Delivering Next Generation Simulation Today
Convergence Through Cloud Technologies

Agenda

- Gaming Market Scale

- The Pace of Technology

- Modularity

- Emerging Requirements for Next-Gen, Cloud-Enabled Simulation

- Whole Earth Game Engines
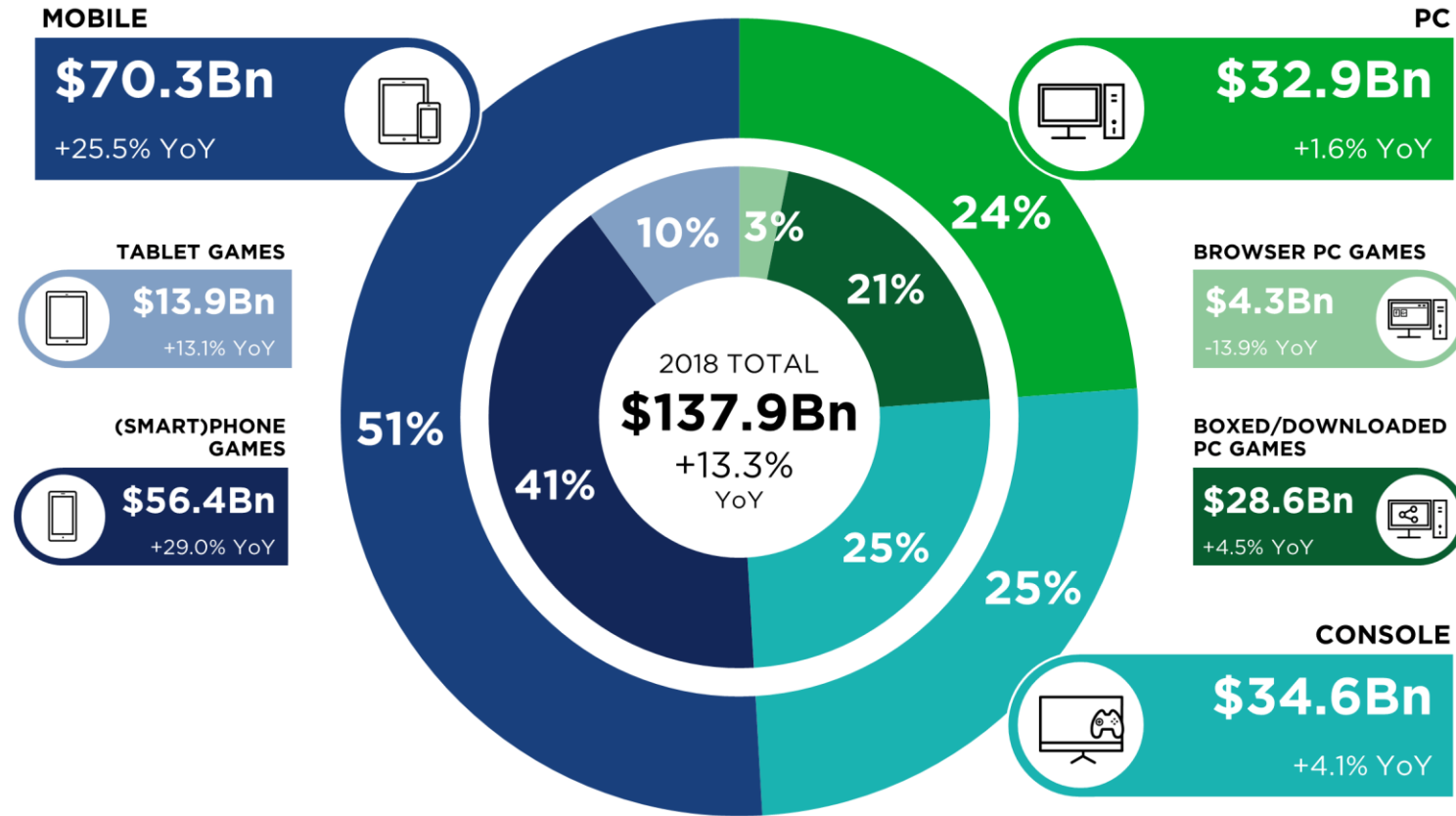
- The Cloud

- Challenges

- Summary & Questions

2018 GLOBAL GAMES MARKET

PER DEVICE & SEGMENT WITH YEAR-ON-YEAR GROWTH RATES

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MOBILE

$70.3Bn
+25.5% YoY

TABLET GAMES
$13.9Bn
+13.1% YoY

(SMART)PHONE GAMES
$56.4Bn
+29.0% YoY

PC

$32.9Bn
+1.6% YoY

BROWSER PC GAMES
$4.3Bn
-13.9% YoY

BOXED/DOWNLOADED PC GAMES
$28.6Bn
+4.5% YoY

CONSOLE

$34.6Bn
+4.1% YoY

2018 TOTAL
$137.9Bn
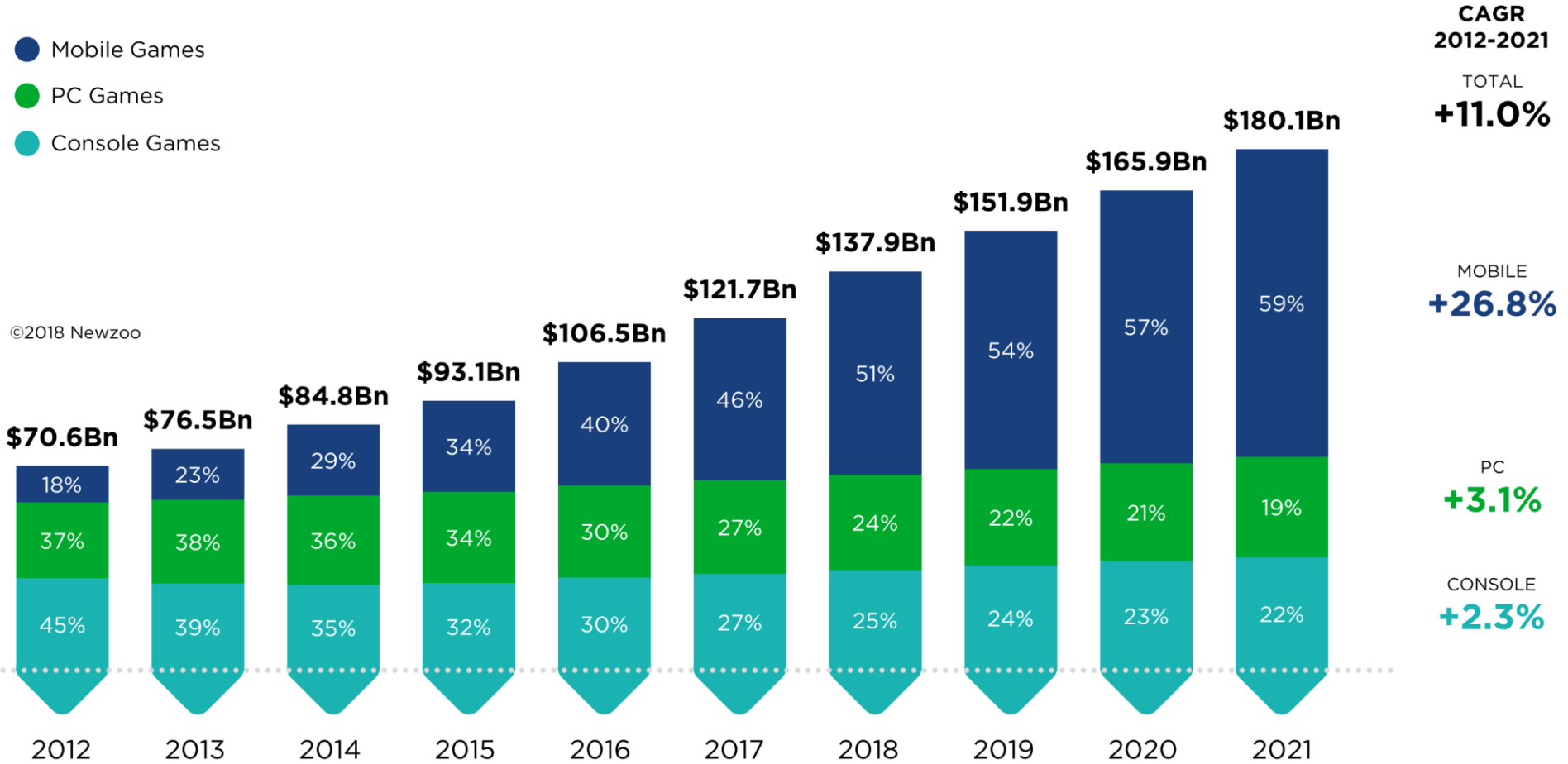+13.3% YoY

10%   3%
24%
51%   21%
41%
25%
25%

