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5G Wireless Research with NI technology

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5G Wireless | What is 5G?

- 5G, 5th generation mobile networks or 5th generation wireless systems, is a term used to describe the next generation of mobile communications technologies. The predicted availability is 2020.

- Currently still in the development phase, but we anticipate it to be. . .
  - More available bandwidth for consumers
  - Lower network latency
  - More network capacity

ni.com/5g/

Wireless Research – Some Perspective

Pope election 2005

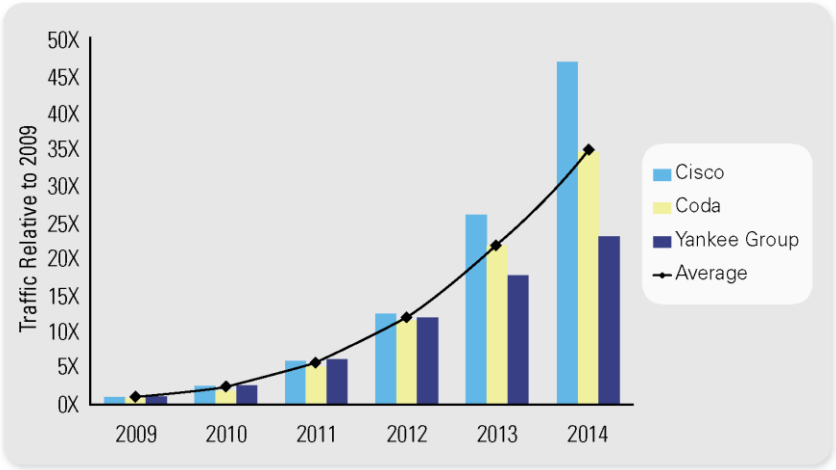
Pope election 2013

What a difference in just 8 years!

Wireless Bandwidth Explosion

Wireless investments escalating to address inevitable bandwidth crunch.

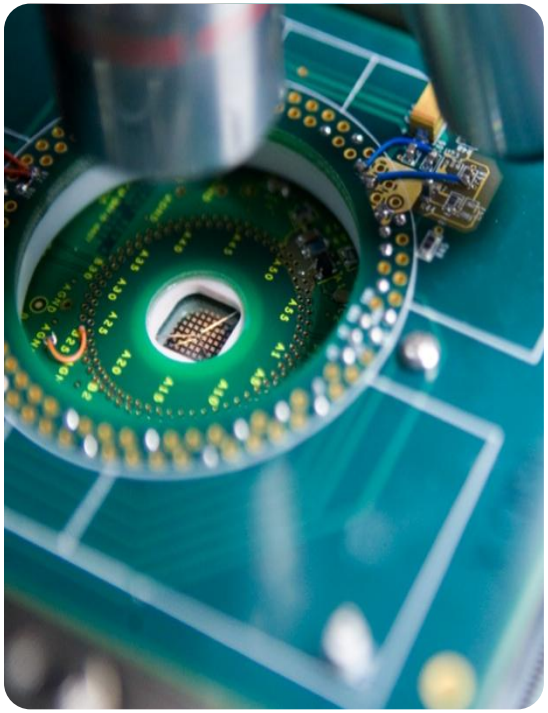
Industry Forecasts of Mobile Data Traffic

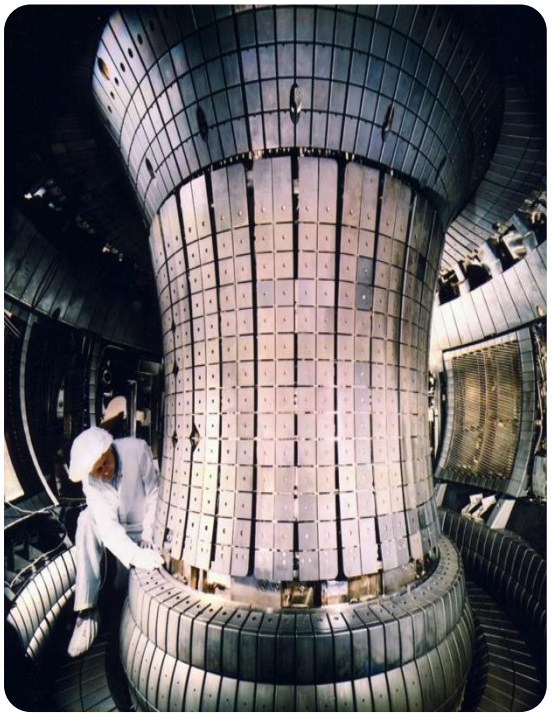


From Mobile Broadband: The Benefits of Additional Spectrum (FCC Report 10/2010)

NI's Mission

We equip engineers and scientists with tools that accelerate productivity, innovation, and discovery.





Graphical System Design

A platform-based approach for measurement and control.

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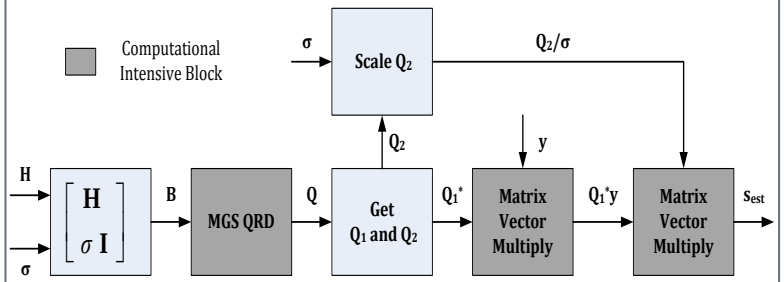
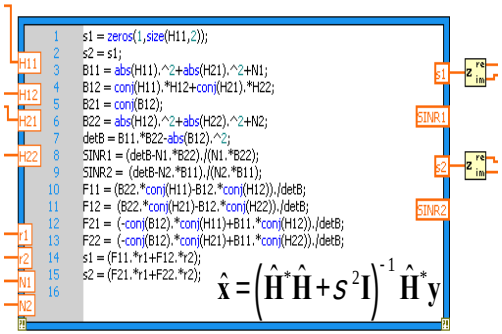
A New Approach to Communications System Design

