



NEEDS OF SCALABLE AR/VR AT THE MOBILE EDGE

April 2019 - Dr. Greg Jones

THE OPPORTUNITY TO PROVIDE VR/AR/VGPU OVER 5G

A Convergence of Visual Compute and 5G and a new Edge Topology



Powerful GPUs

Incredible compute capabilities redefining graphics



Bandwidth and Low Latency

Both are required for VR/AR



Compute is at the Edge

Very few hops - Low Latency

ENTERPRISE MARKET PENETRATION

The Debate of Whether VR is Viable in Enterprise is Over



Autodesk

Automotive

Engineering, Design, Marketing/Sales



ergio Fernando

Enscape

AEC
Entire Design Process,
Sales, Moving to
Construction



Nurulize

M&E
Virtual Production



ESI

Training
Possibly the Largest
Market



Location-Based Entertainment
Enterprise/Consumer

BY FACILITATING CHANGES TO **THE FCX-001** DESIGN IN VR,
VIVE HELPED BELL SAVE TIME AND MONEY.

ENTERPRISE AR

Driving Value Propositions

INSTRUCTION/COLLABORATION



DIGITAL MODELS



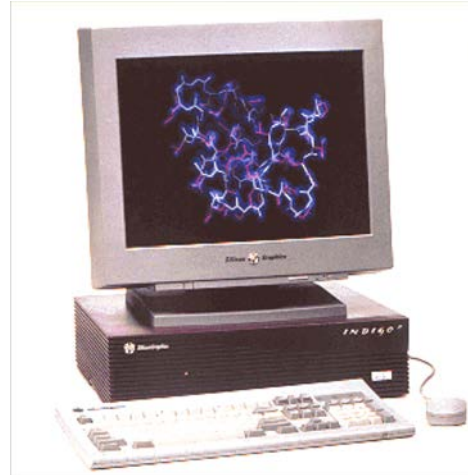
ANNOTATED



VISION



1977 HPC



1997 HPC



2017 HPC

Today, **everyone** is a high-performance computer user, with GPUs in phones, tablets, desktops, game consoles, and cars

