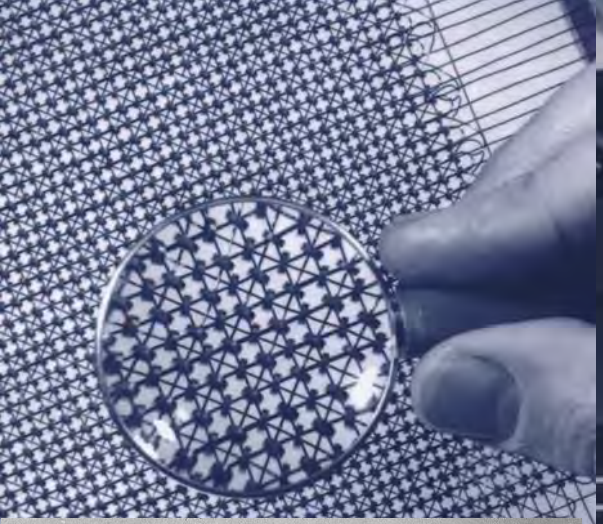
Actualization of the IoT

APS-FIAP
17-19 April 2017
Monterey, CA



The Internet of Things – Present at Its Creation – SAGE – 1954

Paul M. Grant
W2AGZ Technologies
www.w2agz.com

AGING IBM PENSIONER
RESEARCH SUPPORTED UNDER
THE IBM RETIREMENT FUND

IBM Poughkeepsie - 1952

Visit www.w2agz.com for the whole story

Prologue: 1949-50

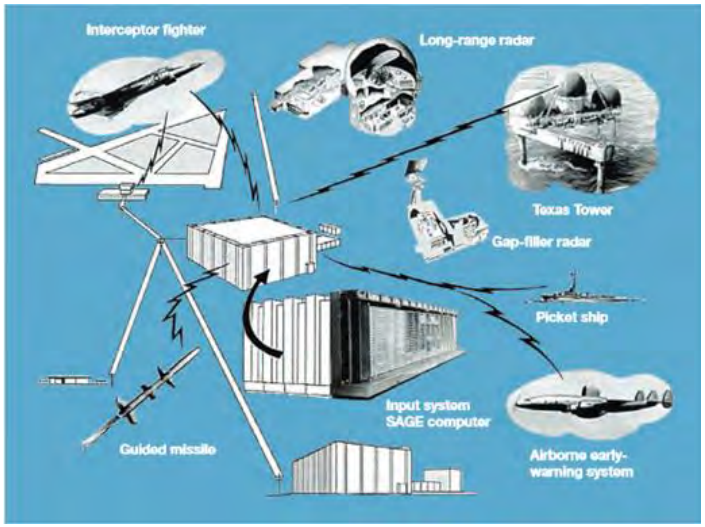
- It's 1949: The USSR has developed nuclear weapons.
- Deliverable via supersonic bombers and elementary ballistic missiles.
- Here was our defense at the time!

Obviously, we needed a new technological approach...

(and not just by substituting XXs with XYs)!

Proposal: 1951-53

- George Valley and Jay Forrester of MIT propose:
  - A net of radars and other data sources, along with computers,
  - That receive radar and additional information to detect and track aircraft,
  - Process such data to depict the total challenge to confront militarily,
  - Then guide weapons to destroy incoming enemy munitions.
- Wow! Ambitious! Their vision became SAGE (Semi-Automatic Ground Environment), first prototyped as XD-1 at MIT Lincoln Labs in 1954.