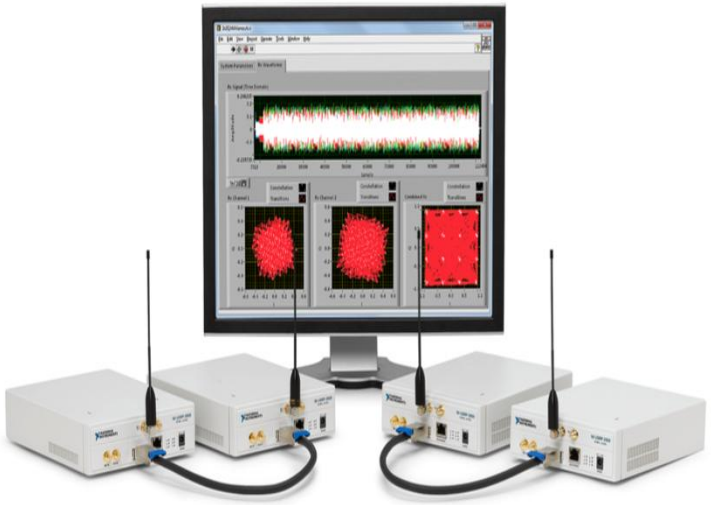
Conceptual Block Diagrams



Textual Math

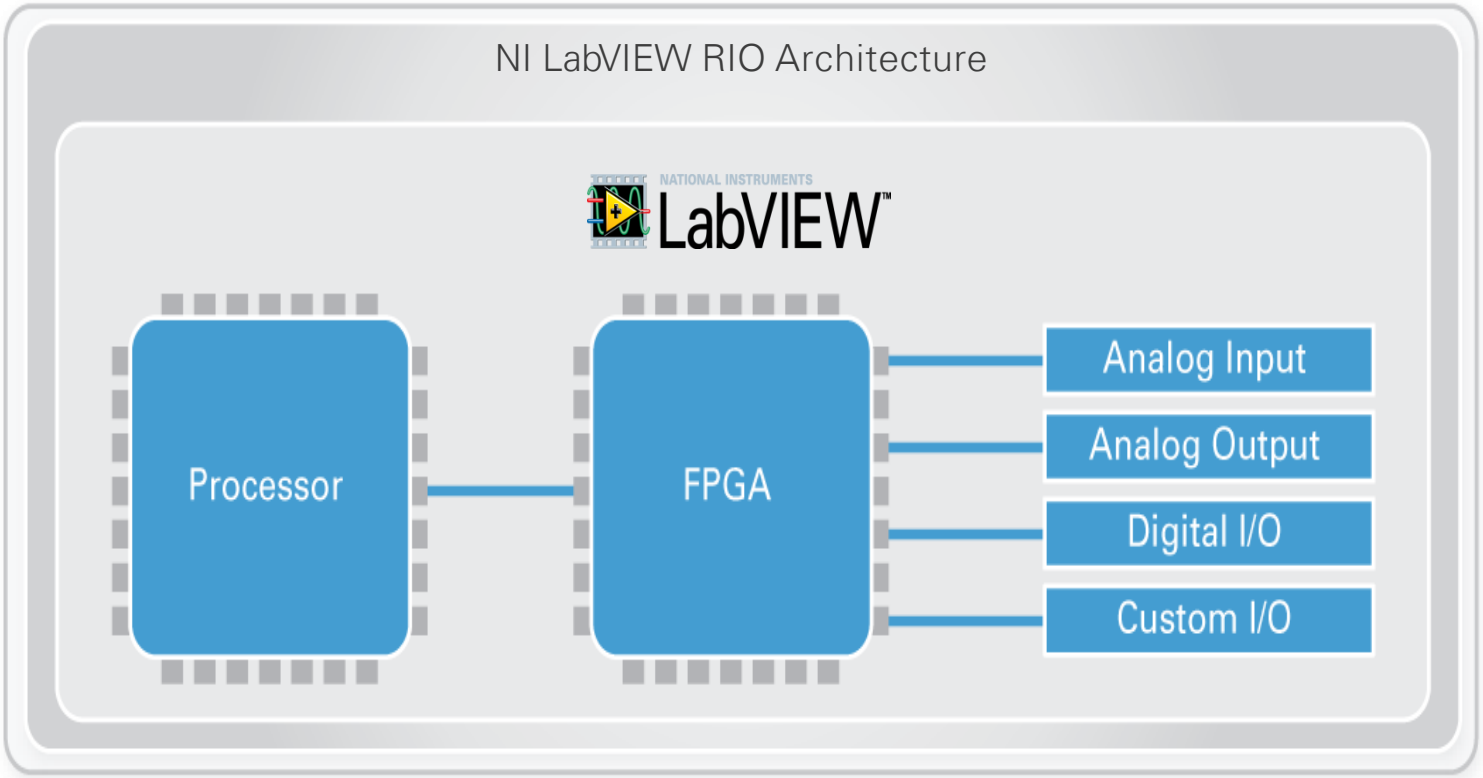