VISION

Power User Technology

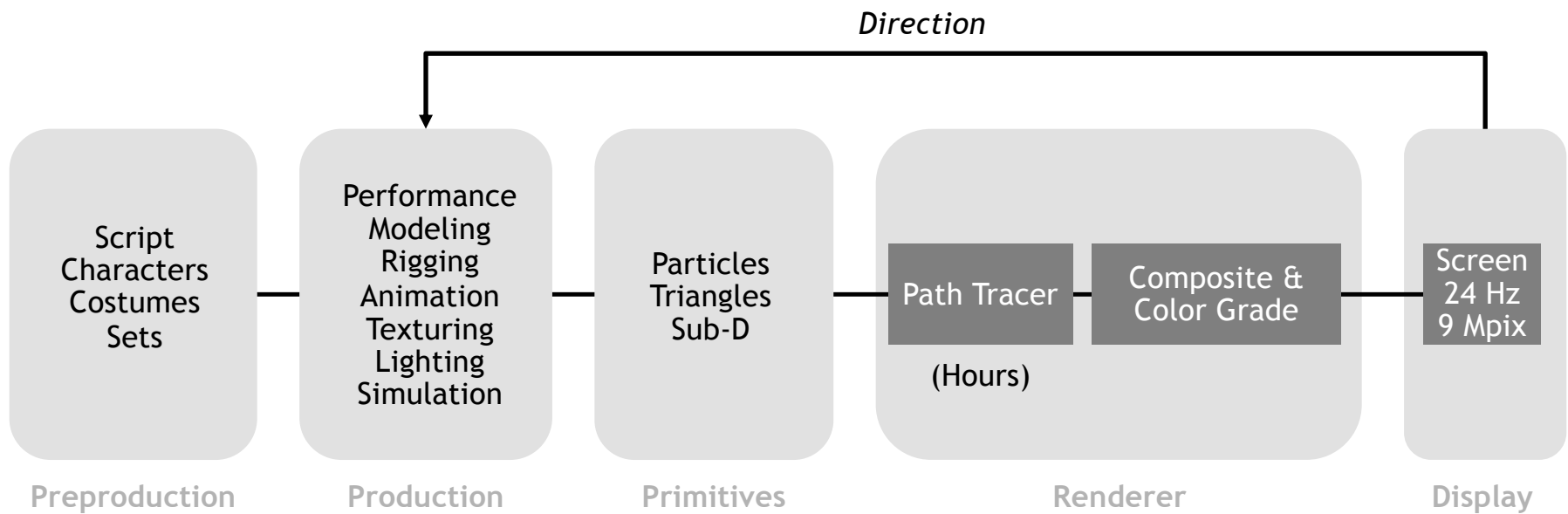


Pervasive

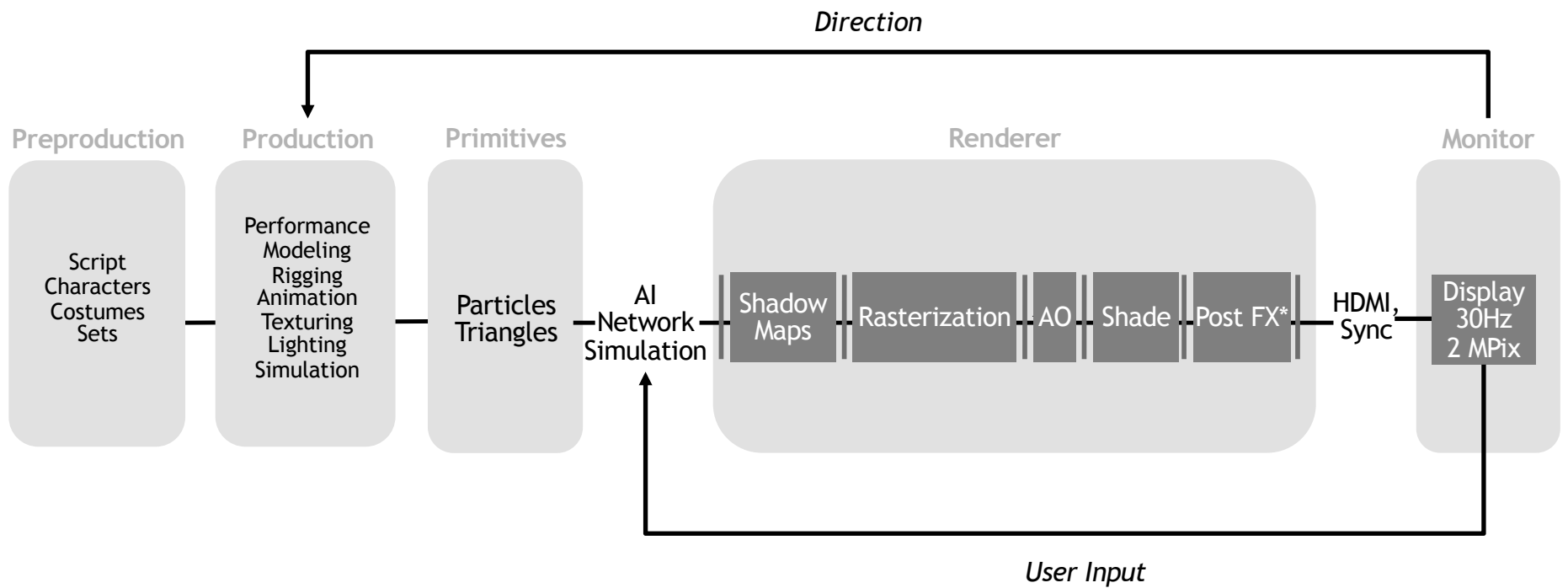


FUTURE VR

FILM CGI: CONCEPT TO PHOTONS



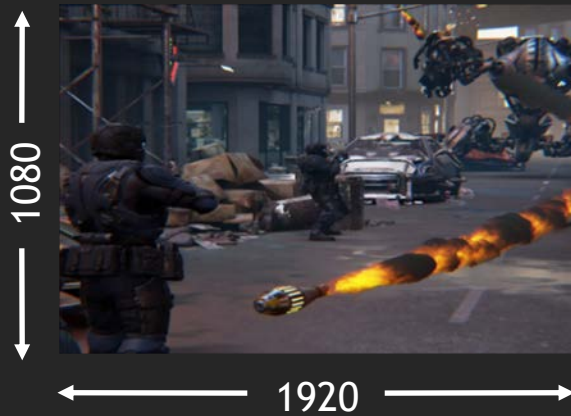
3D GAME SYSTEM



7X THROUGHPUT INCREASE

3D GAME = 60 MPIX/S

(1920 X 1080 @ MIN 30 FPS)

