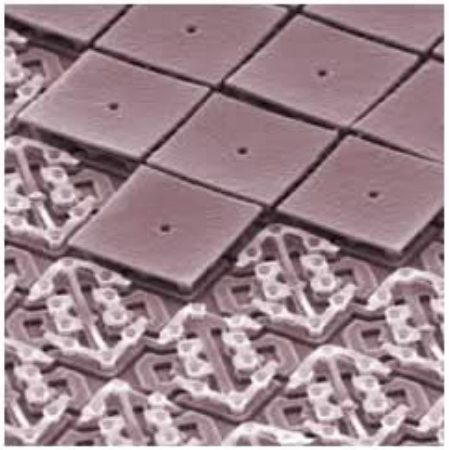
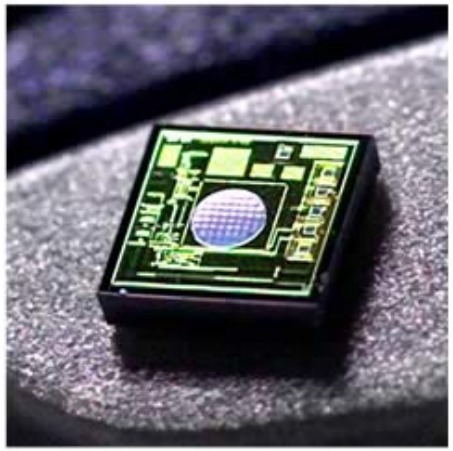
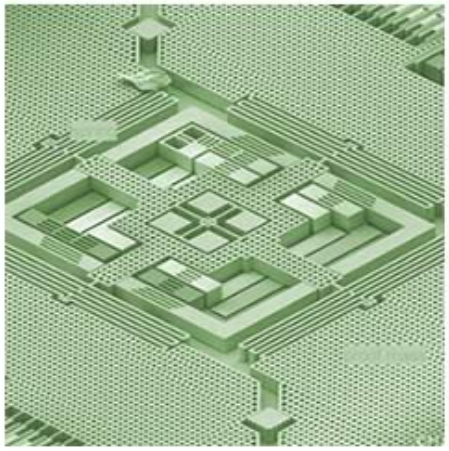
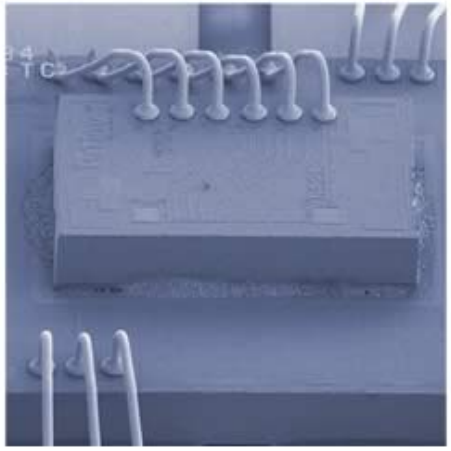
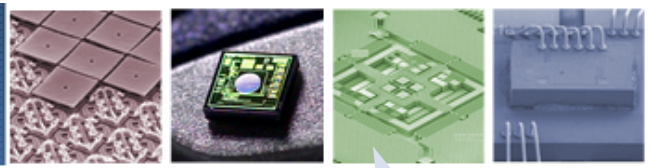
Current Entrepreneurial Environmental for MEMS

Kurt Petersen, PhD
Band of Angels

MEPTEC - May 22, 2014



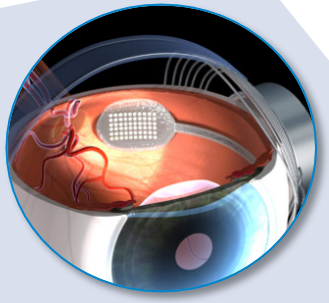
Growth of MEMS

60's - 70's
Industrial

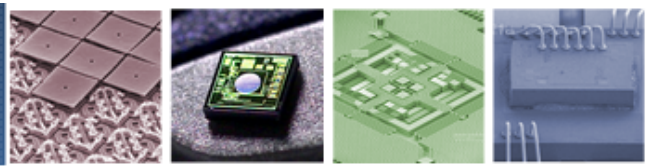
80's
Medical

80's - 90's
Automotive

2000's
Consumer



2010's
Consumer + Bio-MEMS + Environmental



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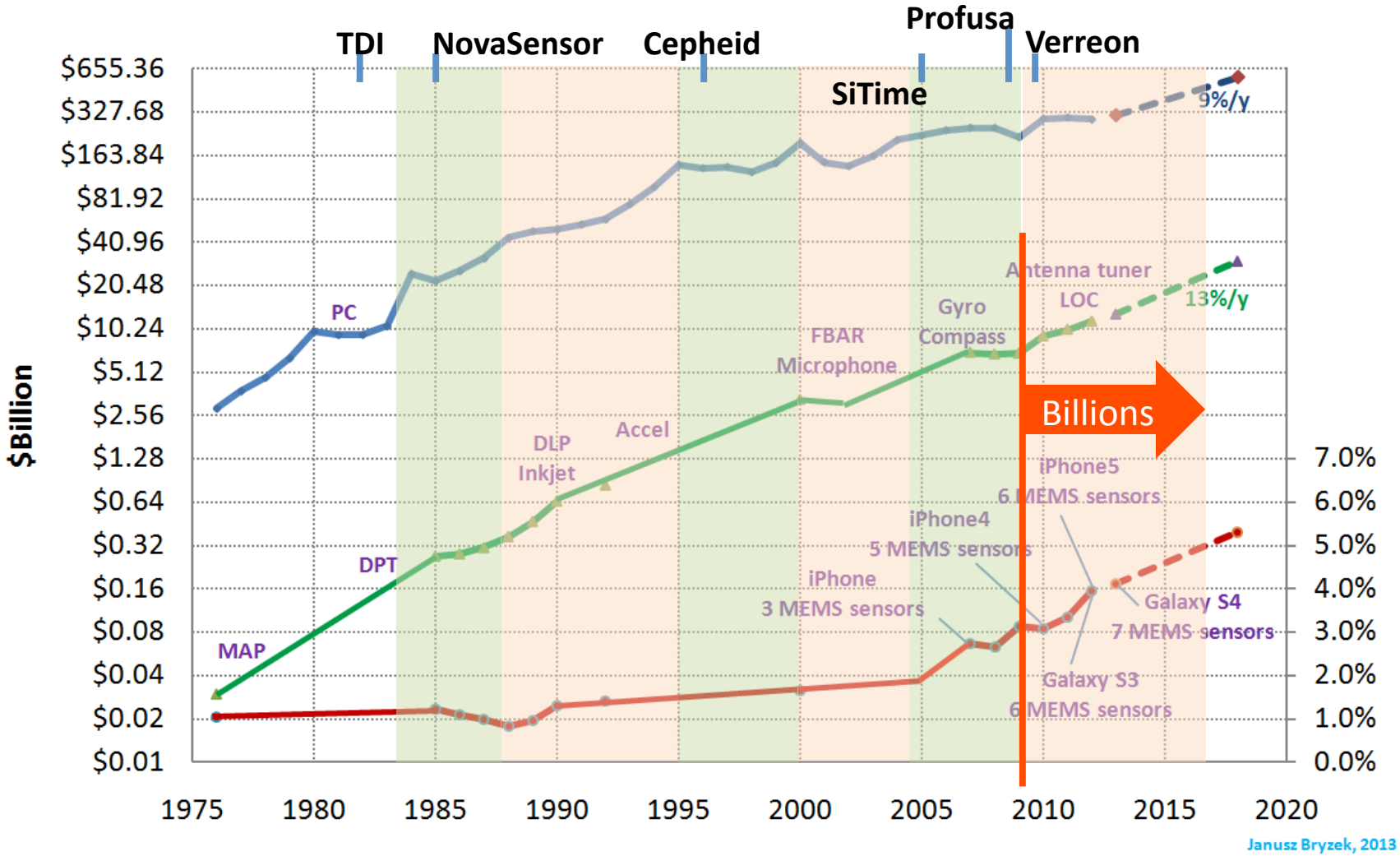
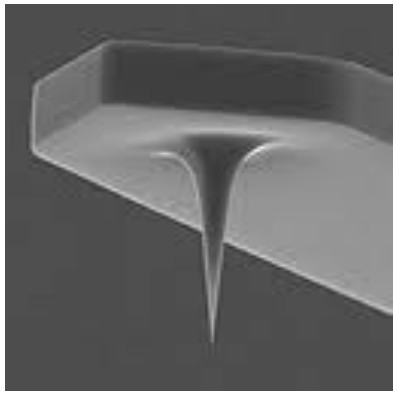
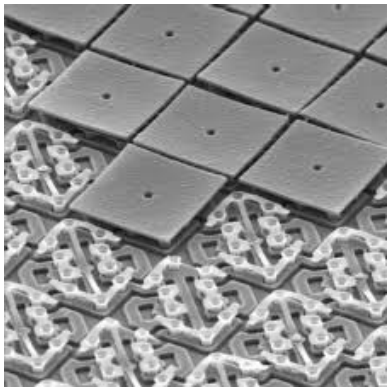
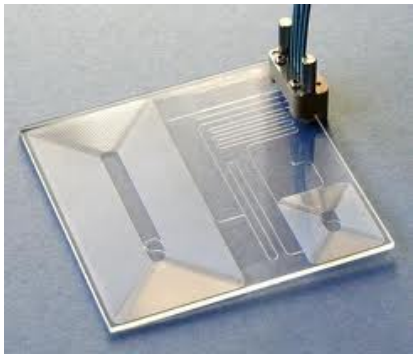
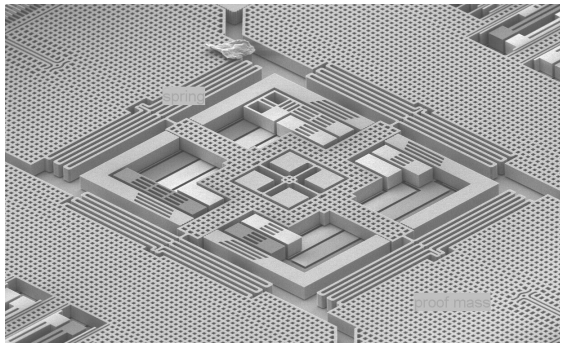