Graphical System Design

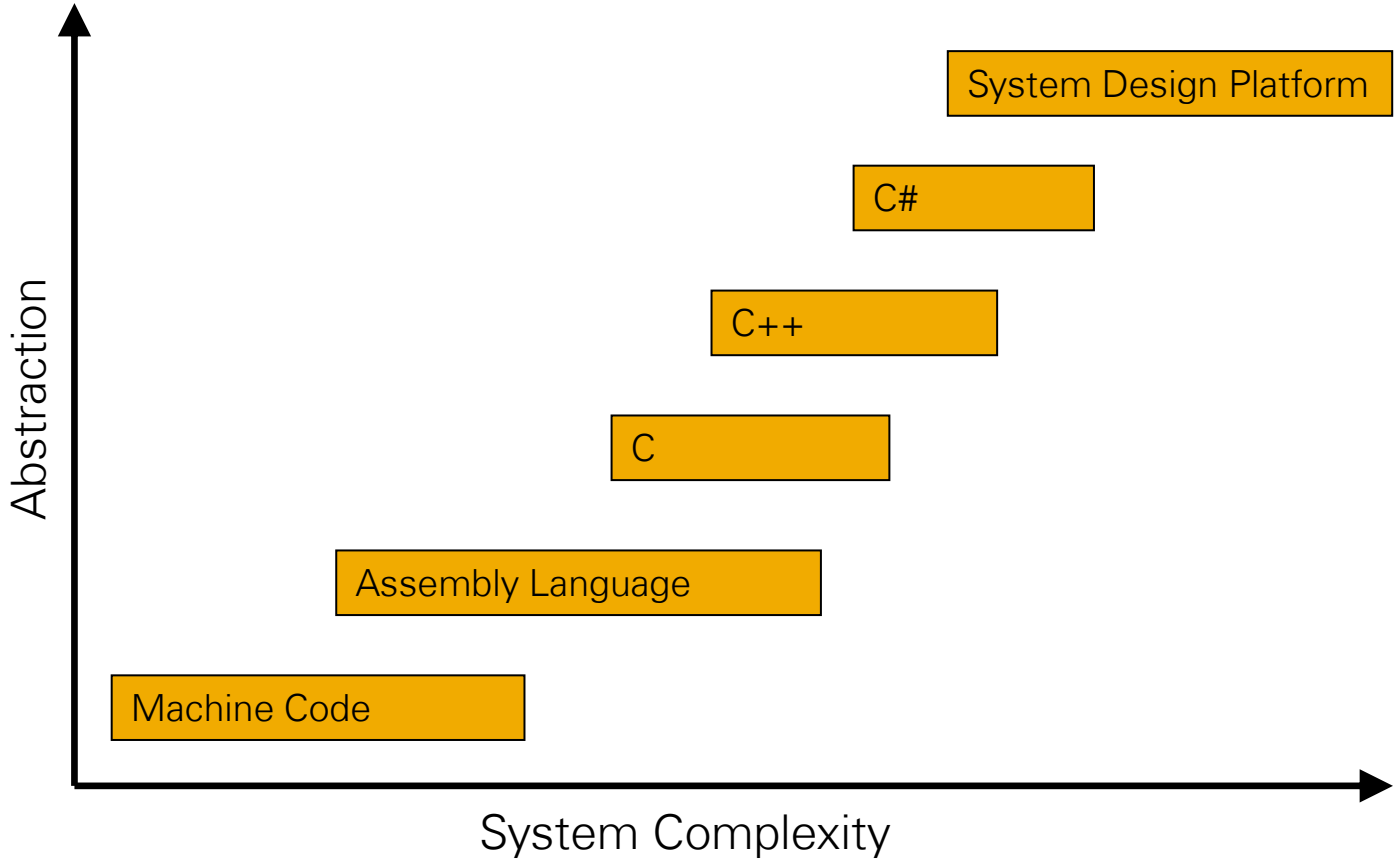


Algorithm implementations are tightly integrated with radio prototyping hardware.