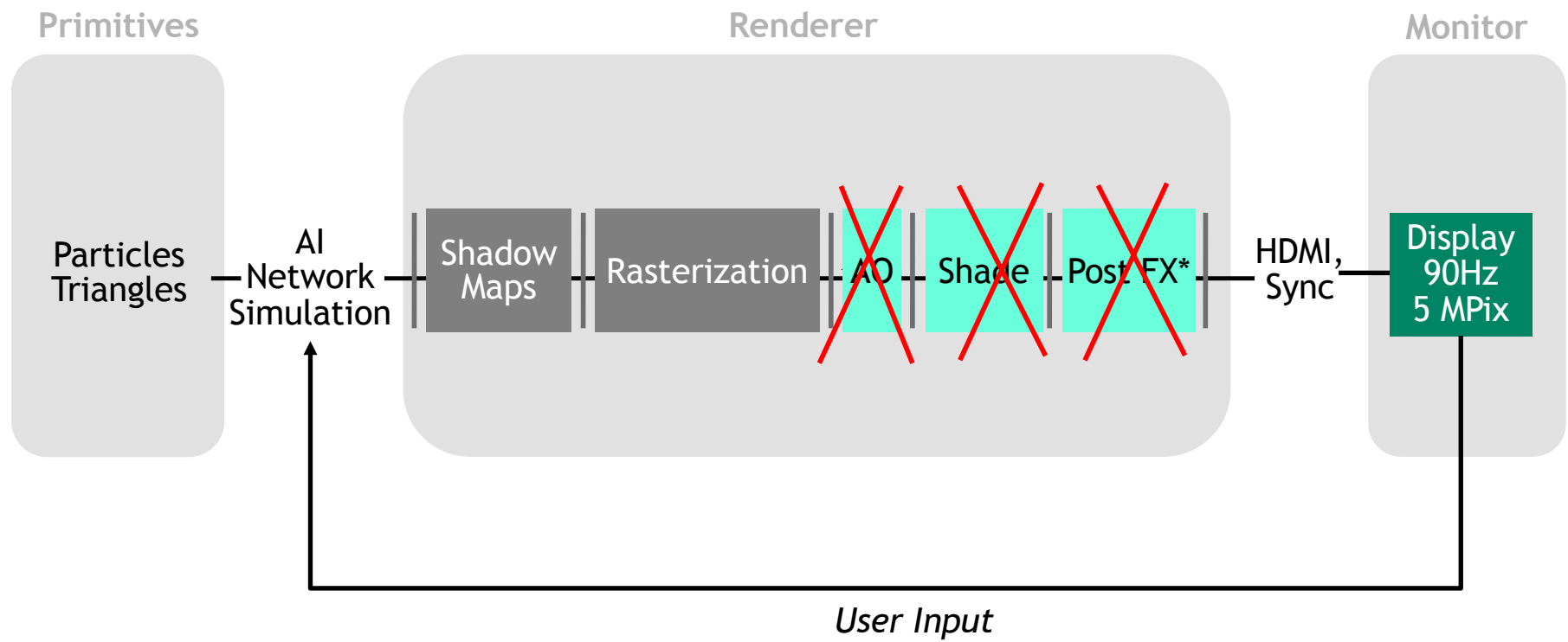


MODERN VR = 450 MPIX/S

(3024 X 1680 @ MIN 90 FPS)*

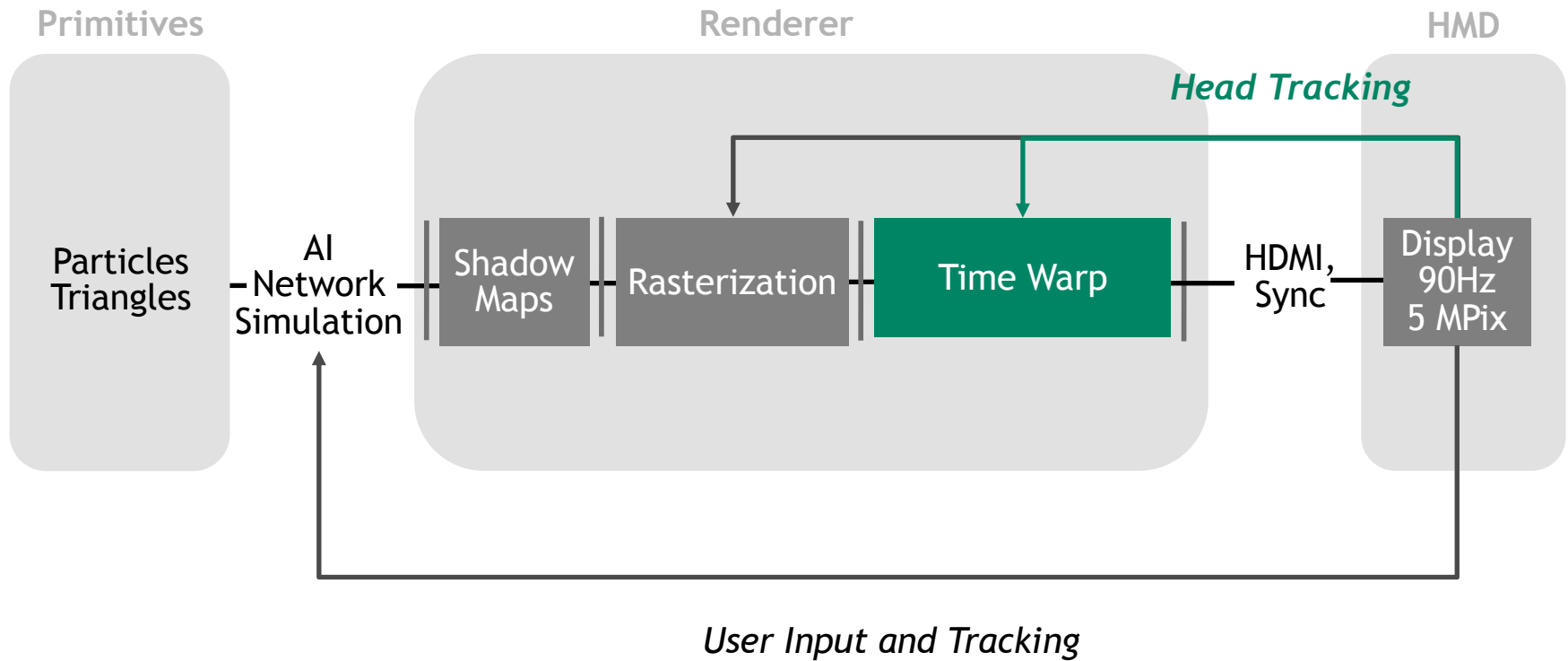


**VR render resolution*

