

# Efficient Sensing of Complex Spectral Environments



Co-Simulation Between  
Agilent SystemVue and STK  
from AGI.

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# Efficient Virtual Simulation of a Communications Link in an Urban Environment



## Communications Link Analysis in an Urban Environment

### Potential Issues:

- Path Loss
- Multipath
- Interference
  - Unintentional
  - Intentional
  - Overload
- Moving Vehicles

### Our Goal:

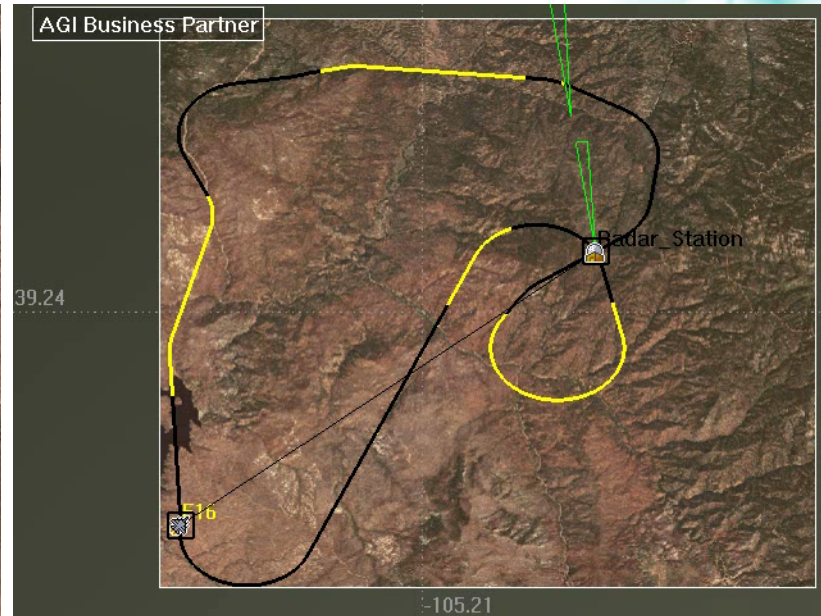
To model the communication environment quickly and inexpensively

# Efficient Simulation of Potential Radar & Communications Links in an Tactical Environment



## Potential Issues:

- Terrain Effects
- Jamming
- Complex Links
  - Ground Forces
  - Satellite
  - AWACS



## Potential Issues:

- Clutter
- Doppler
- 3D Radar Cross Section (RCS)
- Flight Dynamics

## Problem Statement:



How can we verify performance of these existing and next-generation RF Systems in scenarios where it would be grossly expensive, difficult or dangerous to collect the data?

For example, running a convoy of first-responder vehicles through every street in a urban environment to insure reliable communications would be both disruptive and expensive.

Likewise, insuring ahead of time, that reliable communications can be maintained for a strike-team in remote parts of Afghanistan is critical to their success and safety.





# Possible Solution: Combine the Capabilities of Two World Class Simulation Tools

There is no “one-tool” solution that completely solves the problem of verifying communications integrity that includes both the physical environment and hardware.

In order to be able to model the physical environment a world-class EDA tool, STK from AGI is proposed.



To model the physical radio hardware, SystemVue from Agilent Technologies will be proposed.



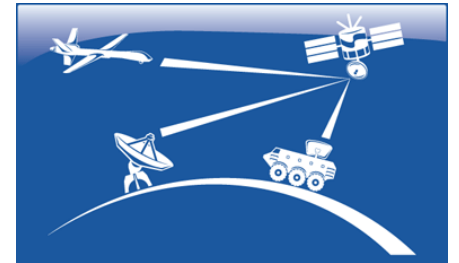
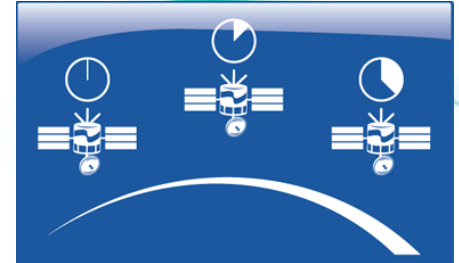
By connecting these two tools together a best-in-class solution can be achieved to quickly and efficiently model and verify system performance and give confidence of success.