Core Prototyping Architecture

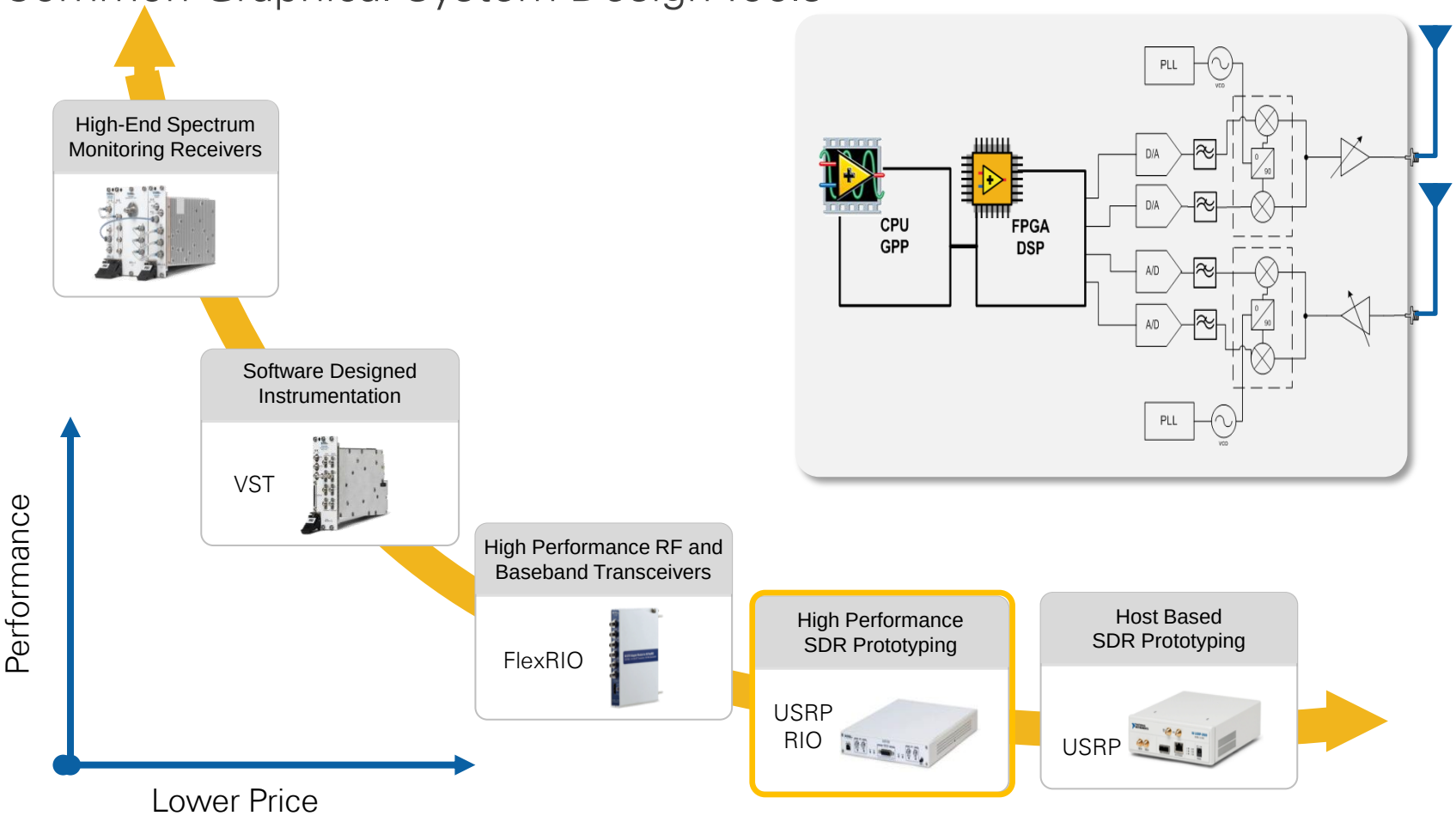


Scalable Software Abstraction



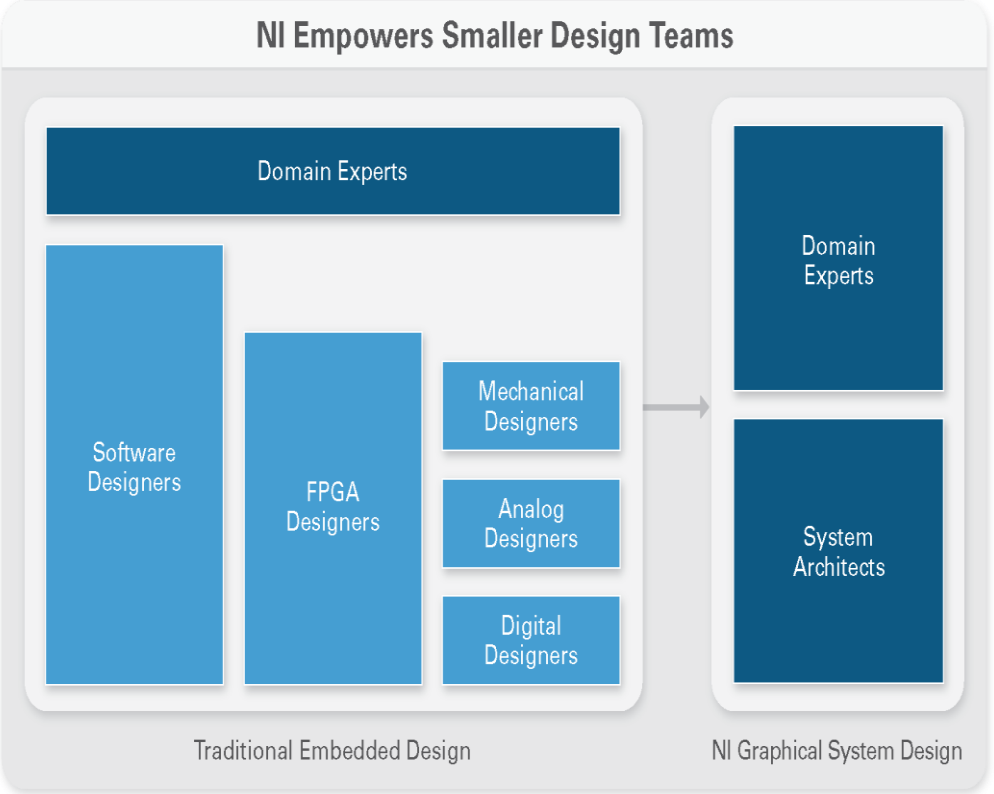
NI Software Defined Radio Platform

Common Graphical System Design Tools



Team Size and Skills

> “Engineers should therefore be equipped with the methods and tools required to develop models for managing this complexity”