Hmmm...seems like a lot of “things” “netted” together. **That’s why “t=0” of the IoT began back then!**

1953

Project Sage – IBM/MIT

AN/FSQ-7 Architecture

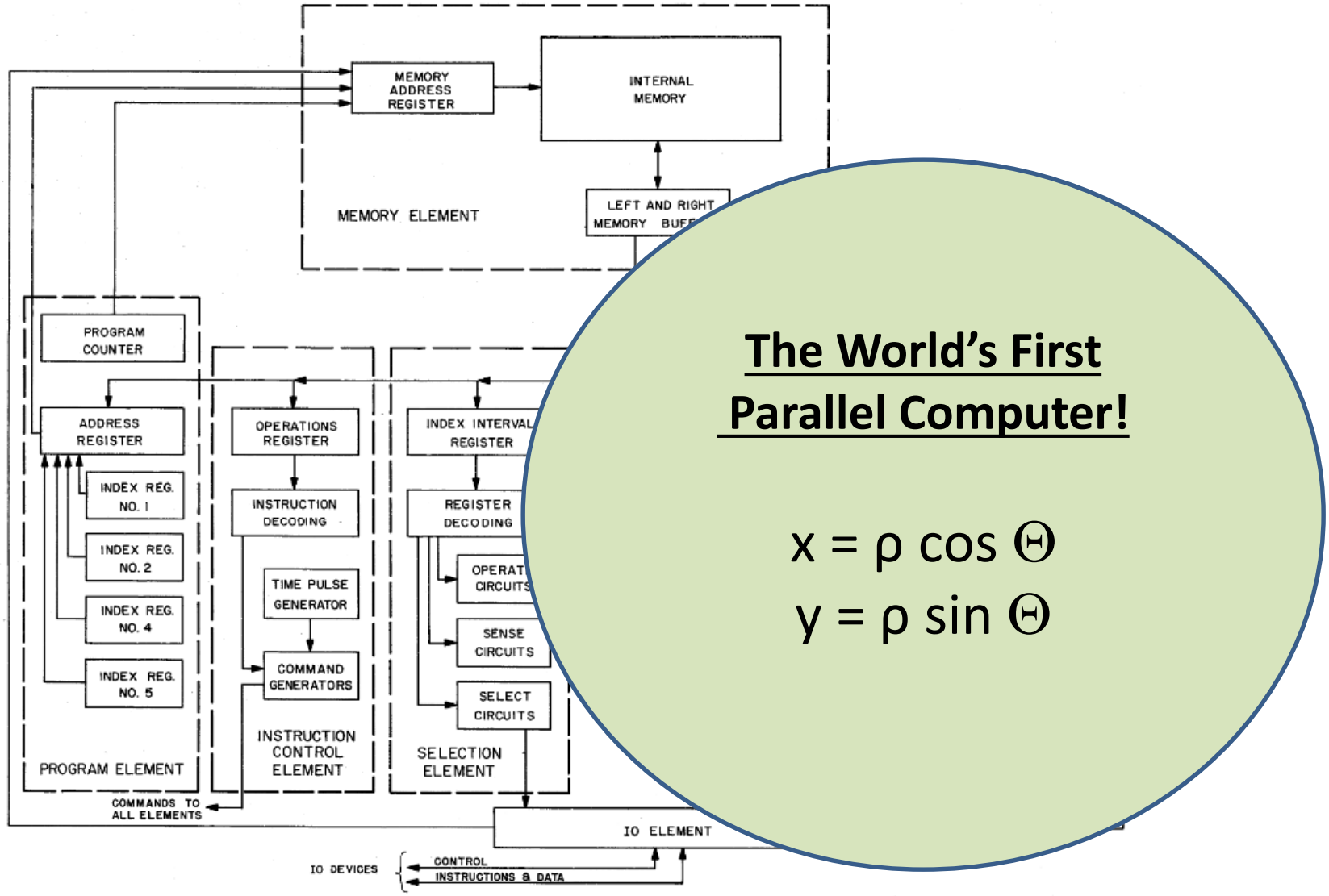


Figure 2–10. Overall Information Flow, Central Computer

The World's First Parallel Computer!