2012-2021 GLOBAL GAMES MARKET

REVENUES PER SEGMENT 2012-2021 WITH COMPOUND ANNUAL GROWTH RATES

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Legend:
- Mobile Games
- PC Games
- Console Games

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CAGR 2012-2021

TOTAL
+11.0%

MOBILE
+26.8%

PC
+3.1%

CONSOLE
+2.3%

Year	Total	Mobile	PC	Console
2012	$70.6Bn	18%	37%	45%
2013	$76.5Bn	23%	38%	39%
2014	$84.8Bn	29%	36%	35%
2015	$93.1Bn	34%	34%	32%
2016	$106.5Bn	40%	30%	30%
2017	$121.7Bn	46%	27%	27%
2018	$137.9Bn	51%	24%	25%
2019	$151.9Bn	54%	22%	24%
2020	$165.9Bn	57%	21%	23%
2021	$180.1Bn	59%	19%	22%

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Why Games?

- The levels of investment in gaming and the speed of development required to consistently release has increased levels of modularity.

- Games increasingly are expected to support user modification and development to increase longevity, this further increases the drive to modularity.

- The modular nature of game technology can help "future proof" future simulation deployments, **reducing the cost of implementing best-of-breed technology in the future.**

- Ultimately, component-based upgrades should be possible – even replacing the core "game engine".

Example: Gears

- **Implementing modular game technology and broader (non-defense) industry standards will allow military organizations to more easily leverage the latest and greatest, and stimulate innovation.**

- Interoperability at individual application level can be achieved through **Gears**, a software development framework that defines a standard way for components to communicate through formal interfaces.