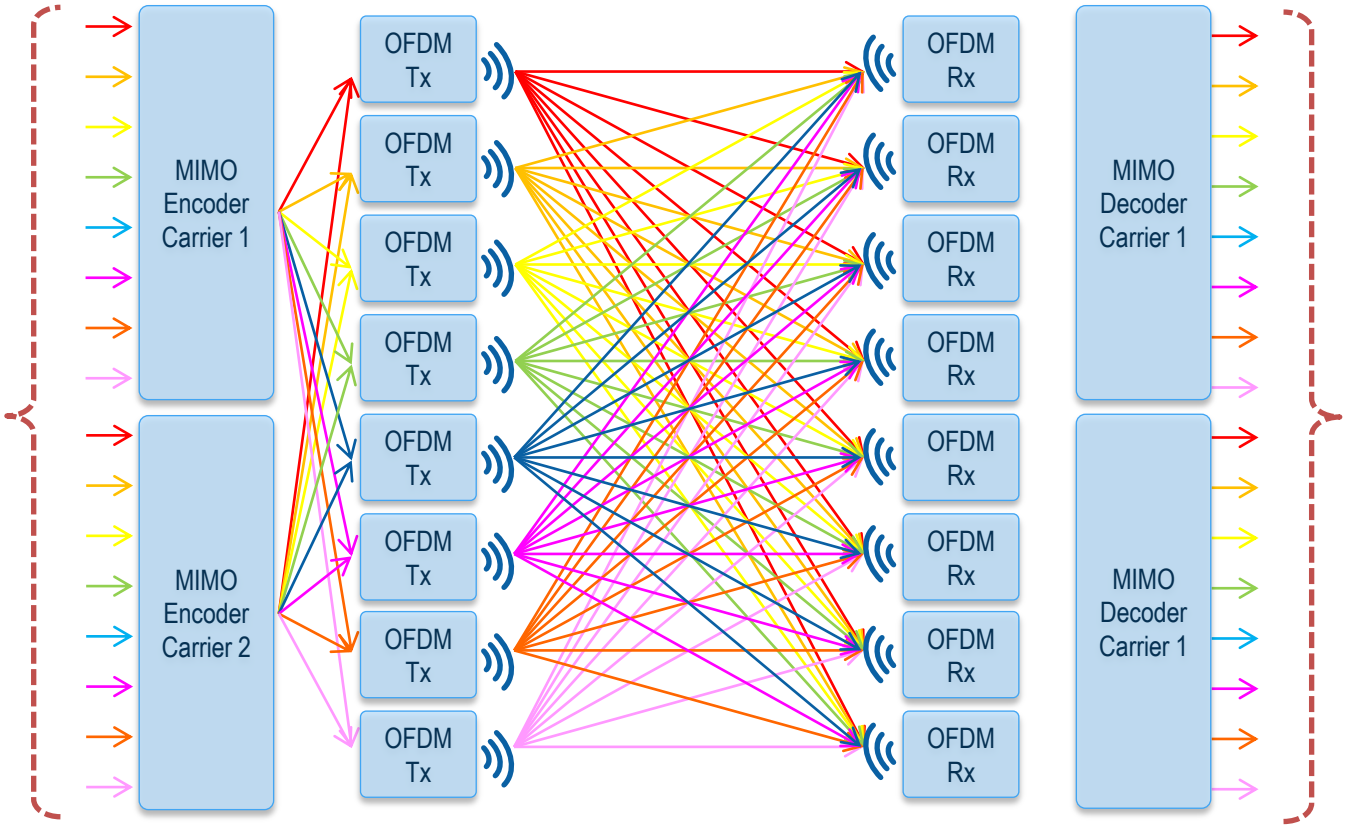
The Need to Prototype

"Experience shows that the real world often breaks some of the assumptions made in theoretical research, so **testbeds are an important tool for evaluation under very realistic operating conditions**"

"…development of **a testbed** that is able **to test radical ideas** in a complete, working system **is crucial**"[1]

[1]NSF Workshop on Future Wireless Communication Research, Nov 2009.

2011: World's First LTE-Advanced 8x8 MIMO Demonstration



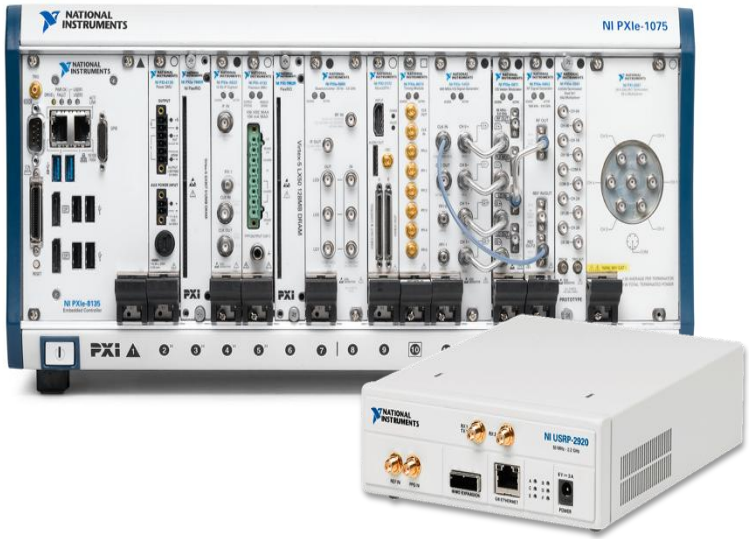
8x8 MIMO Wireless Channel

1 Gigabits per second!

(your current home Internet is probably at 7 Mbps)

