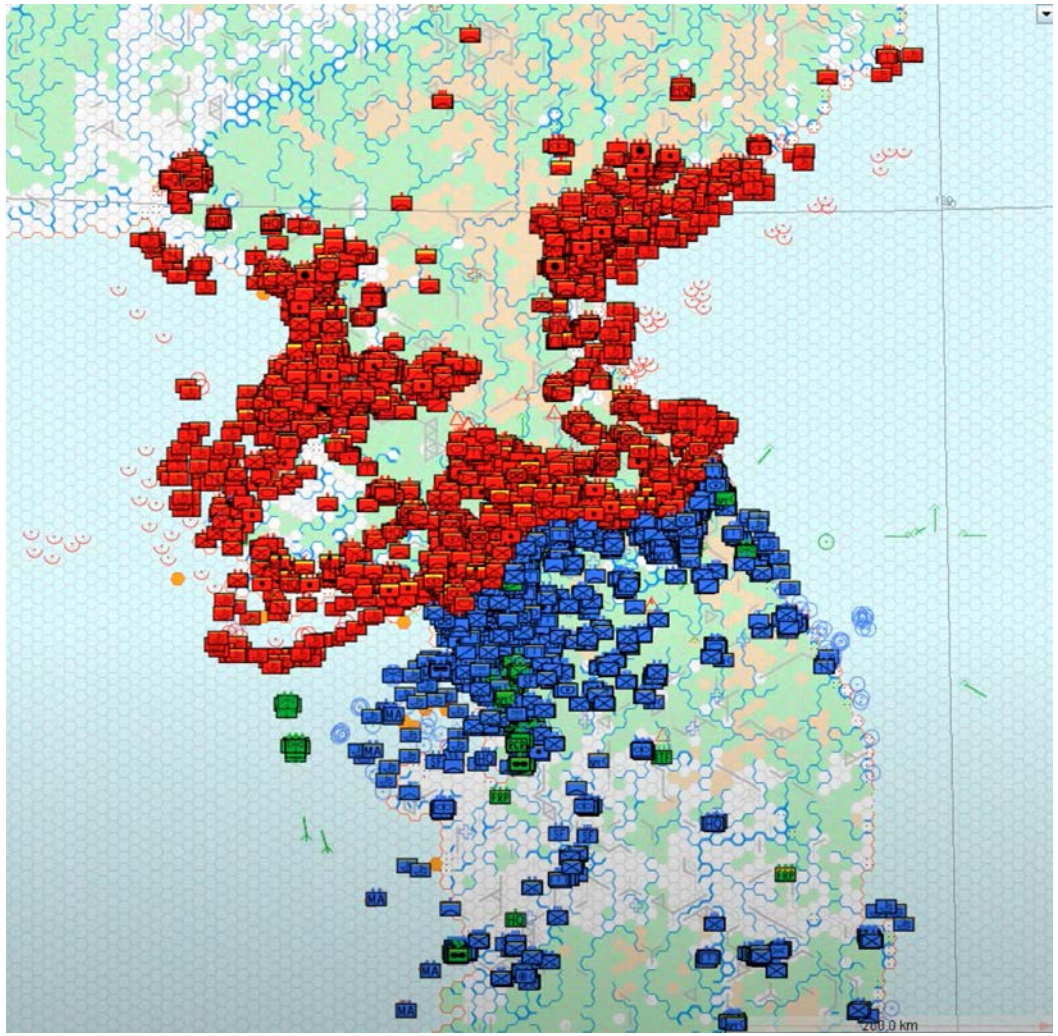
Leveraging Digital Era Technologies for a New Synthetic Environment – A Panacea?