- Gears simply uses tools and approaches common to modern web development, where all software easily connect with each other by connecting DLLs (Dynamic Linked Libraries).
  - Modular software design has been around for many years. Dynamic Linked Libraries (.dll files) are a common part of any Windows-based software application.
  - A dynamic linked library is compiled source code that provides some function or capability, which connects to an application via an API.
  - *Gears is simply a way to more easily connect many dynamic linked libraries, to increase programming effectiveness and efficiency.*
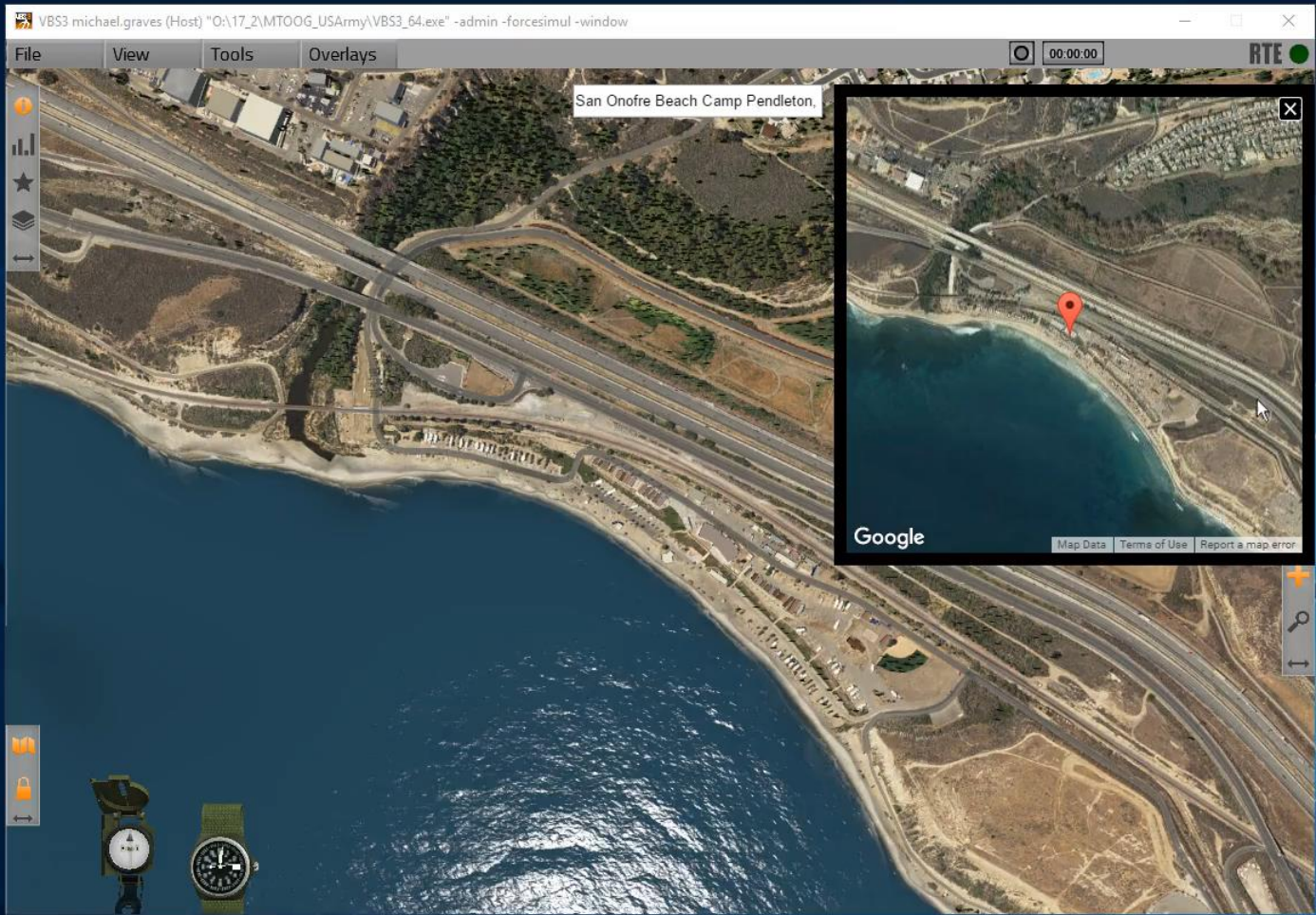
GEARS STUDIO

Simplify and Standardize Your Software Development Process

Download
Gears Studio Community Edition

What is Gears?

Gears is a software development framework that defines a standard way for components to communicate through formal interfaces.

Gears uses a component-based architecture to promote rapid development by building applications from self-contained systems and having them communicate via formally defined interfaces. This allows functionality to be reused and avoids the complexity of tightly coupled systems.

Gears Studio Overview

Gears Studio is a development environment to facilitate the development of products, components, and APIs within a framework intended to avoid common pitfalls and to automate common tasks encountered in software development.

Emerging Requirements

- Gaming technologies – especially those that leverage the Cloud – offer an unprecedented opportunity to *scale* simulation

- At least three premier militaries are considering Cloud deployment in future procurements:
  - United States Army ("Synthetic Training Environment" or "STE")
  - United Kingdom Ministry of Defence ("Collective Training Transformation Programme")
  - Australian Army ("Land Simulation Core 2.0").

- The US Army STE program clearly articulates a need to "converge" virtual and constructive simulation, and deliver a holistic "One World Terrain" to the point of need, **via the Cloud**

Note: The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

Emerging Requirements

The following requirements are emerging among premier Western military forces.