Demonstrated at NIWeek 2011

NI and TU Dresden Collaborate on 5G Wireless



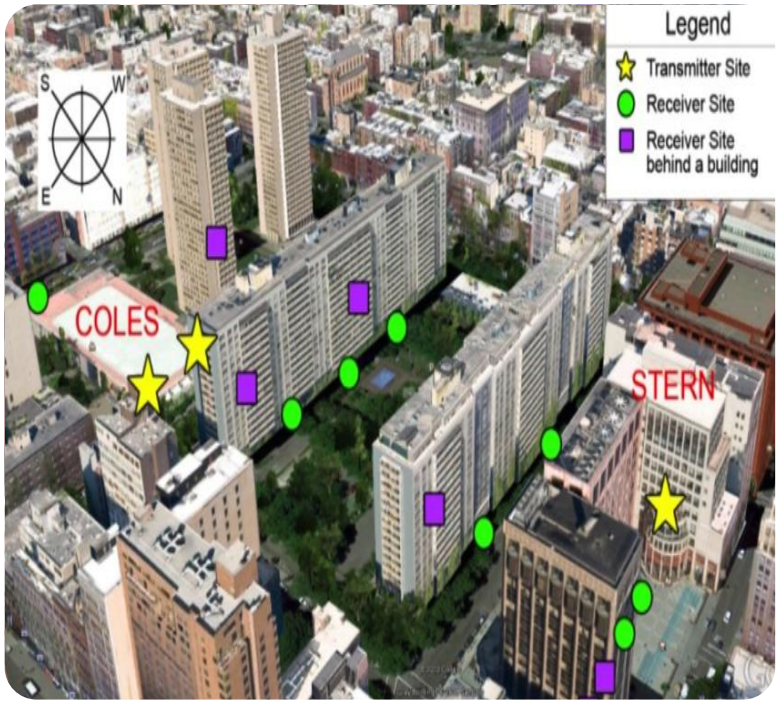
5G Lab and Testbed

5G PHY exploration and prototyping

Using LabVIEW system design software

Dr. Gerhard Fettweis

NI and NYU Poly Collaborate on 5G Wireless

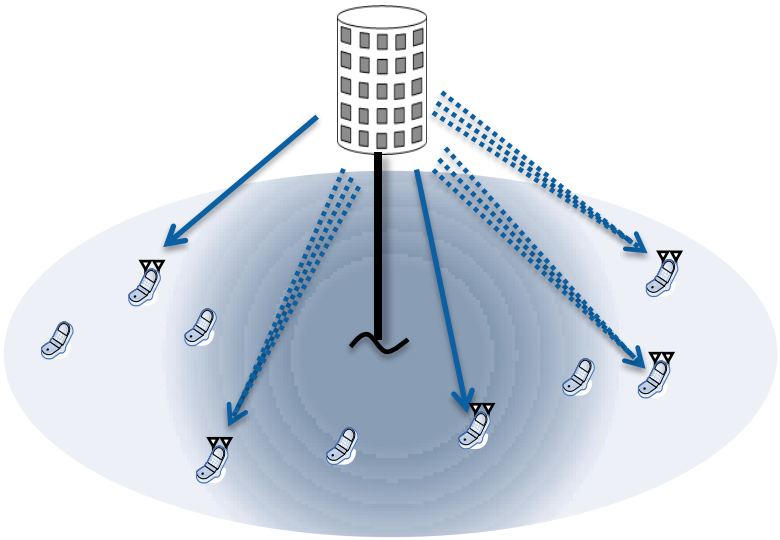


Channel sounding at 28, 38, and 72 GHz

Prototype system uses NI FlexRIO and NI LabVIEW

Prof Ted Rappaport

NI and Lund Collaborate on 5G Wireless



Prof Ove Edfors

Prof Fredrik Tufvesson

Goal: Build a massive MIMO prototype 100x100 antenna system with real time processing

Challenges:

System complexity

- 100 Tx chains
- 100 Rx paths

Data throughput for processing

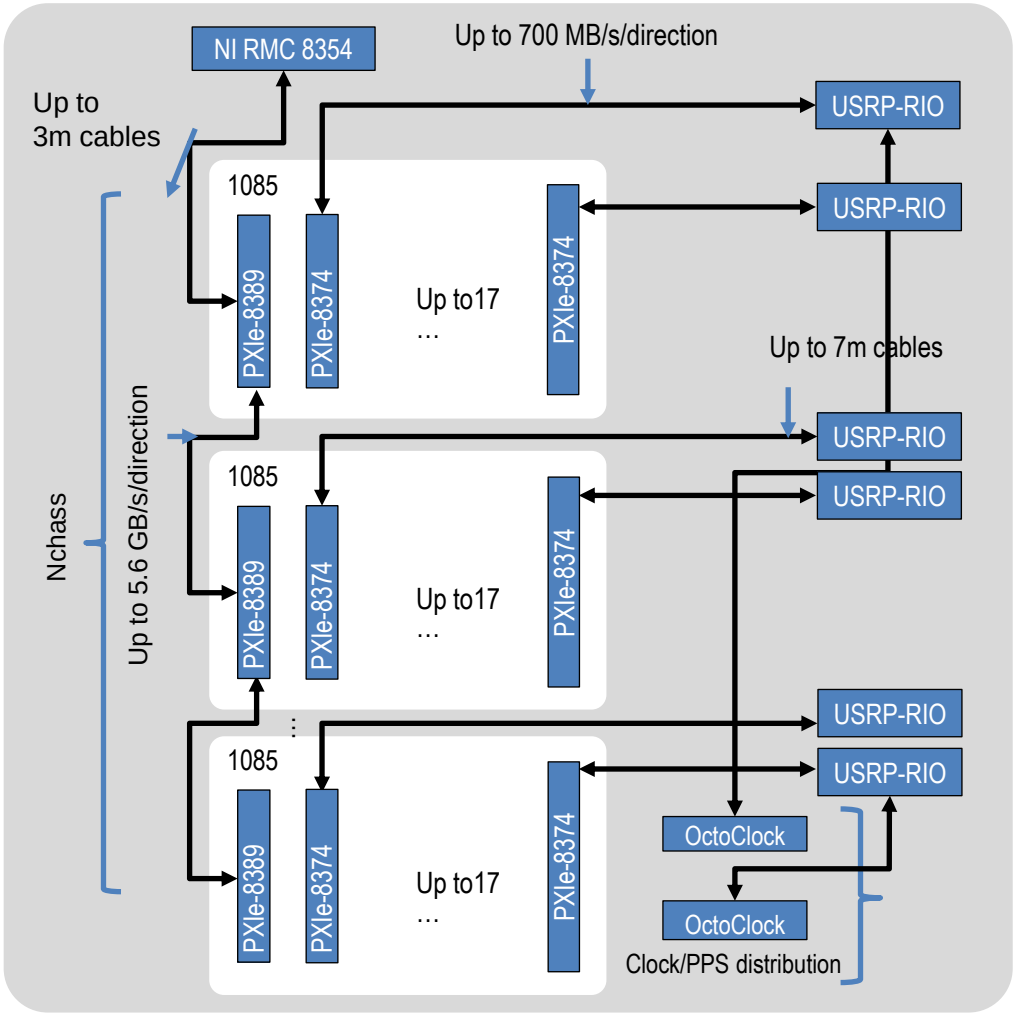
- Aggregation of multiple channels

Heterogeneous computation

Using abstraction and graphical system design

http://www.ni.com/newsroom/release/national-instruments-and-lund-university-announce-massive-mimo-collaboration/hu/