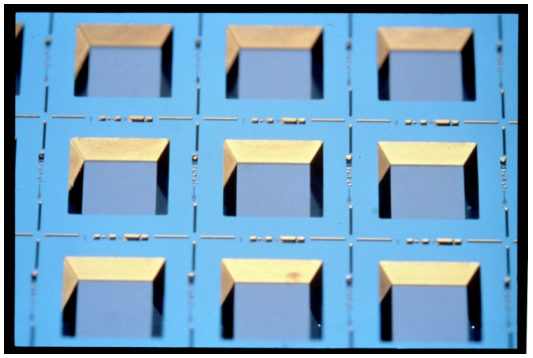
Janusz Bryzek, 2013

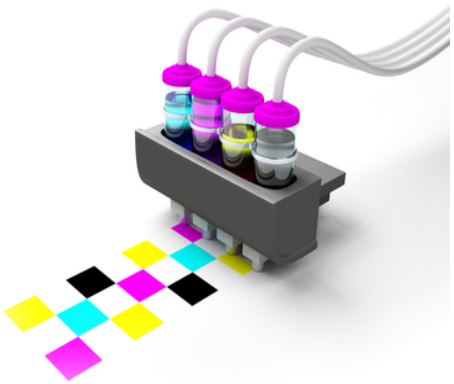


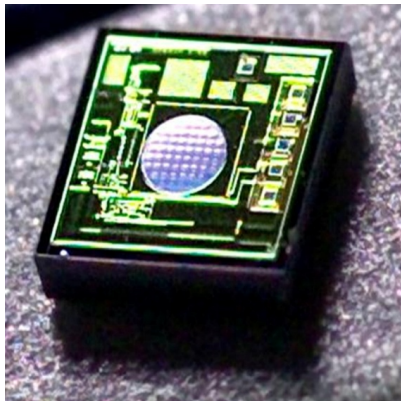


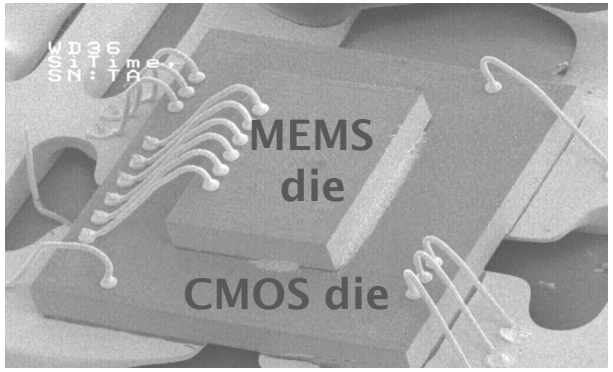


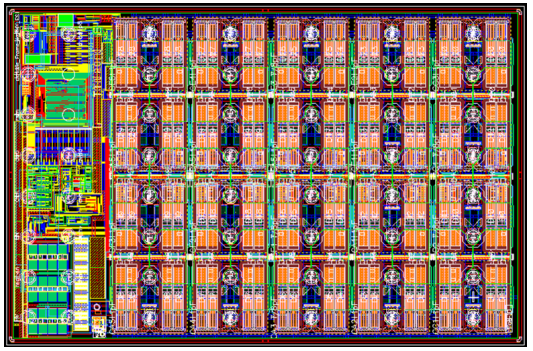




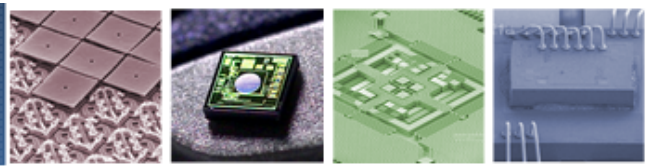


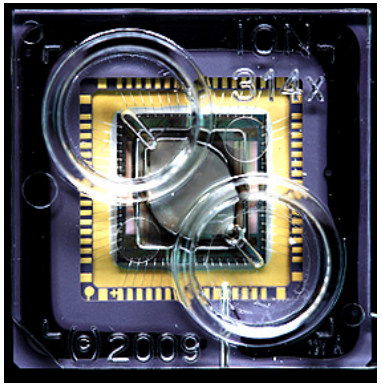


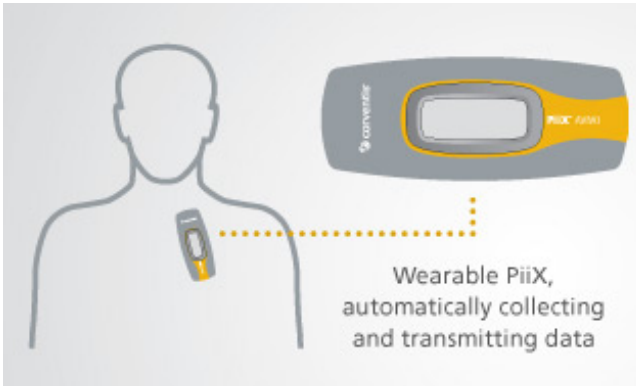

MEMS
die
CMOS die

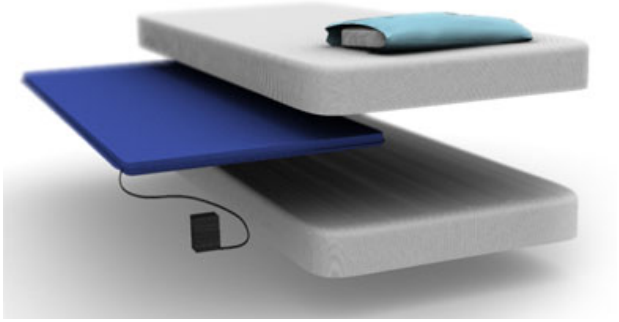


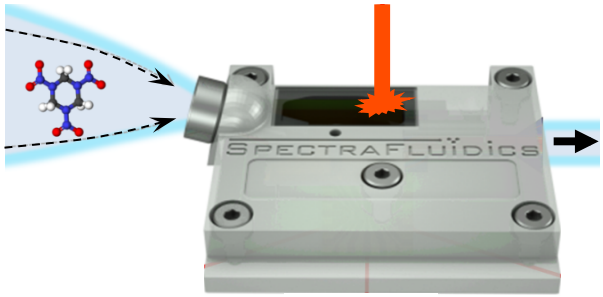
Biomedical MEMS

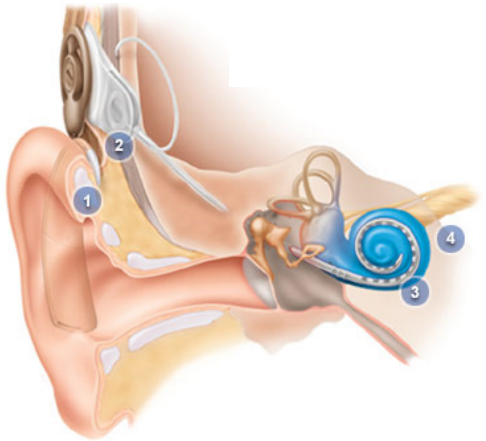


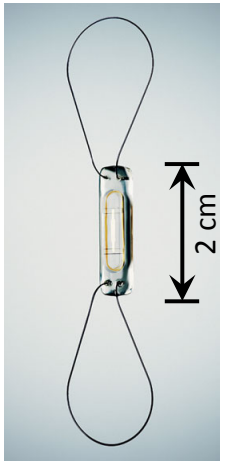


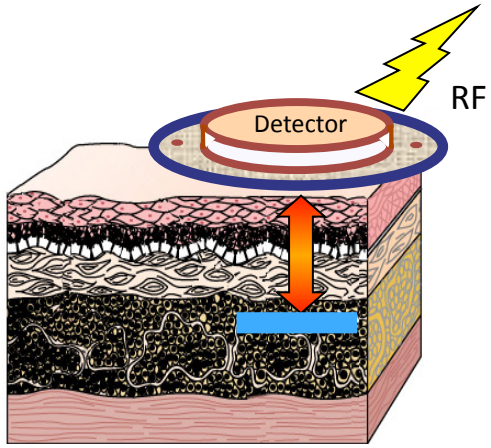


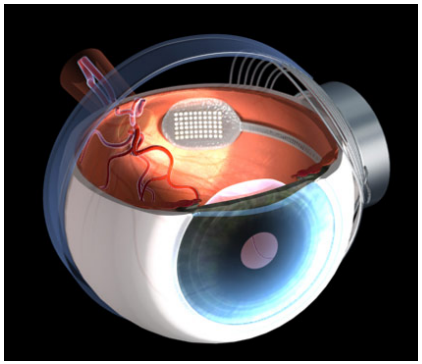




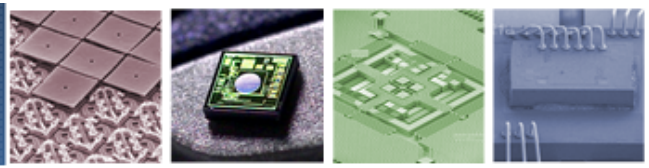








Protein Panels