$$x = \rho \cos \Theta$$

$$y = \rho \sin \Theta$$

AN/FSQ-7 Instruction Set

TABLE 2–20. SUMMARY OF BASIC INSTRUCTIONS

INSTRUCTION NAME	MNEMONIC NAME	OCTAL CODE	EXECUTION TIME	INDEXABLE	CAUSE OVERFLOW
Halt	*HLT*	000	12 μsec	No	No
Clear and Add	*CAD*	100	12 μsec	Yes	No
Add	*ADD*	104	12 μsec	Yes	Yes
Twin and Add	*TAD*	110	12 μsec	Yes	Yes
Clear and Subtract	*CSU*	130	12 μsec	Yes	No
Subtract	*SUB*	134	12 μsec	Yes	Yes
Twin and Subtract	*TSU*	140	12 μsec	Yes	Yes
Full Store	*FST*	324	12 μsec	Yes	No
Left Store	*LST*	330	18 μsec	Yes	No
Right Store	*RST*	334	18 μsec	Yes	No
Add One Right	*AOR*	344	18 μsec	Yes	Yes
Branch on Positive Index	*BPX*	51-	6 μsec	No	No
Branch on Full Zero	*BFZ*	540	12 μsec	No	No
Branch on Full Minus	*BFM*	544	6 μsec	No	No
Branch on Left Minus	*BLM*	550	6 μsec	No	No
Branch on Right Minus	*BRM*	554	6 μsec	No	No
Reset Index Register	*XIN*	754	6 μsec	No	No

PMG@IBM: 1953-56

- July, 1953: At age 18, hired as mail boy, Project High laboratory, Poughkeepsie
- November, 1953: Promoted to bench technician...
  - Helped build pluggable unit and core memory test equipment for XD-1 assembly line.
  - Worked on assembly line of XD-2, Poughkeepsie Manufacturing.

- Summer, 1954: Attended first SAGE support programming class, IBM Poughkeepsie, taught by Art Samuel, pioneer of "Checkers AI" gaming.
  - **With a TvN machine instruction set of only three operations (store, substact, branch on minus), you can compute anything!**
- Spring, 1955: Posted to MIT Lincoln Lab as member of XD-1 service team.
- August, 1956: Now 21, began pursuit of undergraduate degrees in EE and physics at Clarkson as IBM employee on educational leave.

It’s 2017 = SAGE + 64 Years

Is the IoT of today any different from the IoT of SAGE?

I.E., Does Ecclesiastes 1:9 Hold? Depends...

SAGE
AN/FSQ-7

- Weighed 250 tons
- Consumed 3 MW
- 60,000 vacuum tubes
- 75,000 instructions per second (6 µsec/memory cycle)
- 3rd class phone linkage: (400-3400 Hz)
- IBM card reader, card punch, line printer, magnetic tape units
- 70,000 15-bit words of magnetic core RAM
- 100,000 15-bit words of magnetic drum SATA storage
- > 50 CRT display consoles, keyboards, light guns
- Total Cost of NORAD: 10x10^9 USD

wow!

Some More “Things”

Nov 1964 : IBM 1800 Data Acquisition & Control System

World’s first production mainframe capable of processing analog input/output acquired externally and in real time

Semi-Anthology of 1800 Lab DAC Papers from IBM San Jose Research published in IBM J. Res. Devel., 1968 Special Issue

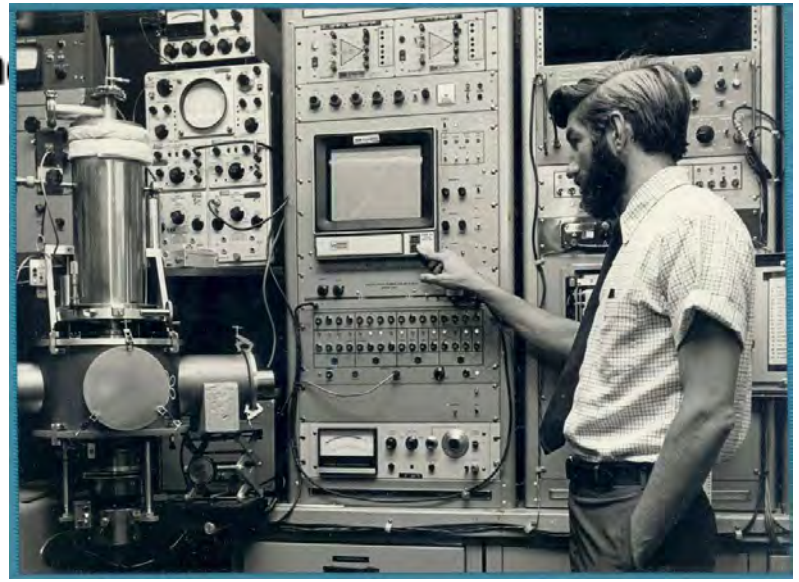
Authors: Grant, Schechtman, Ramondi, Winters, Clarke, Gladney...
... and many others