100-Antenna Massive MIMO Block Diagram

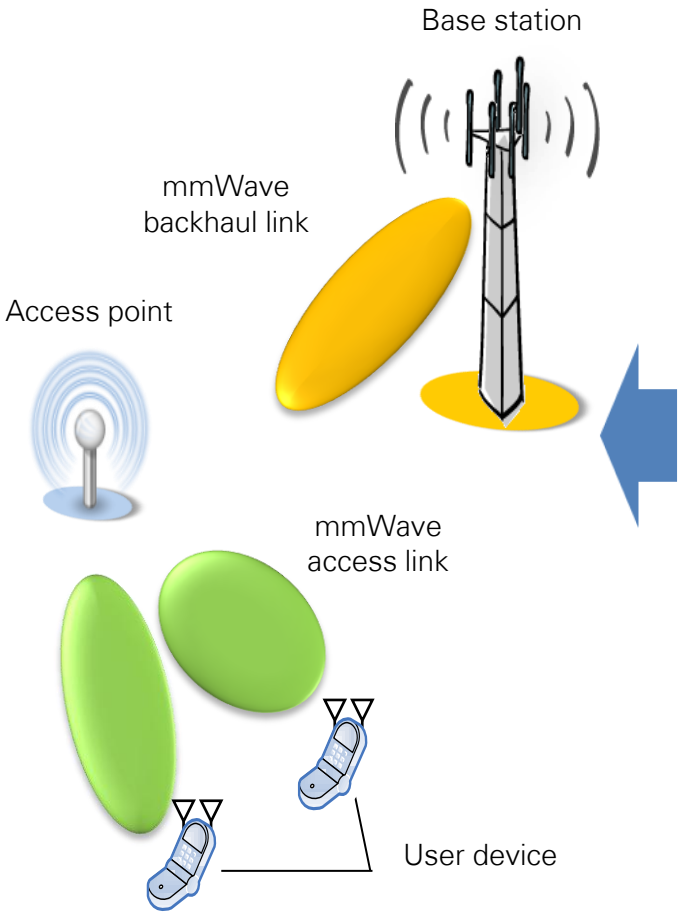


Massive MIMO

System Design Challenges

- Programming
- Synchronization
- Data aggregation
- Signal Processing
- Bandwidth

Baseband Prototype for mmWave Investigation



Digital baseband

Real-time PHY
> 1 GHz Bandwidth
"LTE-like"

Conclusion

Today's networks are evolving to become more heterogeneous

5G will employ a range of new technologies

- MmWave
- Massive MIMO
- Enhancements to physical layer

Engineers are using NI tools to design and test next generation communications systems

We equip engineers and scientists with tools that accelerate productivity, innovation, and discovery.

Thank You

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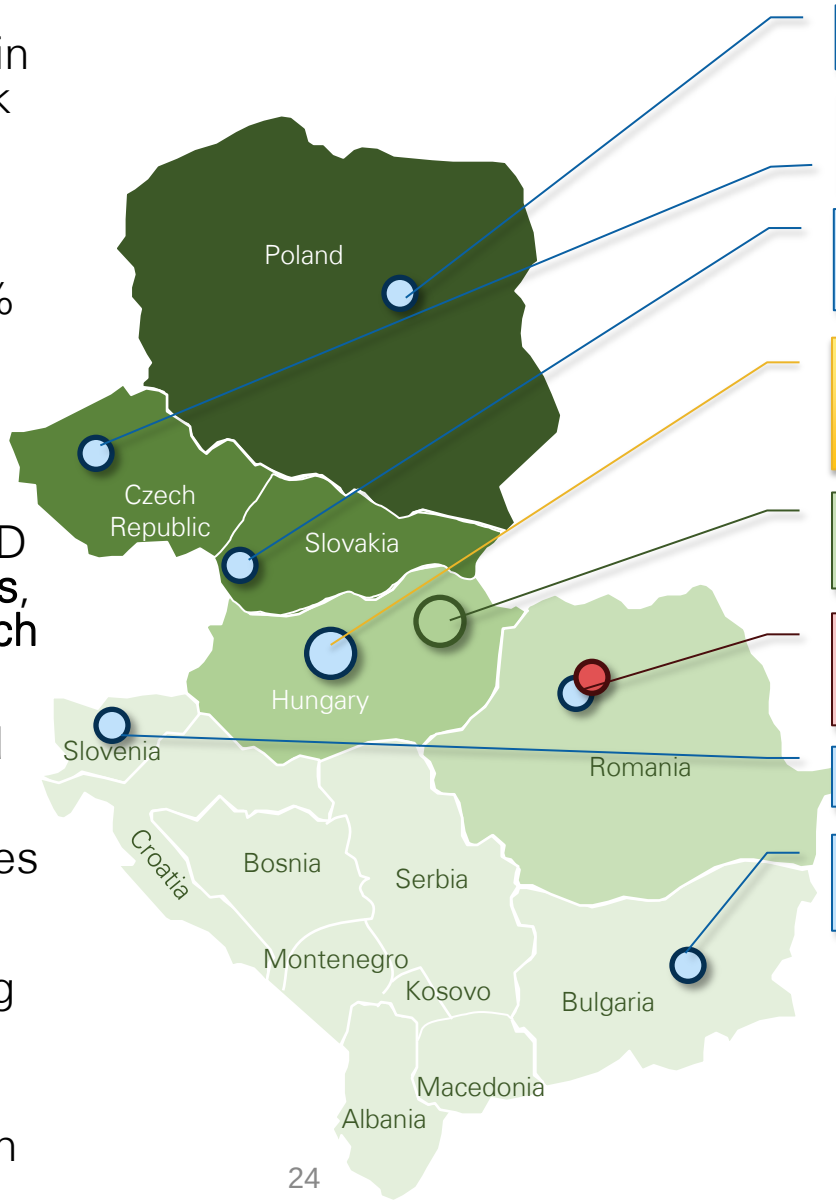
NI Representation in CEE