Cellular Manipulation
Contact Lens Sensors
More Fluidics
Sports Monitoring
. . . . . etc



Three **ENORMOUS IoE** Initiatives

QUALCOMM TRICORDER X PRIZE

Trillion Sensor Roadmap !!

initiated by Janusz Bryzek

Introducing the Qualcomm Tricorder X PRIZE

A $10 million competition to bring healthcare to the palm of your hand

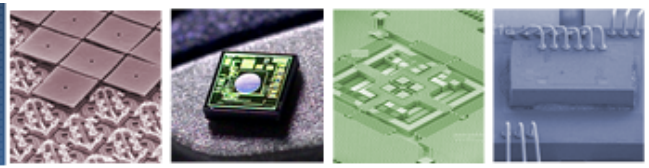
Mobile as an Innovation Platform

Credit Card Reader

Glucose Finger-stick Sensor

Blood pressure monitoring cuff

Ultrasound machine from Mobisante went on sale in October 2011



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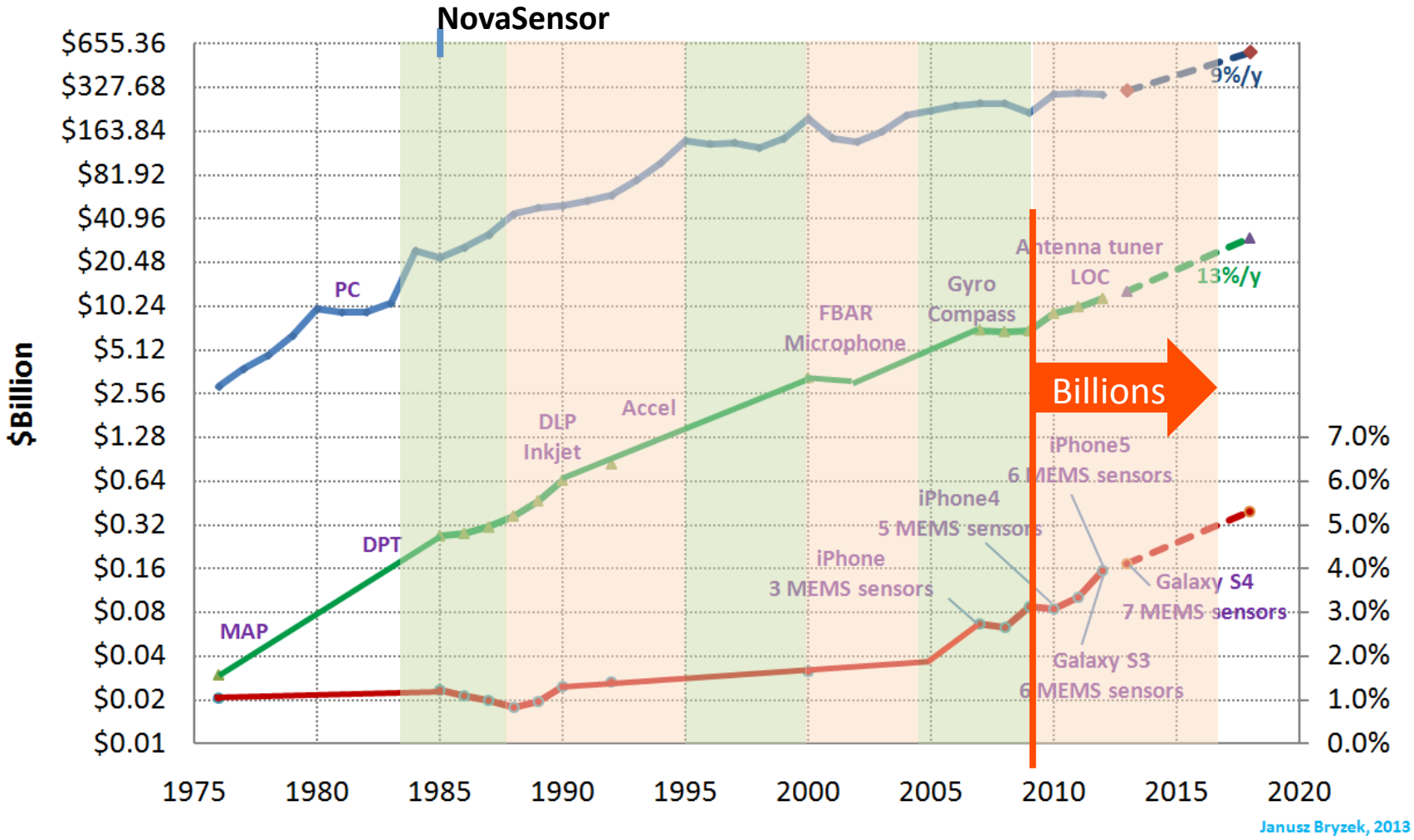
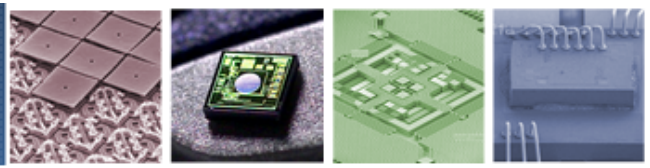
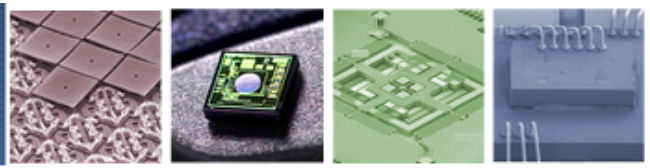