# AGI STK Overview



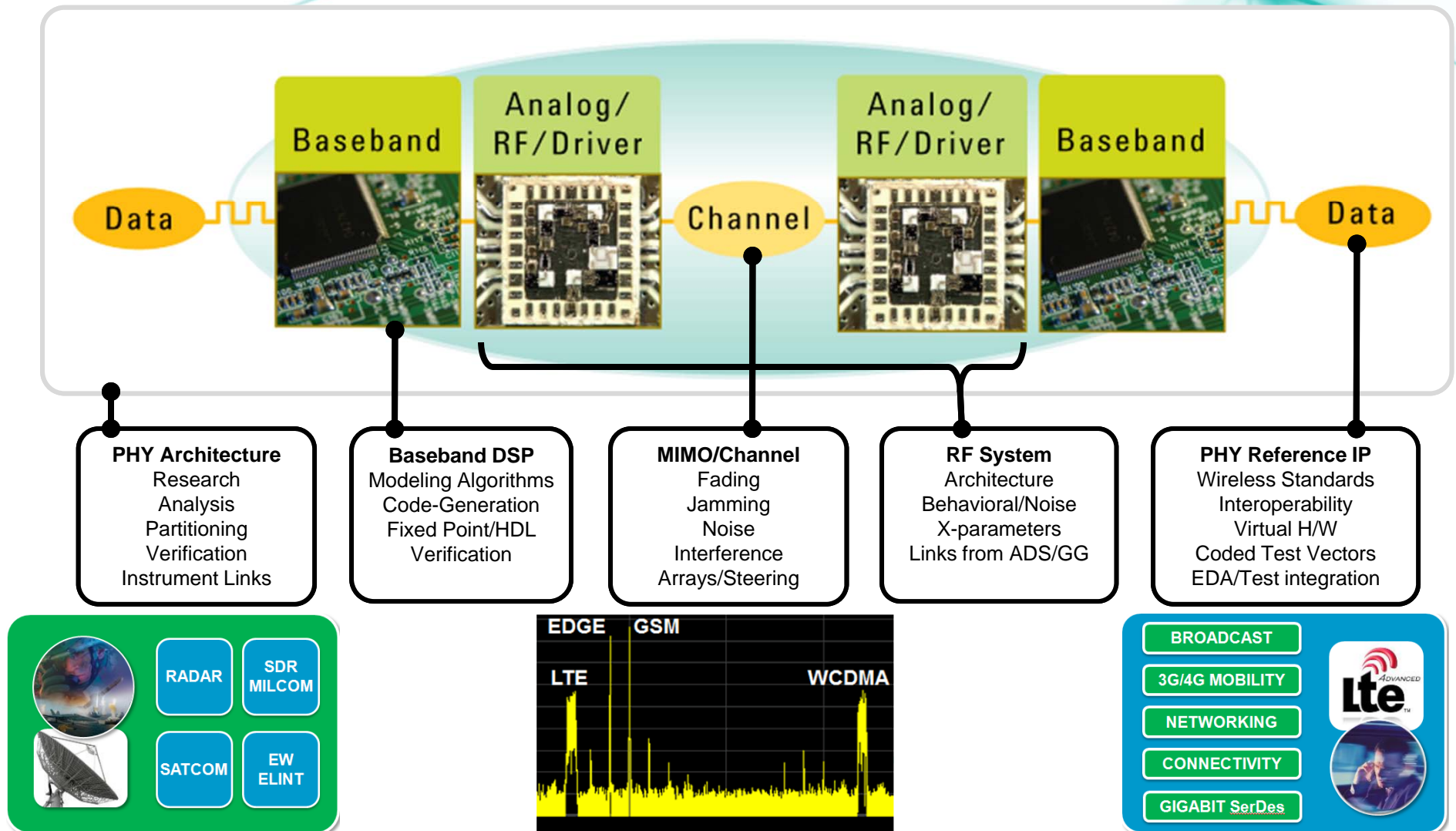
•The Analytical Graphics Inc. (AGI) STK® product is a physics-based software geometry engine that accurately displays and analyzes land, sea, air, and space assets in real or simulated time.

- Users can model the time-dynamic position and orientation of vehicles.
- Given these dynamic positions and orientations, users can model the characteristics and pointing of sensor, communications, and other payloads aboard the asset. STK can then determine spatial relationships (e.g. line of sight) between an asset of interest and all of the objects under consideration.
- These relationships can also be modeled across multi-hop links or over regions of interest.
- STK can assess the quality of these relationships through a wide array of constraining conditions (e.g. payload capability, unique user algorithms, etc.) while also incorporating environmental effects such as terrain, lighting and weather conditions on sensor visibility or communication link quality.