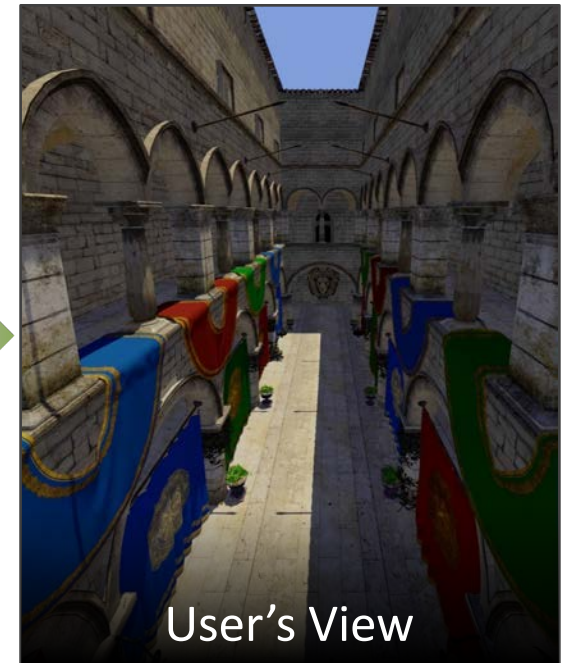
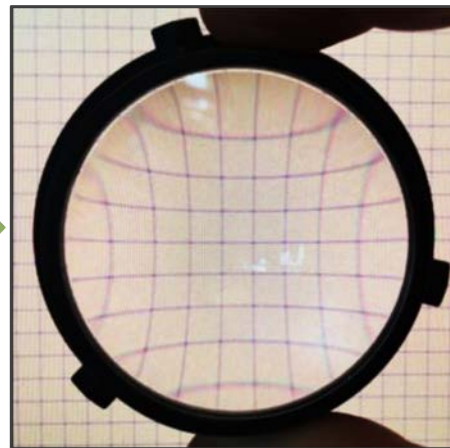


* Includes depth of field, reflections, fog, color grading, motion blur, antialiasing