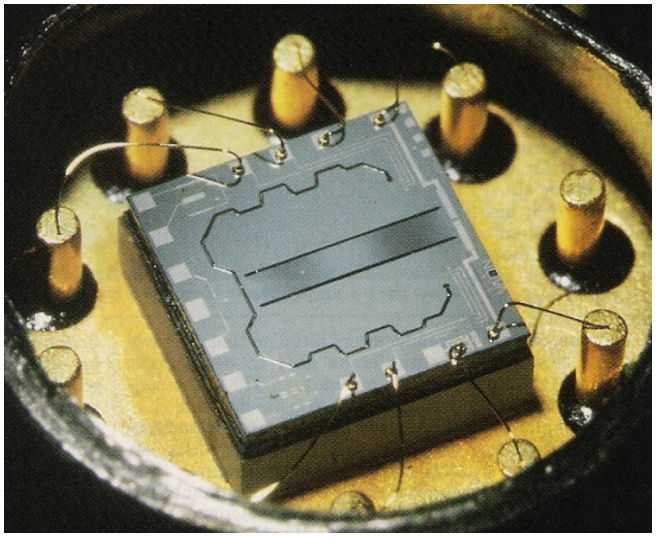


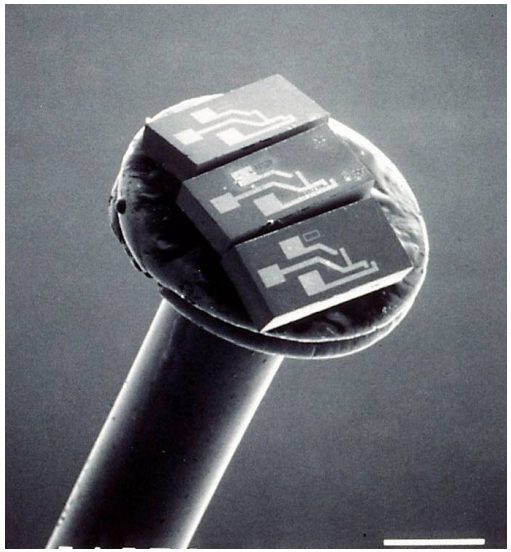
NovaSensor Products

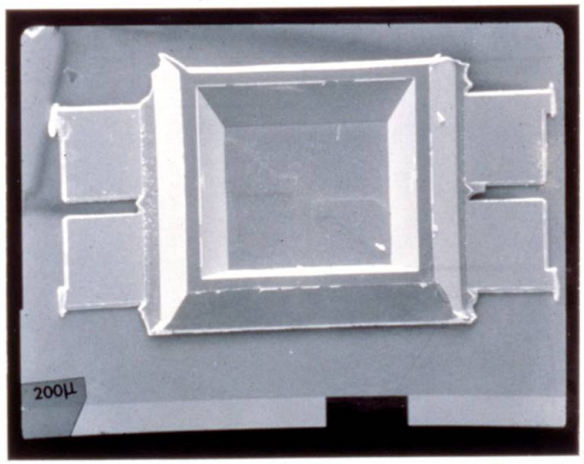
- Total Equity Funding from Schlumberger
- **Second source** disposable blood pressure sensor
  - developed in response to a customer inquiry
  - **VERY** tight distributions of parameters (sensitivity, offset, etc)
  - shipped as die (no packaging issues)
  - higher yields, more reliable deliveries
- This first product got NovaSensor ***into production***
  - We had no fab, but . . .
  - first production shipment was 6 months after funding, 12 weeks after we took the first order
- Later products got NovaSensor into :
  - Industrial
  - Consumer
  - Automotive