Common, whole-Earth terrain representation • Solves correlation issues between different simulation systems	**Cloud-enabled** • Centralizing simulation capability • "One button" to start simulated training exercises
Connectivity to the point of need • In-theatre forces training with those at home • Real-time terrain updates from in-theatre	**Unprecedented scale** • Millions of simulated entities • "Massively multiplayer"
Persistent virtual world • A persistent simulation of large regions of the Earth with cause and effect • Support for "non-kinetic" simulation	**Convergence of virtual and constructive sim** • Soldiers and commanders training simultaneously • Seamless aggregation and disaggregation of entities depending on the training need
Aggregation of performance data • All training systems should connect to a common LMS, facilitating Army-wide performance measurement and machine learning (ML)	**Exploit Machine Learning** • ML informing changes to training scenarios based on human performance • ML for improved artificial intelligence

BISim and "Whole Earth Simulation" – A Brief History

- We began developing "whole earth rendering" tech in 2013 using IR&D exclusively – VBS Blue.

- We started doing funded R&D in 2017, prototyping "whole earth" concepts in VBS Blue. We developed multiple distinct demonstrations/technologies related to One World Terrain (OWT).

- VBS Geo, a prototyping application based on VBS Blue, was demonstrated by the U.S. Army at the STE Industry Day and I/ITSEC 2017.

- The following videos show our early work - PMESII layers in the prototype, and VR terrain editing.
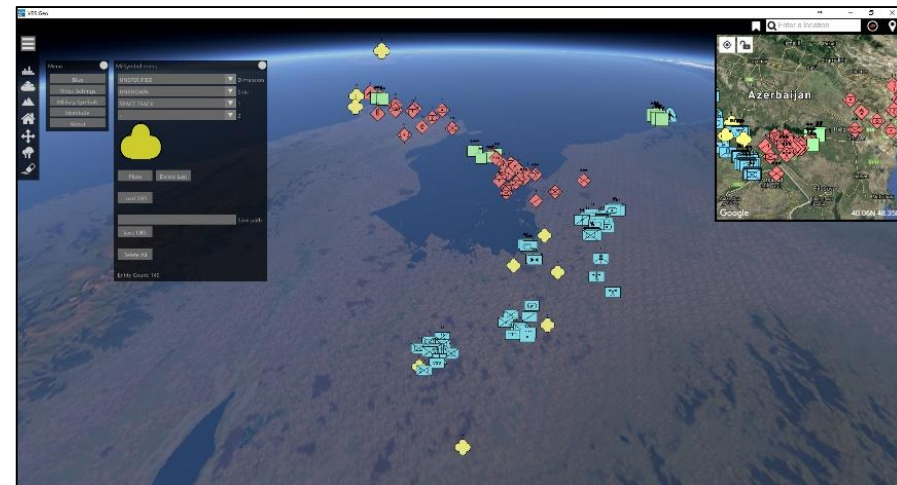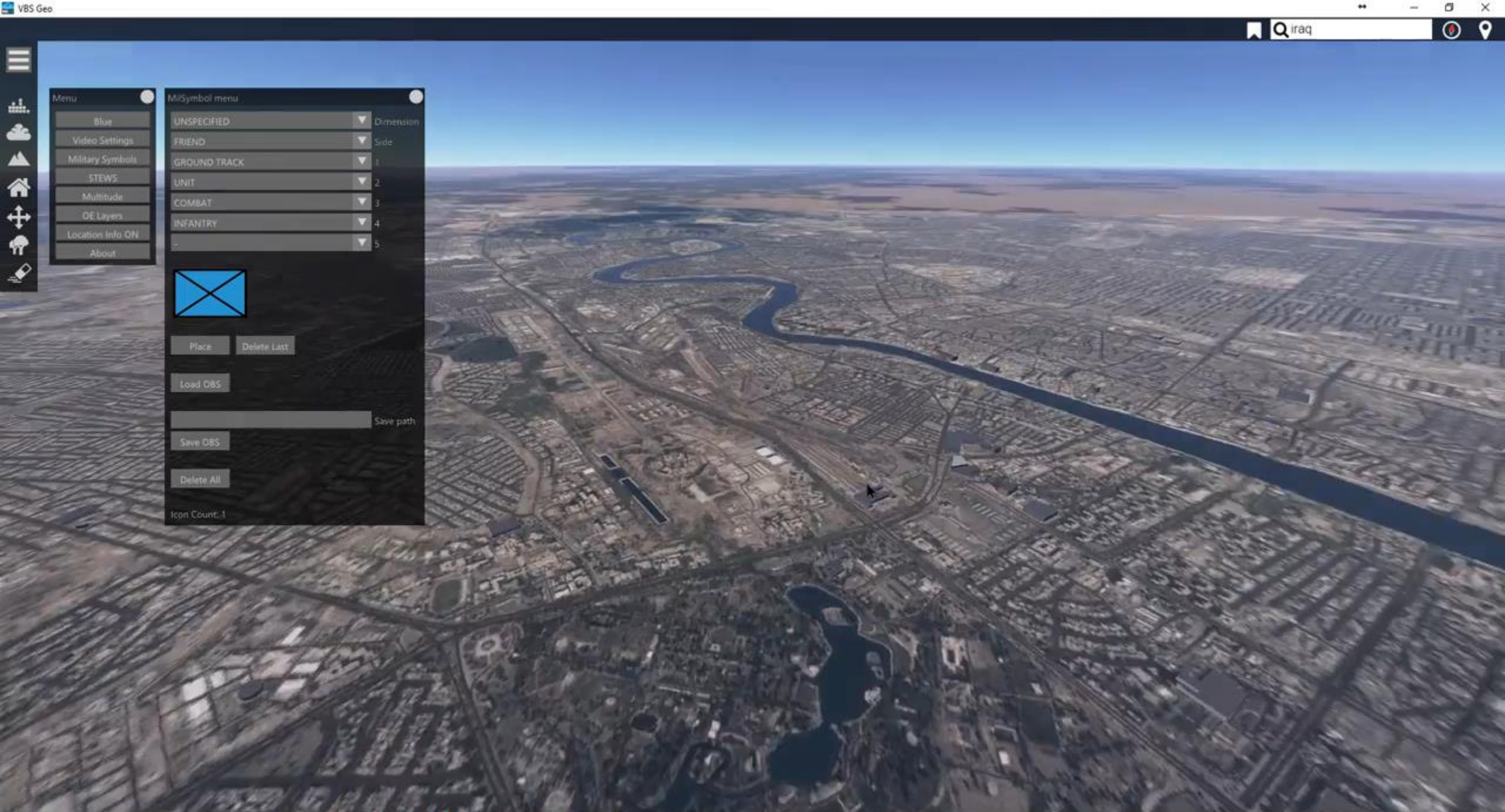
From Space to Blades of Grass…