# SystemVue within Communications EDA

*Focused on improving system-level design for Defense & Communications*



Anticipate —Accelerate —Achieve



Agilent Technologies

Wireless Innovation Forum  
1/9/2013

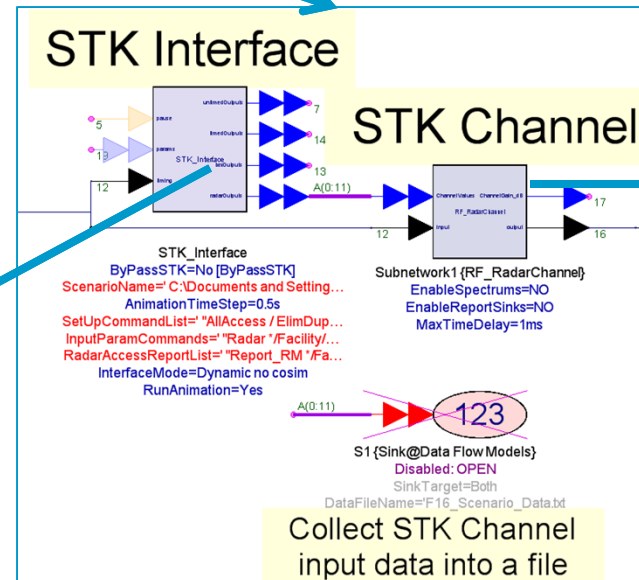
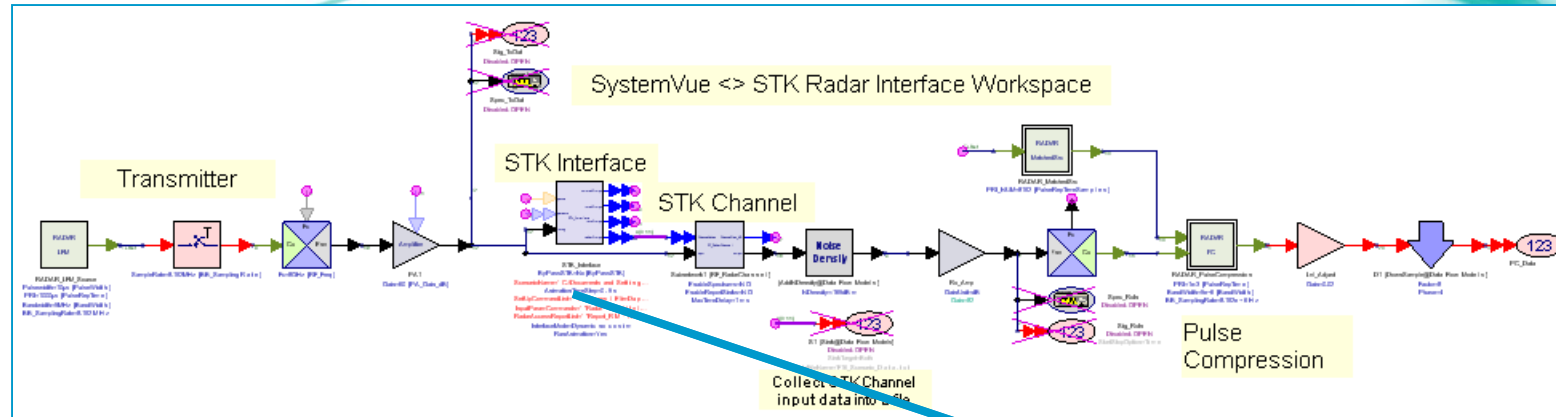
# Why STK and SystemVue?



- The basic STK process is to define a radar/comm system link scenario with moving TX, RX and interferer objects, analyze the scenario to obtain system metrics as a function of time (such as range, propagation loss, RCS, noise bandwidth, RX signal strength, Probability of Detection, CFAR, Doppler, BER, Throughput, etc).
- Almost everything in STK and SystemVue can be controlled by 3<sup>rd</sup> party tools.
- STK does not have any inherent capability for processing radar/comm signals, SystemVue does not model terrain or aircraft flight dynamics.
- SystemVue enables system architects and algorithm developers to innovate the physical layer (PHY) of wireless and aerospace/defense radar and communications systems and provides unique value to RF, DSP, and FPGA/ASIC implementers.
- By linking STK with SystemVue, arbitrary TX/RX radar/comm systems can be modeled with STK dynamic environment link characteristics.



# SystemVue & STK Interface – Radar Example



# What does this Link Allow Me to do?

- Allows the testing of multiple radar scenarios with your existing, or proposed, system quickly and repeatedly.
- Allows for the incorporation of measured data, for example from a new threat.
- Allows for the incorporation of multiple dynamic emitters and targets into the scenario.
- Allows for dynamic operation, such as incorporating various types of jamming based upon a defined set of criteria.
- Allows for the modeling and evaluation of cross domain effects, such as AGC operation.
- Unintended interference effects from commercial wireless communications networks can be incorporated into the simulation.
- By linking STK with SystemVue many realistic flight testing scenarios can be evaluated before or in place of physical flight testing, saving time and money.