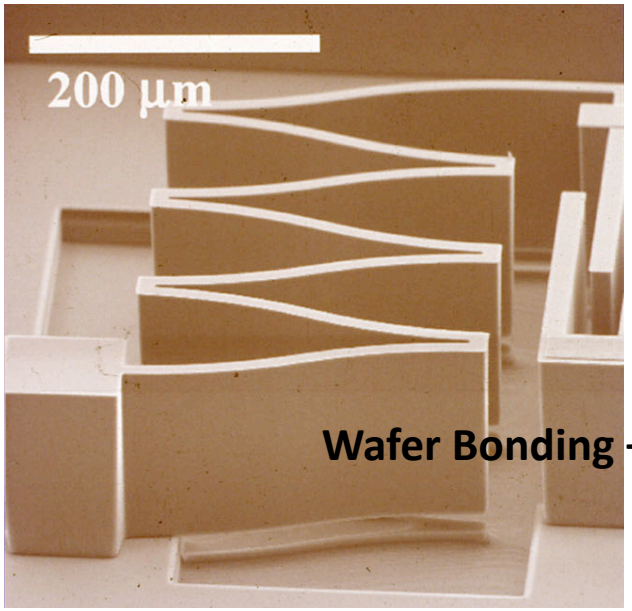
NovaSensor



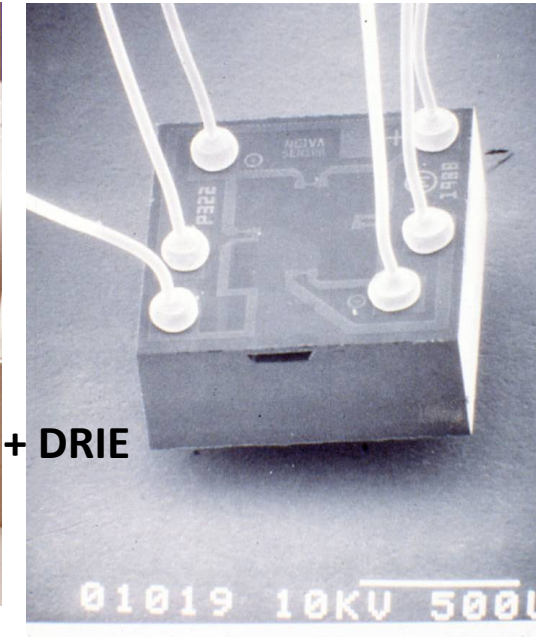


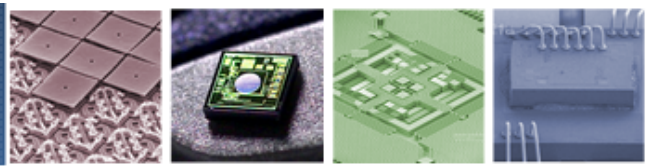






Wafer Bonding + DRIE





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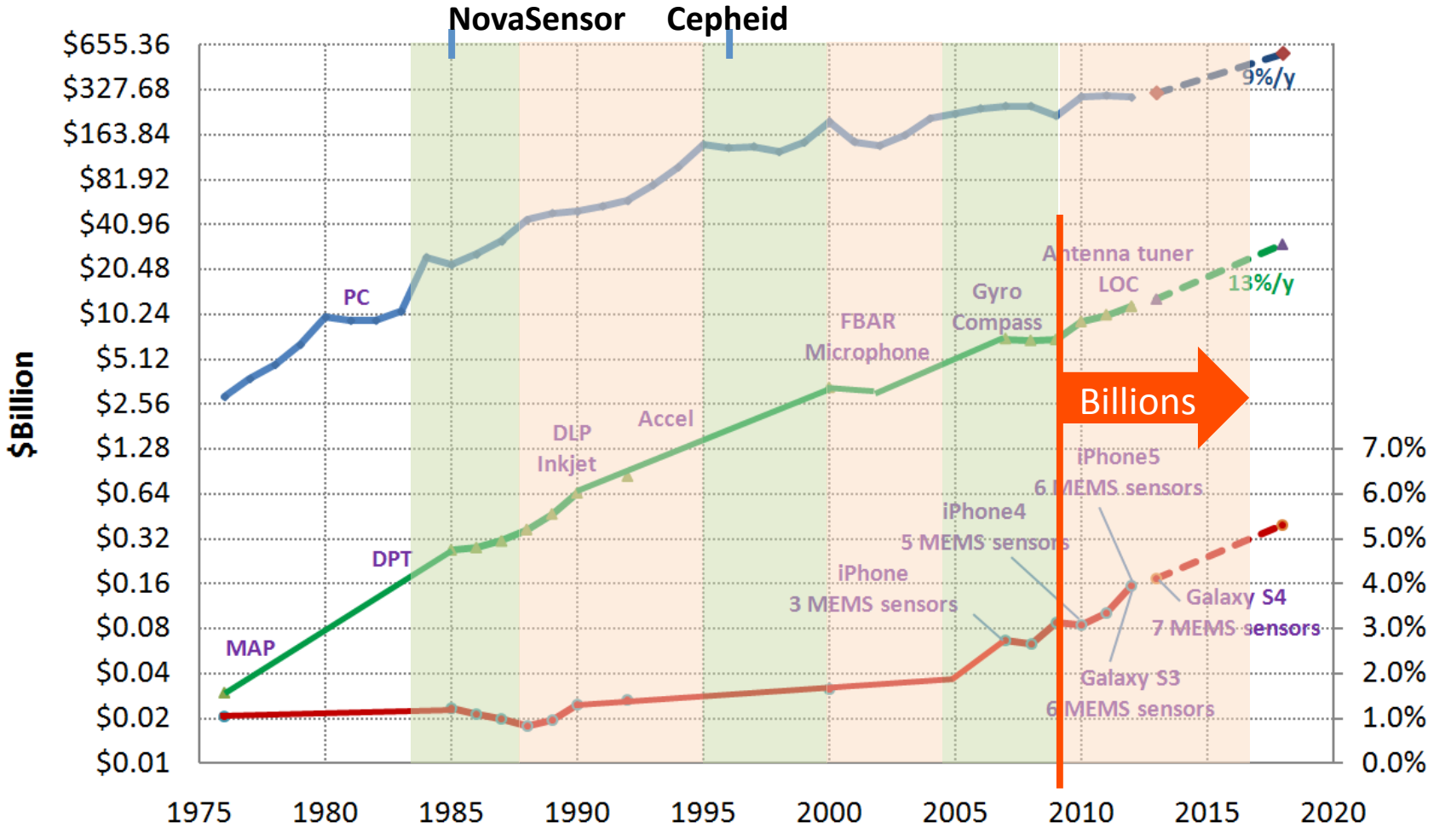
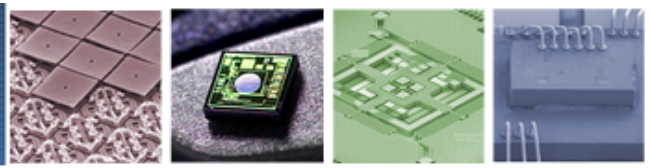


Janusz Bryzek, 2013



Cepheid

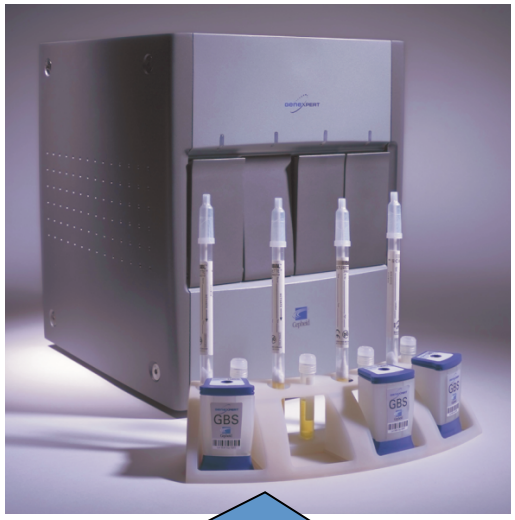
- Rapid, micro-PCR, micro-fluidic sample prep for DNA diagnostics
- First product; rapid, micro-PCR for life sciences research
- Home run product; rapid, automated human DNA diagnostics
  - FDA approvals required
  - MENU of tests required before wide-spread system adoption
  - First Test is non-FDA regulated anthrax for US Postal Service
- First product, SmartCycler, in production 3 years after start
- Homerun product, GeneXpert, in production 7 years after start
  - For the USPS only
- First FDA-approved test, in production 10 years after start
- $100M in annual revenue, 10 years after start

Cepheid Hardware Development

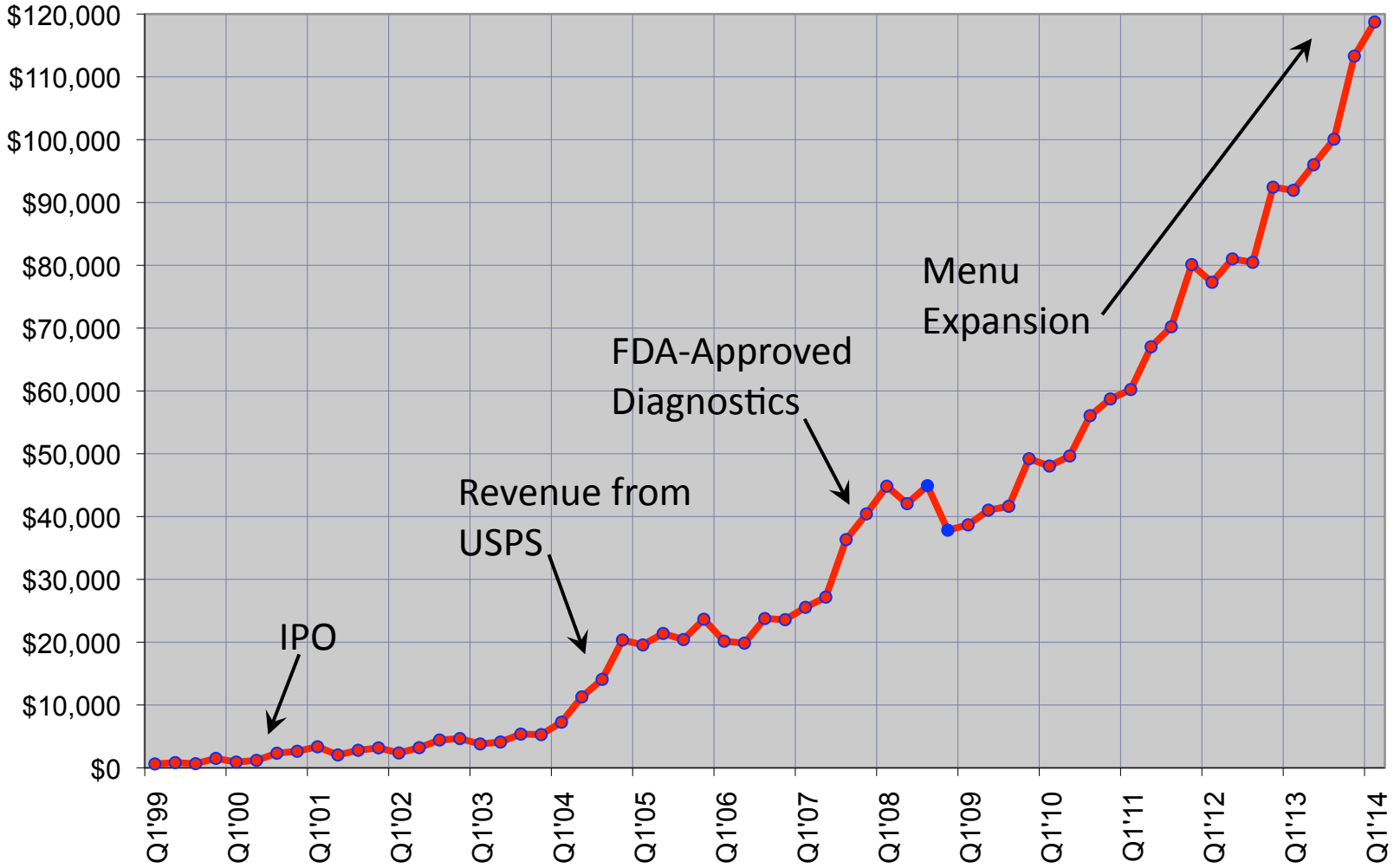
Optics/Reaction
PCR Module

Smart-Cycler
for Life Sciences

GeneXpert
for Diagnostics



Cepheid Quarterly Revenue

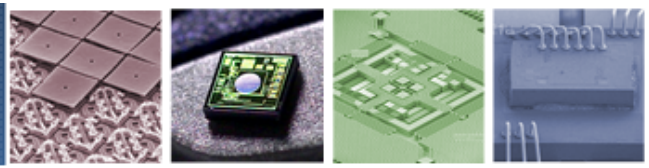


Cepheid Today

- CPHD is one of the Silicon Valley 100 largest companies
  - total revenue in 2013 of >$400M
  - Revenue growth rate of 20%/year
- GeneXpert now has 14 FDA approved human tests
  - Cepheid TB test rated by WHO as "better than current gold standard"
- Large program in developing countries
  - In partnership with Gates Foundation
- Large pipeline of additional human tests under development
- Revenue from the US Postal Service is now <<5% of total revenue