Nick Giannias
Senior Technical Fellow

Dramatic advances in digital era technologies hold the promise of improved synthetic environments

Synthetic environments at the extremes

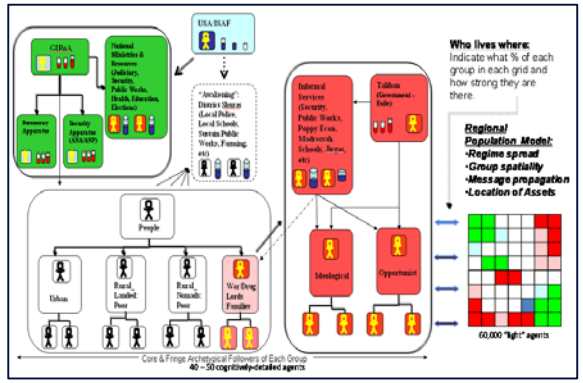


The vision of a new synthetic environment

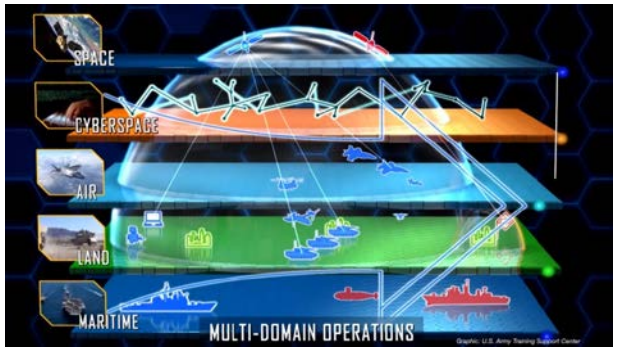
AI assistance/operation

Next generation weapons

Human behaviour models



Multi-domain operations



Ecosystems & metaverse

Benefits of game engines for visualization

Capability/Feature of Game Engines	Value to Training/Digital Immersion
Lighting model	Improved material, contrast, and object perception compared to legacy IG's. Physics-based rendering (PBR)
Shadowing	Depth and height perception
Robust code base, extensively tested	High reliability and fewer deficiencies
Ray tracing / Global illumination	More realistic reflections and scene immersion
Highly optimized rendering pipeline	Higher scene density, higher mesh and texture Level of Detail (LODs)
Triple-A game rendering techniques	Increased scene realism; Access to future engine features
Marketplace of assets and plugins	Faster prototyping of new features and effects
Extensive Digital Content Creation (DCC) tools	Rapid development of special effects by artists
Integration of commercial DCC tools	Rapid 3D model content creation, lower artist training costs
Access to advanced graphics debugging tools	Quick turn around on low-level performance and stability issues
Comprehensive visual scripting language	Faster model animation and control by artists
On-going gaming engine evolution exploiting new GPU capabilities	Shorter delivery of new GPU rendering or performance enhancements to training

Game engine modifications to support the synthetic environment use case

Worldwide scale

- Newly introduced 64 bit precision and world partition system make this possible
- Modified with a custom tiling and paging system

Improved anti-aliasing

- Simulators with large displays and critical small objects in the distance break game engine assumptions
- Use of forward rendering precludes many advanced engine features
- A hybrid approach was developed

Performance and determinism

- Swap chain and garbage collection impact performance

Sensors

- Physics based sensor simulations now available as plugins to game engine

Environmental effects

- Synchronized weather, 3D ocean wave models

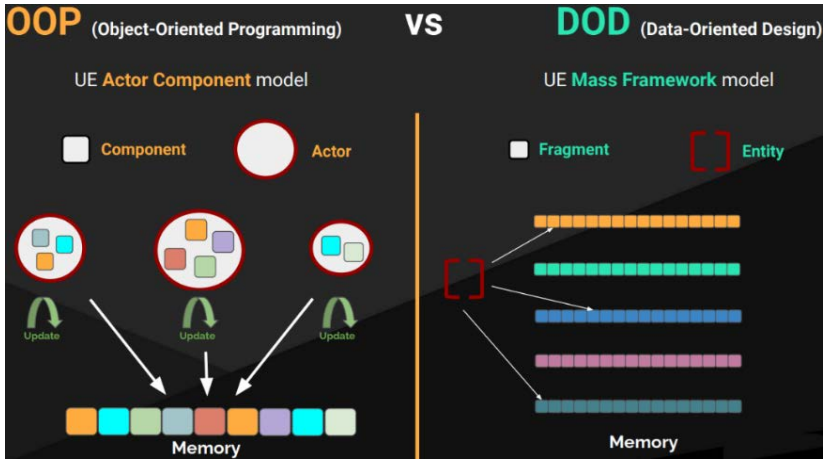
CAE

Cloud computing and scalability platforms

Cloud computing provides easy access to vast amounts of computing resources

However:

- Most simulations currently in use not designed for scalability through parallelization
- Object oriented programming handles complexity well but not scalability



Our Approach

- Limited refactoring of existing simulations to support a data first approach (what's old is new again)
- Rely on scalability platforms to scale across many computers in the cloud
- Spatially partition the simulation ("divide and conquer")

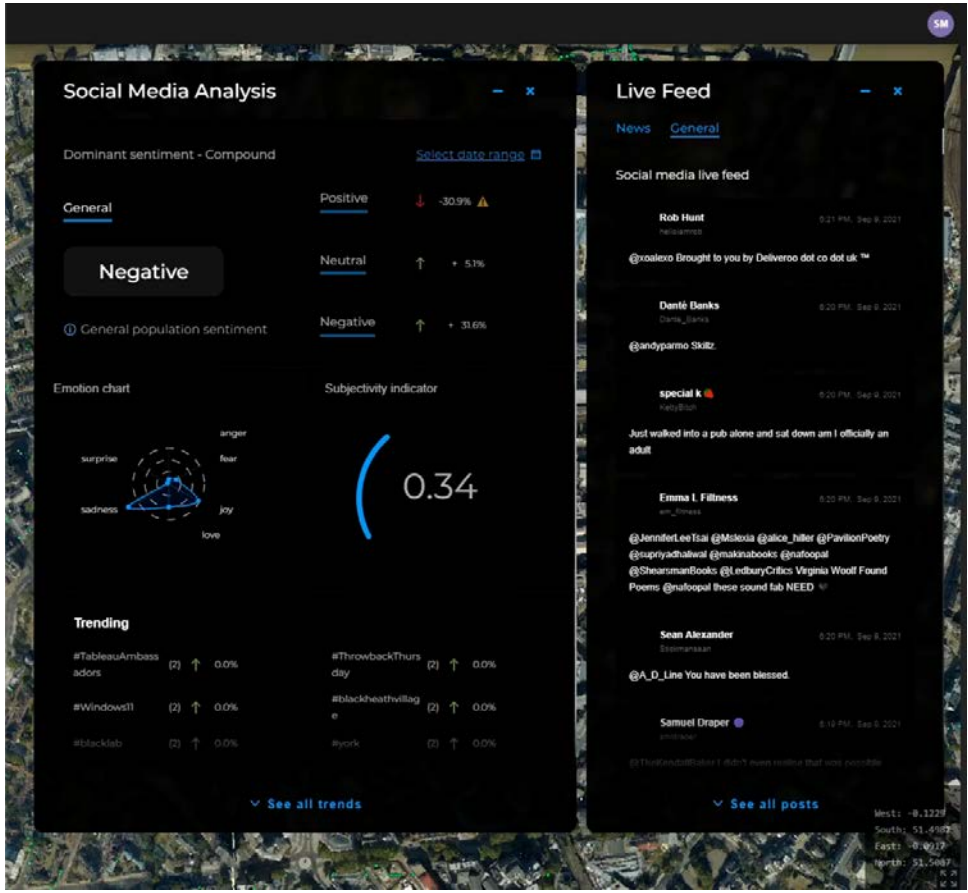
Artificial intelligence and human behaviour

Social and Information aspects of PMESII have been traditionally underrepresented in the synthetic environment

Social media and AI can be combined to provide a richer environment especially in interactions with other elements such as military and infrastructure

Social media was analyzed and even synthesized via AI

Human behaviour was both observed and triggered by social media



Summary

Digital era capabilities have the potential to unify previously bespoke SE’s

Use of a gaming engine, UE5, for real-time visualization is possible, with appropriate enhancements and modifications

The data-oriented framework of UE5 provides enhanced scalability

Further scalability across large scale cloud deployments can be achieved with the use of scalability frameworks

The use of AI has the ability to open up new avenues in synthetic environment representation such as social media analysis and synthesis