Interleaving Slow- and Rapid-data-rate Experiments with a Time-sharing Laboratory Automation System

Automation of Data Acquisition in Transient Photoconductive Decay Experim

Automation of a Residual Gas Analyzer on a Time-shared Computer

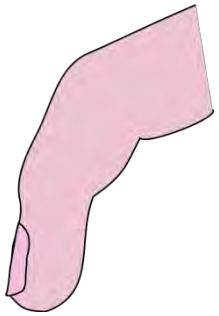
Automation of a Wide-range, General-purpose Spectrophotometric System



Now We Have!

Our iToys + Wireless + The Cloud

...and...oh, yeah...APPS!



12-Year Old Devin Grant's
" Big Data" Homework Assignment

- How many of GrandPa's *really silly* 1953 IBM Punched Cards does it take...
- ...to fill up a 32 gig iPhone?
- Well?
- **A stack about 30 miles high!**
- **> 3000 miles in a 4 TB home CLOUD!**
- **Wow!* That's really "Big Data! "**

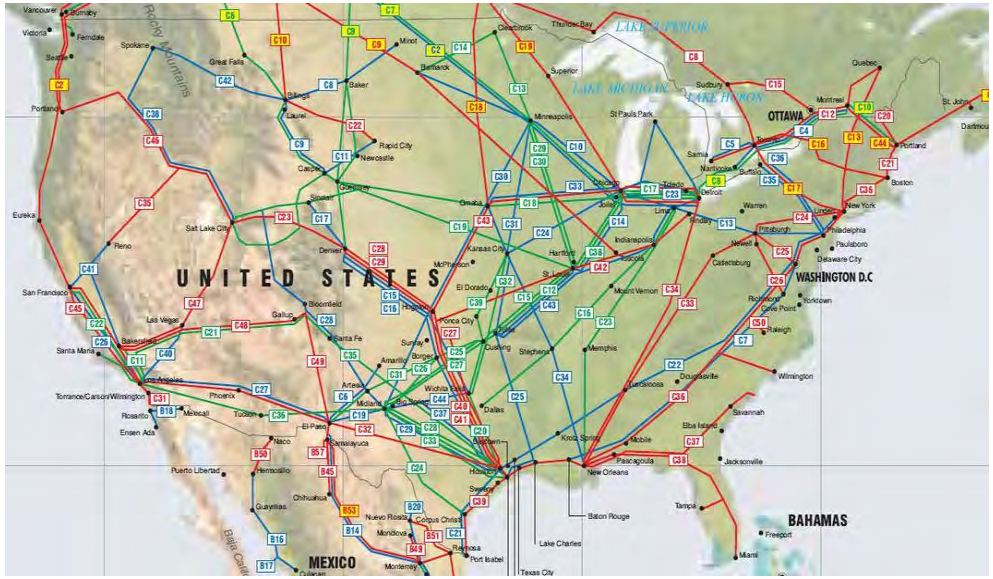
So What's Next?
Putting Your 1's & 0's in a Black Hole?