GeneXpert I

GeneXpert Infinity



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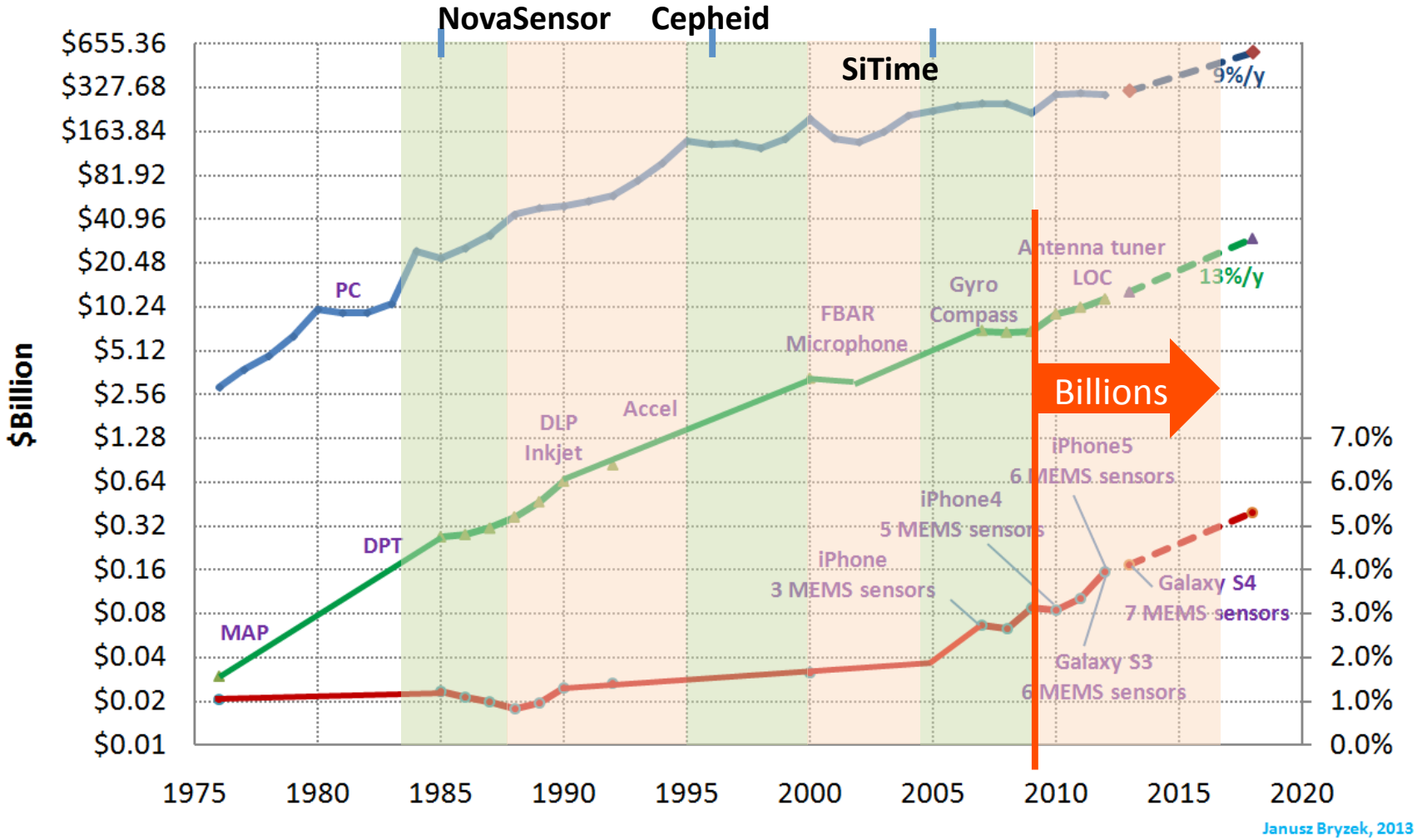
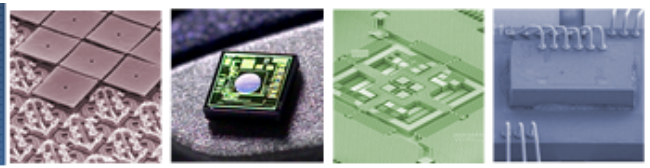


Janusz Bryzek, 2013

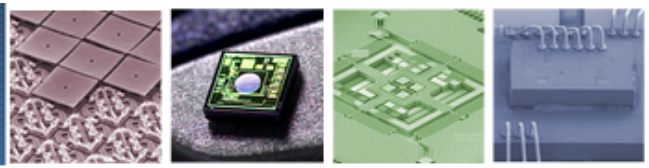
SiTime Founding Team

Bernard Boser



SiTime Today

- Wide variety of products in full production
  - Jazz/Tower Foundry for MEMS
  - TSMC for CMOS
  - Malaysia for package and test
- NO MEMS production problems; **NO** customer returns
- Focus has shifted to 3 MEMS die, **MANY** CMOS die
  - 43 different products
  - Fabless semiconductor company
- Cumulative shipments of over 200M units
- SiTime oscillators are now better than quartz in every way
  - Quality and Reliability
  - Frequency stability over time
  - Temperature and noise performance
  - Cost (>100K devices on 8” wafer with ~97% yield)



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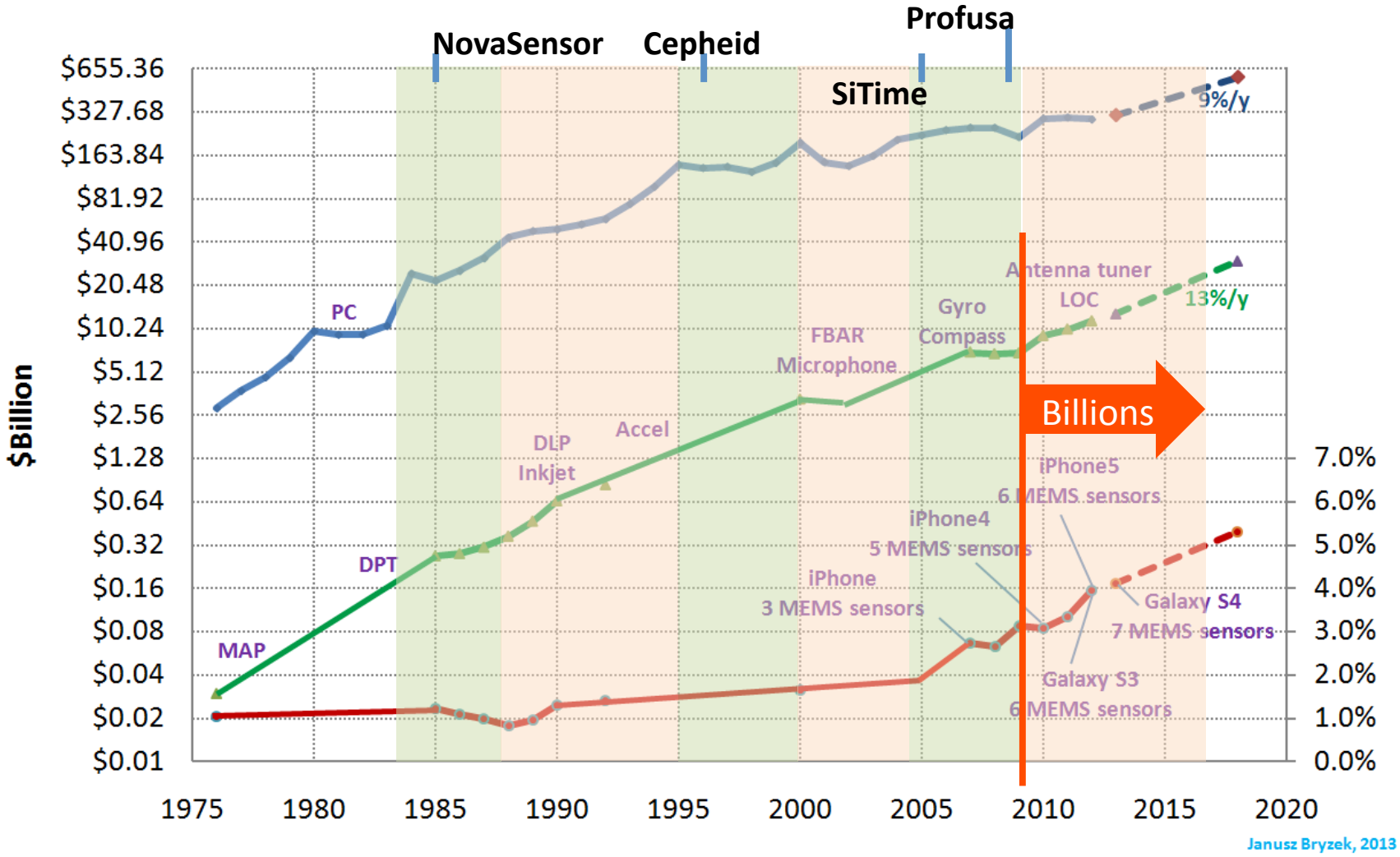
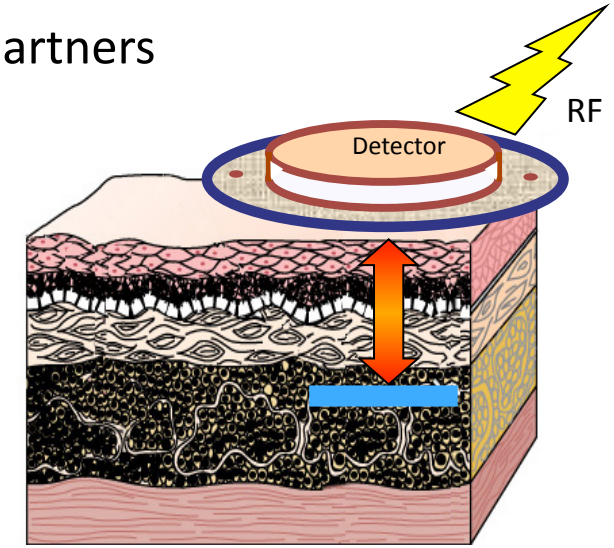
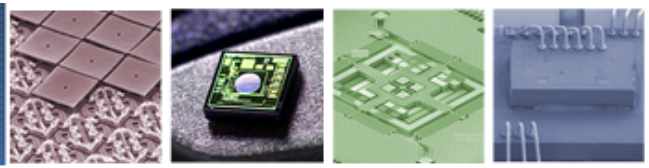


