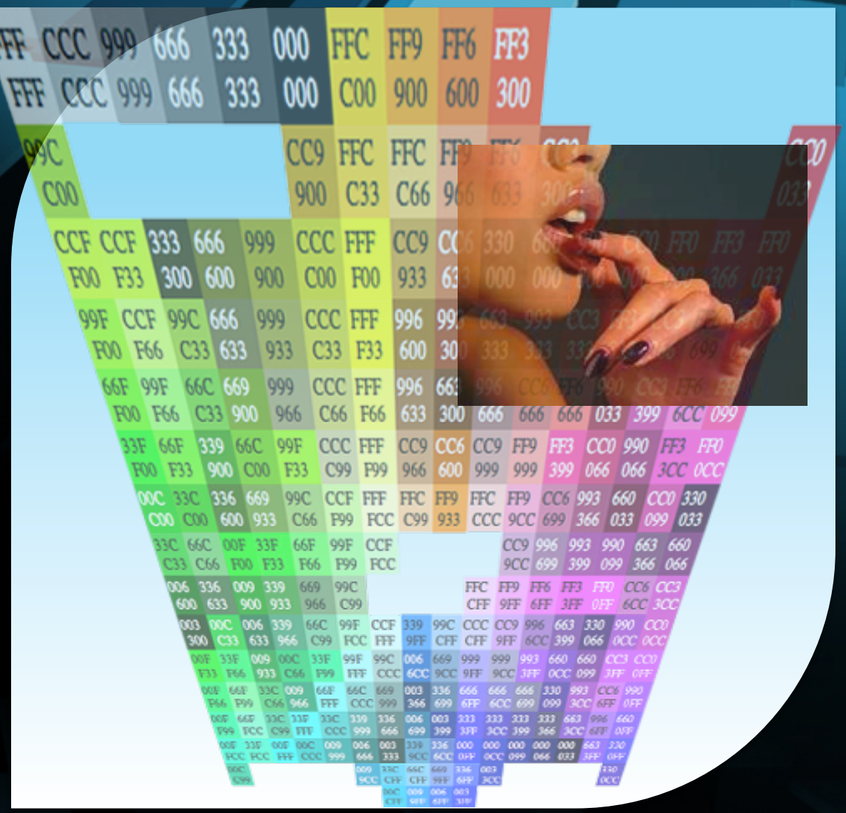

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Thank you!

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