- Whole-earth engines like our own "VBS Blue" use cube-mapping techniques to render realistic scenes (with realistic view distances) at any altitude.

- Many modern computer games use similar techniques to deliver "whole planet" experiences…
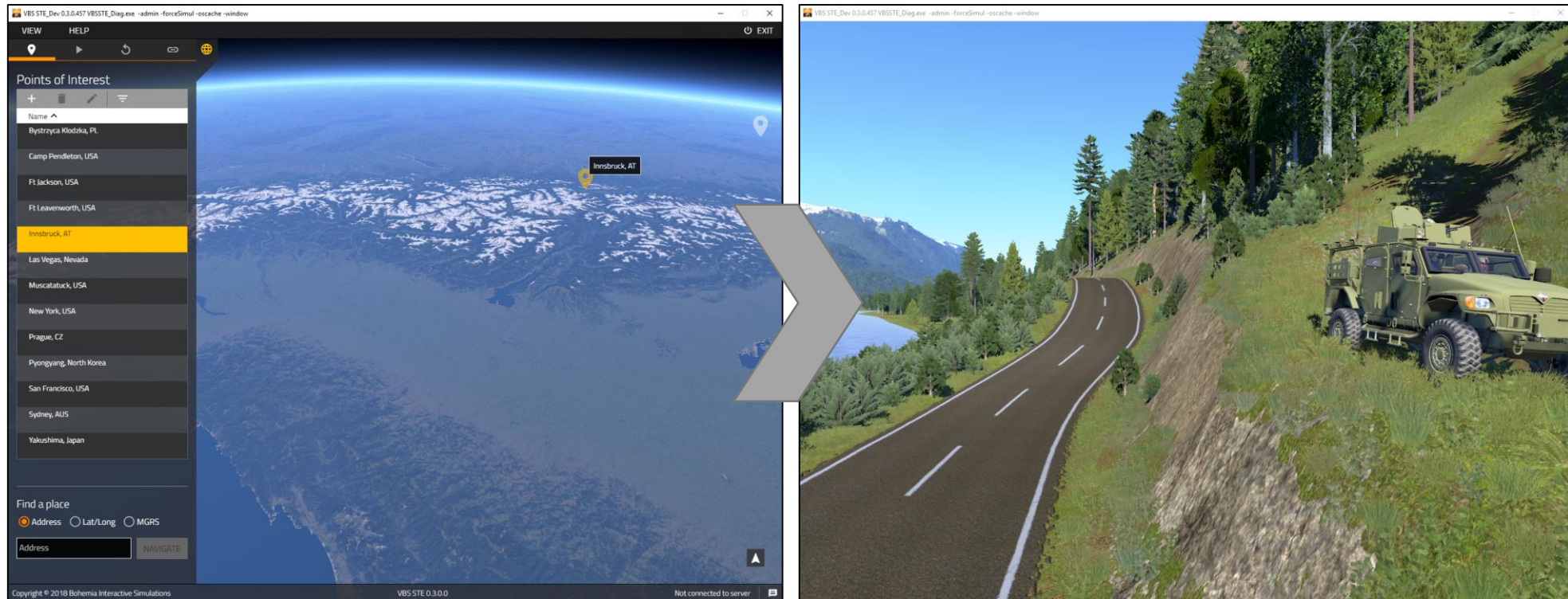
Shaping the Roadmap

Emerging requirements in programs such as STE are shaping the BISim technology roadmap...

- VBS Blue whole-earth game engine
- STE World Server for whole-earth paging terrain
- VBS Control AI framework
- Support for both Cloud **scalability** and Cloud **deployment**

The Cloud

- Cloud technologies are already in heavy use for current games

- Games commonly use the cloud to support gaming infrastructure such as matchmaking, user profiles and game servers.

- Cloud technologies have been utilised more outside of gaming for Big Data analysis and processing intensive tasks.

- Projects like Google Stadia aim to utilise the capability of the cloud to deliver high end gaming experiences to customers directly.

- As games continue to grow in scale and complexity the capabilities of the cloud are becoming increasingly attractive to game developers.

Challenges

- These new requirements are very challenging!

- STE (for example) needs to be rolled out to a massive number of U.S. Army simulation systems.
  - Likely to cost millions of $ in integration costs for each system (e.g. CCTT, AVCATT, CFFT).
  - Networks will need to be re-architected to integrate with OWT.
  - Integration with live training / operations is also critical – further increasing bandwidth requirements

- Traditional interoperability standards don't readily transfer to the cloud.
  - DIS (and other multicast protocols) weren't designed for WAN operation.
  - HLA requires expert knowledge and expensive technology (e.g. RTIs).

- Cloud technologies are relatively new to the military.
  - Security concerns
  - Bandwidth concerns (e.g. 10-15mbps required for pixel-streamed graphics, *per 1080p channel*)
  - Cost concerns (e.g. virtualizing a graphics card is still expensive!)
  - Fears of being locked into an infrastructure which is pay-per-use

- There is a desire to leverage game technology, but a lack of understanding how to employ it…
  - Government desires ownership of source code, but still wants to leverage the best the game industry has to offer
  - Rendering whole-earth terrain, representing whole-earth roads, rivers, bridges, buildings, etc., is not supported by many engines.

Summary

- "Game Technology" is vast and *could* offer higher fidelity or cost effectiveness compared to traditional approaches, depending on the training need!
  - Game "middleware" supports modularity
  - Cloud-based technology behind games like Worlds Adrift could accelerate STE

- Projects like STE are highly ambitious and remain a moving target. However the opportunities are many (for both Government *and* Industry), revolutionizing the way simulation is used in training.

- Modern industry open standards and technologies can address the challenges, and encourage innovation.

- Future approaches must be completely open – any simulation can interface through open APIs
  - Gears encourages software reuse.

Questions?