Profusa

- Implantable Glucose Sensors
  - over the past 25+ years, >$2B has been spent to develop such sensors – totally unsuccessfully
  - 4-5 years ago, NIH stopped funding because nothing was working
- Profusa has a totally new concept
  - the company started with bio-issues (our Foreign Body Response), instead of engineering issues
  - Profusa has a team of top-notch academic partners
  - NIH has changed its “no-fund” policy for Profusa and has funded the company with >$6M
  - Today, the top executive staff has Profusa sensors implanted in their bodies
- Profusa has raised seed and Series A equity totalling ~$4.5M





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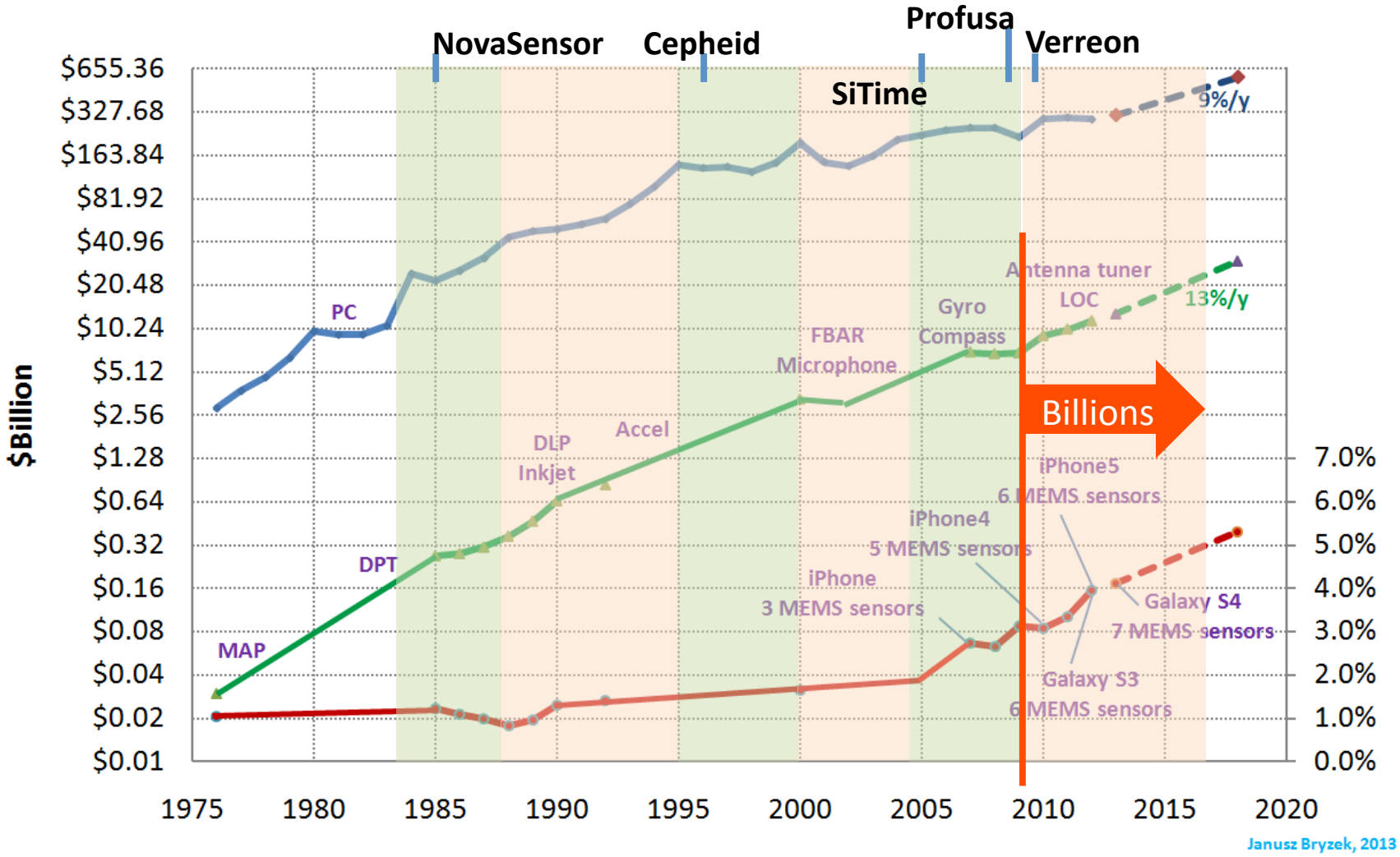
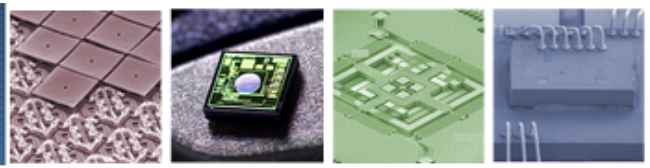