# Conclusion

- Extensive field measurement and flight testing using aircraft and vehicles is prohibitively expensive, especially in these tight financial times and where is a need to perform them.
- By comparing physical testing and virtual testing results, continuous verification and validation of results can be improved.
- No two flight of field measurement tests can produce identical conditions. Simulation allows for repeated runs with the same or alternative environmental or radar/comms system conditions.
- Virtual flight testing allows for the evaluation of new interference/jamming techniques or new threats.
- Radar systems can be evaluated to see their effects on commercial wireless communication systems and vice-versa.





***Thank You!***



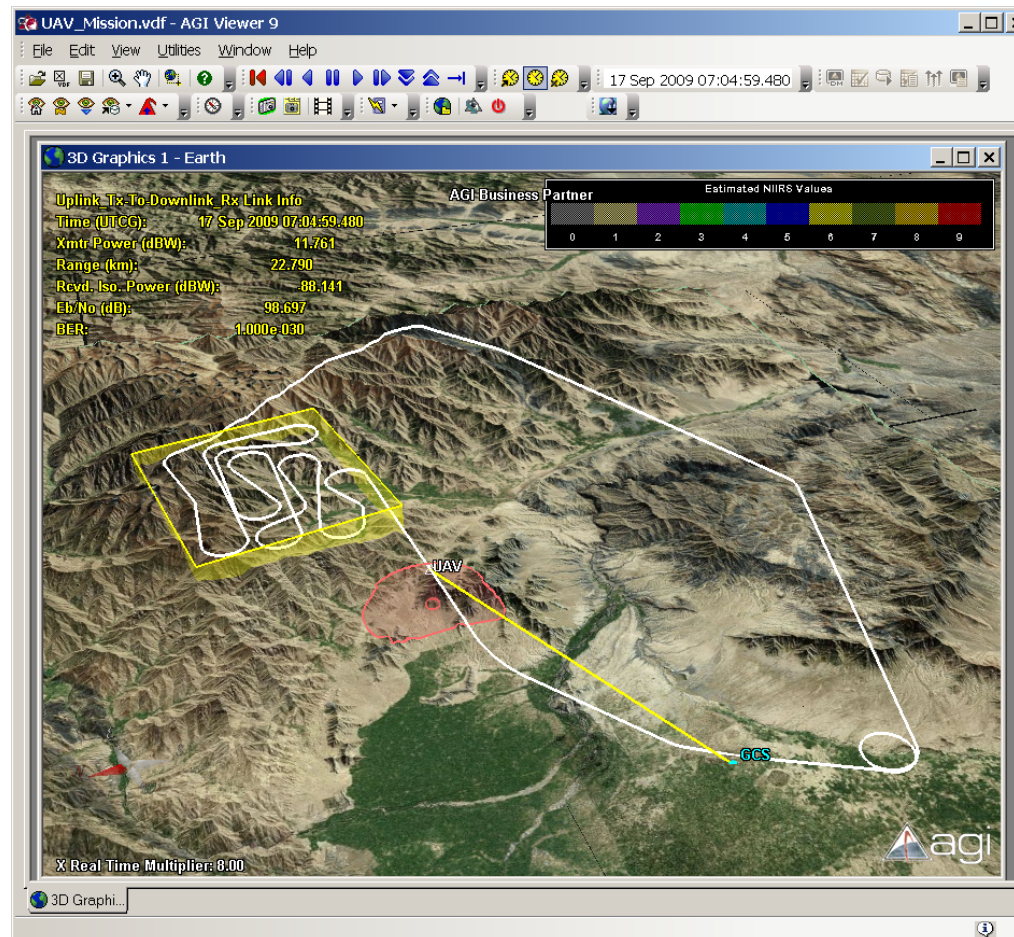


# STK Viewer Demo

## Available Free from [www.agi.com](http://www.agi.com)



<http://www.agi.com/products/stk/modules/default.aspx/id/stk-viewer>



# References & Resources

Product Web sites:

SystemVue <http://www.agilent.com/find/systemvue>

AGI STK <http://www.agi.com/products/by-product-type/applications/stk/>

Whitepapers and application notes:

**Radar System Performance Analysis under Dynamic Jamming**

[http://www.agi.com/downloads/events/2006-agi-user-exchange/12\\_Radar\\_Jamming\\_Rashid2.pdf](http://www.agi.com/downloads/events/2006-agi-user-exchange/12_Radar_Jamming_Rashid2.pdf)

***Uncovering the Hidden Impairments in Advanced RADAR Systems***

[http://wdv.com/Electronics/Reference/pdfs/agilent\\_apr1410.pdf](http://wdv.com/Electronics/Reference/pdfs/agilent_apr1410.pdf)