*Assumptions:
- 120 bytes/card
- Thickness = 0.007 inches

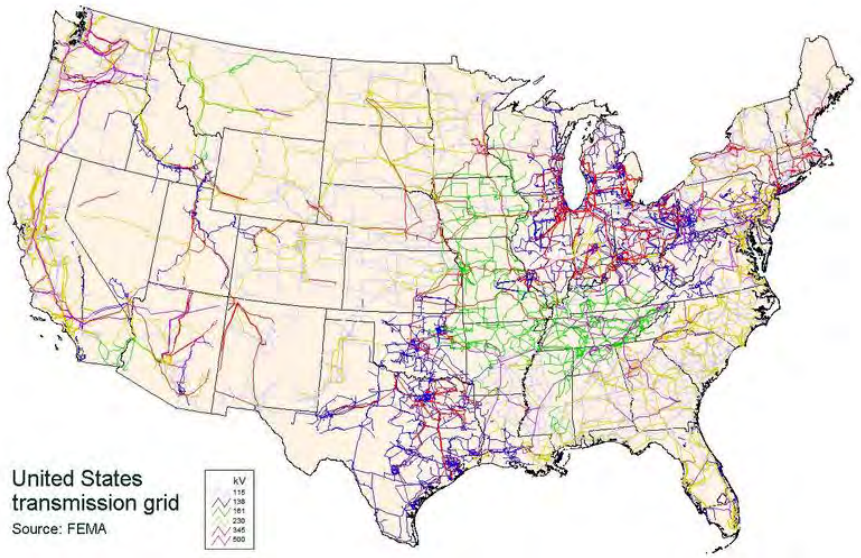
The Ultimate IoT

- The Energy Enterprise -

Molecules



Electrons



The barriers to widespread deployment of sensors and actuators within the EE are complex political and sociological issues, **not** technology (which we already have plenty of).

Lastly...Questions for the Audience

- Quantum Computers...what are they?
  - What I understand:
    - Prime number factorization, e.g., 15=5x3
    - Qubit arithmetic and manipulation
    - Entanglement/Encryption (I've consulted for a 3-letter US agency...oops!)
    - Quantum Monte Carlo Calculations

      (See next slide)

PRB **31,** 4712 (1985)

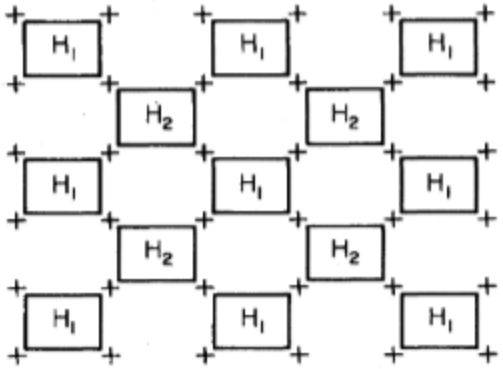
Monte Carlo studies of the quantum XY model in two dimensions

E. Loh, Jr. and D. J. Scalapino
Department of Physics, University of California, Santa Barbara, California 93106

P. M. Grant
IBM Research Laboratory, San Jose, California 95193

(Received 22 June 1984; revised manuscript received 28 January 1985)

Monte Carlo simulations are performed for the spin-$\frac{1}{2}$ XY model in two dimensions for large (up to 24×24 sites) lattices. Results are obtained over a wide temperature range which includes the critical temperature T_c, estimated to be 0.4–0.5. The energy, specific heat, vortex density, and derivative of the helicity modulus are given as functions of temperature. As the lattice size is increased, the specific heat per spin approaches a finite value and does not diverge.



$$Z = \mathrm{Tr}(e^{-\Delta\tau H})^L \qquad \exp(-\Delta\tau H) = \exp(-\Delta\tau H_1)\exp(-\Delta\tau H_2)$$

$$H = H_1 + H_2 = -\sum_{\langle ij\rangle} (S_i^x S_j^x + S_i^y S_j^y)$$

QC Questions Continued

- Quantum Computers...what are they?
  - What I don't understand:
    - Is there a basic architecture and instruction set...like there is for a Turing – von Neumann machine?
    - I've asked D-Wave Systems, BC Canada, and, so far, their response has been deafening in its silence
    - Can I take the square root of pi on a QC ... like I can on a TvN ?
    - Finally...and most critically...is a QC exempt from the Landauer Limit?

OK...basta...enough already...

Thanks for your attention!

-Slainte