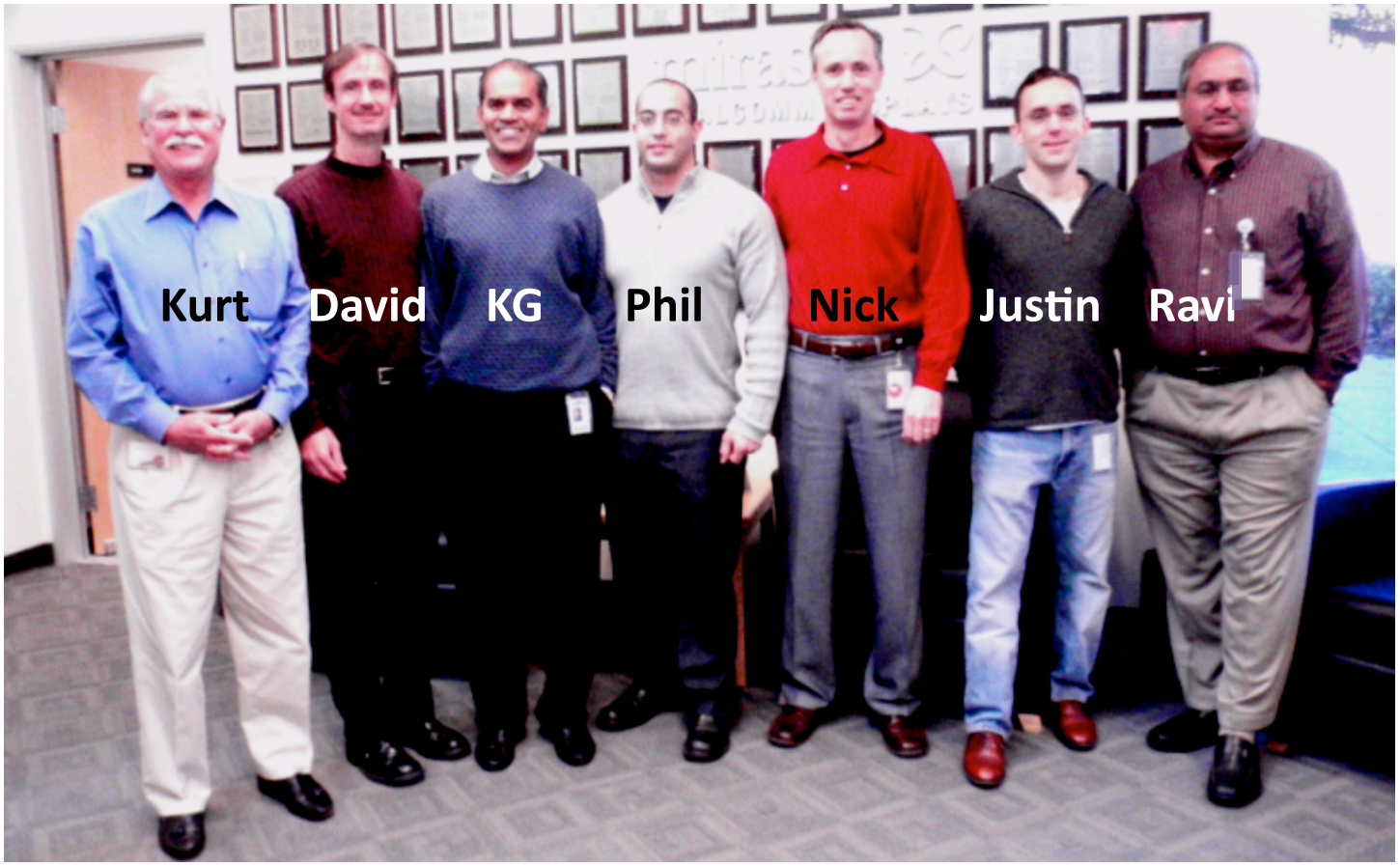
Janusz Bryzek, 2013

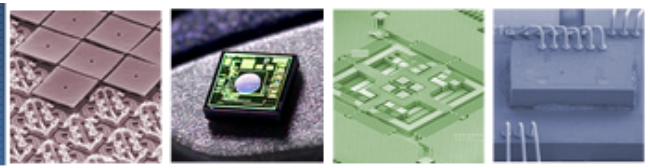


Verreon

- New technologies and designs for manufacturing MEMS sensors and other devices on GLASS
- Verreon was *designed* to be acquired by Qualcomm
  - We hired a MEMS patent expert
  - We hired an operations person to round out the team
  - We documented an extensive IP portfolio
- Within one year, in April 2010, we were acquired and the team went to work for Qualcomm MEMS
  - (Thank God, because we had no Plan B)
  - In Qualcomm's yearly employee evaluation rankings, Verreon staff all ranked in the top 1/3 at QMT
  - Four still work at Qualcomm
- All of us have lunch every year on the anniversary of the acquisition

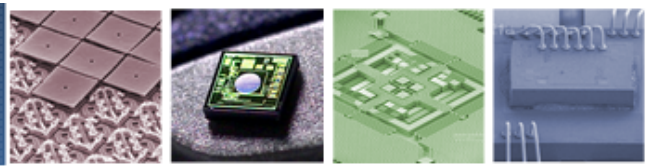
Verreon





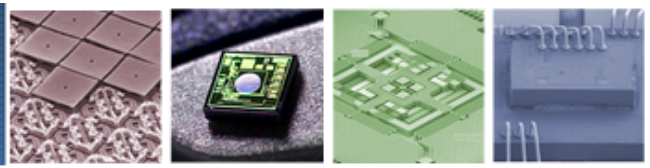
Two Economic Crashes in Less Than 10 Years

- Venture Capital has severely retrenched
  - Series A funding of "hardware" companies has plummeted
- Entrepreneurs have not gone away, but have also retrenched
  - MUCH *"scrappier"* attitudes
  - MUCH more dependence on government money
  - Much more use of angel investors
  - More early partnering with large companies
  - NRE and investments from large companies
  - More exploration of funding from/by other countries
- The funding Bar has even been raised for Angel investments
  - Ideally, should have experienced start-up team
  - Should have nearly completely developed products/protos/demos
  - Should have engagements with customers/collaborators
  - IP should be well underway
  - Typical ~$3.0M pre-money valuations; trying to raise ~$0.6-1.0M



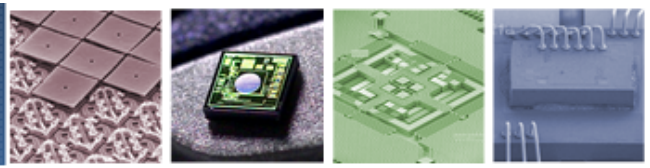
Unique US Advantages which are necessary for strong entrepreneurial success

- POWERFUL entrepreneurial culture and infrastructure
  - A business culture which ***EMBRACES*** risk
  - In much of the US, little fear of failure and little stigmatism for failure
  - In every Starbucks in Silicon Valley, start-ups are being discussed
  - Band of Angels alone sees 60 ***new*** start-up companies/month
- POWERFUL entrepreneurial collaborations and partnerships between industry, university, and government
  - ***MANY*** US professors and students have started companies
  - 5/6 of my start-ups have involved university professors and/or students
  - Largely, they understand how start-ups work and what the markets want
  - Major universities have start-up "contests" for the students
  - Major universities have progressive policies for licensing professor/student IP to start-ups
  - Major high-tech companies have venture investment groups
  - Most high-tech companies have offices in silicon valley to tap into new technologies and the entrepreneurial culture



Unique US Advantages which are necessary for strong entrepreneurial success

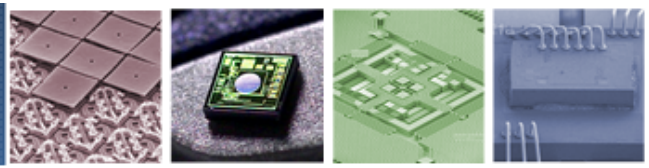
- INCREDIBLY effective funding of *research and innovation* by the US government (DARPA, NSF, NIH, DOE, etc)
  - DARPA has actively encouraged inventors, "let us be your angel financing"
  - Other agencies are trying to emulate super-successful DARPA
  - Government dollars are non-dilutive investments !!
- Sophisticated infrastructures in major US technology cities
  - Start-up incubators, angel investors, technology and business mentors, wafer fabs and foundries, legal, technology and business consultants, Venture Capital, human resources, etc, etc
  - More importantly, thousands of already successful entrepreneurs are enthusiastic to start, to lead, to mentor, to help, and to invest in new start-up companies
- Incredibly exciting entrepreneurial environment



MEMS - where do we go from here?

- Over the past 30 years, MEMS has grown at a faster rate than the semi industry, increasing from 1% to 3.5% of semi shipments
  - This increase in percentage will continue to grow
- Within only the last 3-4 years, many MEMS manufacturers have announced cumulative shipments of over 1B devices
  - Now these same manufacturers are shipping >1B/**year** !!
- **HUGE** new commercialization markets and opportunities for sensors and MEMS have only scratched the surface
  - *Ubiquitous* Wearables, Consumer, Mobile electronics
  - *Ubiquitous* Healthcare and medical
  - *Ubiquitous* Environmental monitoring

  } **IoE**
- The entrepreneurial environment in the US and elsewhere is experienced, dynamic, vibrant, incredibly intense, and growing
- Expect ***further*** innovation, ***further*** growth, and ***further*** successes for MEMS start-ups and for established MEMS companies



Thank You