- 12 countries, 12 languages (in the region we currently work directly with 8 countries).
- Low but growing R&D investments (<1% of GDP), high in manufacturing (>20% of GDP)
- Top market segments: **Automotive** (vehicle assembly, electronics parts production, **Electronics** (R&D and manufacturing), **Fuel/Gas**, **Energy, Academia & Research**
- Legal sales entities in 6 countries: HU (regional head office), PL, CZ, SK, RO, SI.
- SEE/Balkans serviced by sales office in Slovenia (sales) and regional office in Budapest (technical support, marketing and operations)
- Including manufacturing and R&D, NI has >1300 people in CEE.



NI Poland (Warsaw)

NI Czech Republic (Prague)

NI Slovakia (Bratislava)

NI Hungary (Budapest) – EE Head Office

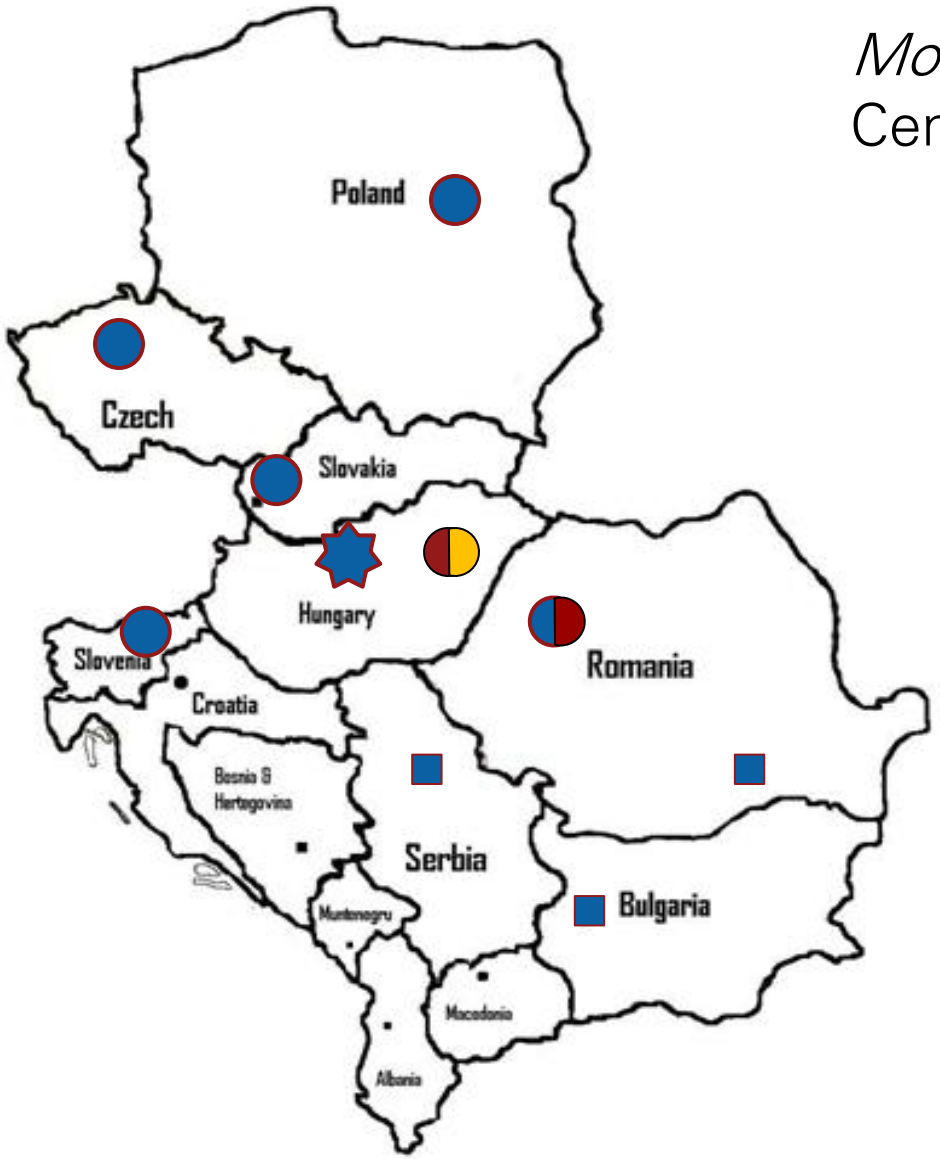
NI Manufacturing (Debrecen)

NI Romania – Sales, R&D (Cluj)

NI Slovenia (Celje)

Distributor Metrisys (Sofia)

Eastern European Region



More than **1300 employees** in Central Eastern Europe

- Regional Headquarters: Technical Sales and Support, Marketing, Operations and Systems Engineering
- Technical Sales Office
- Technical Sales Representatives
- Manufacturing and share services
- R&D

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Sales and Marketing Headquarter Budapest, Hungary

- 60+ colleagues
- Full scale Customer Support: Sales, Application Engineering, Systems Engineering, Marketing, Operations, Finance , IT, HR
- Almost 60% engineering ratio

http://hungary.ni.com/