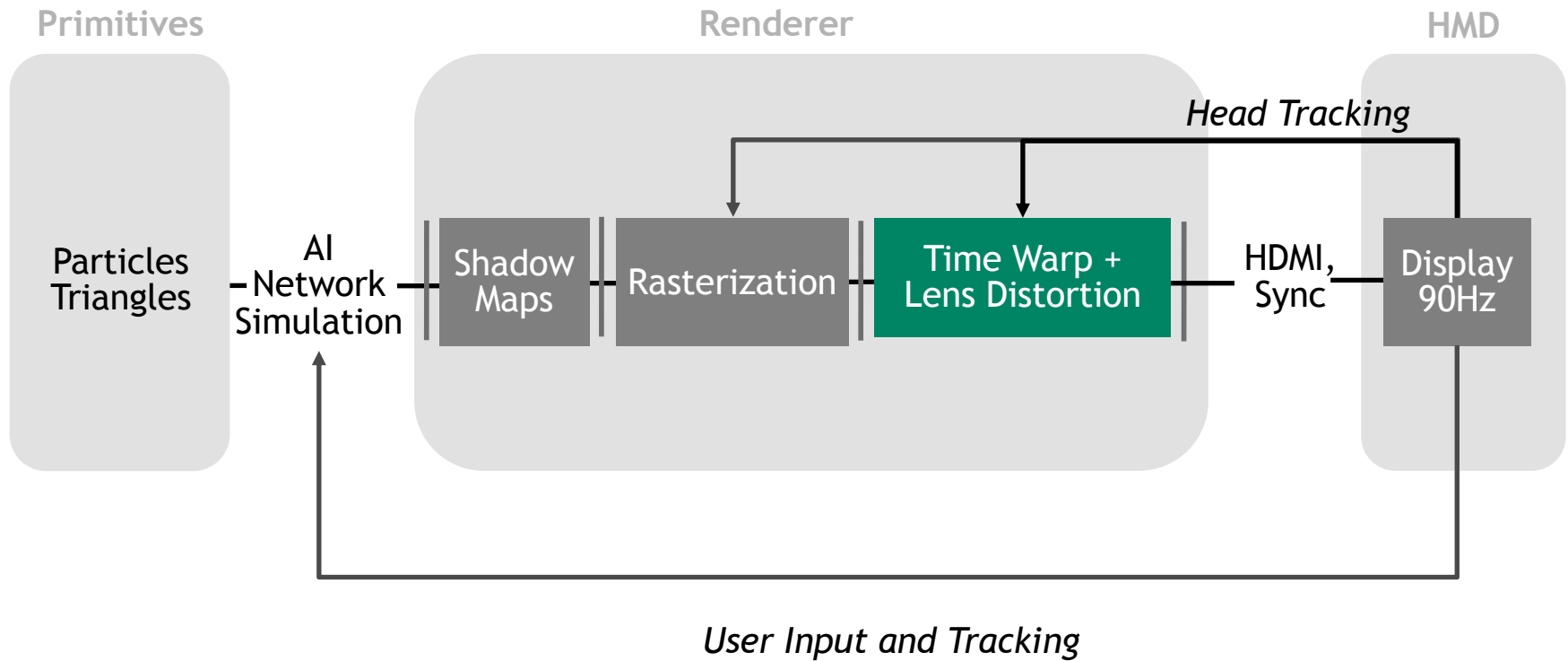
MODERN VR SYSTEM



LENS DISTORTION



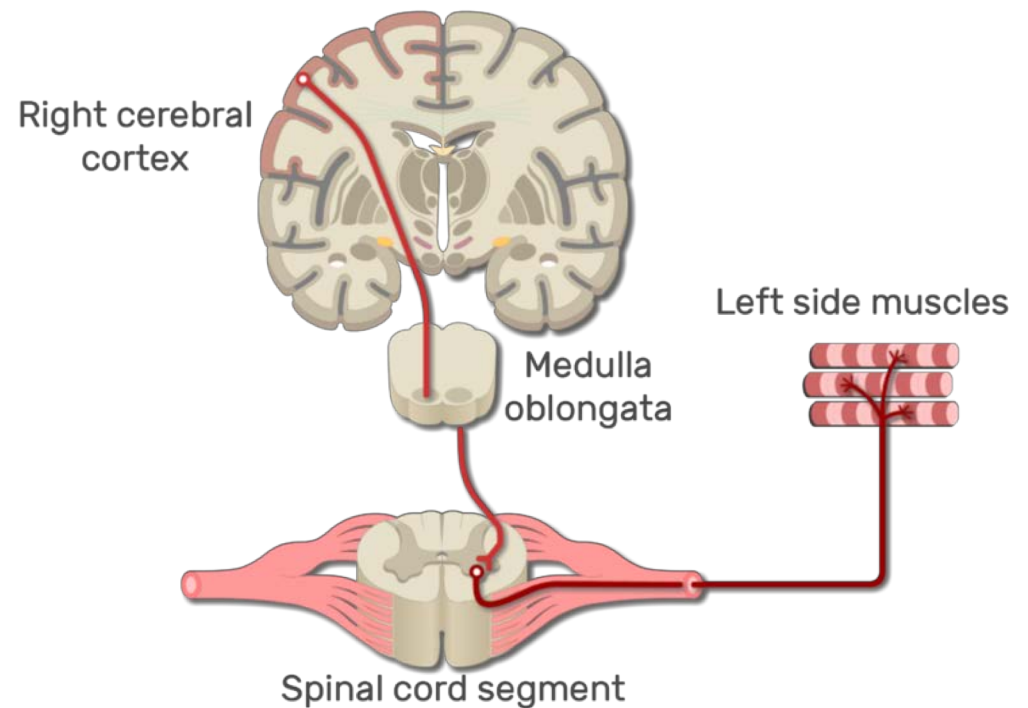
MODERN VR SYSTEM



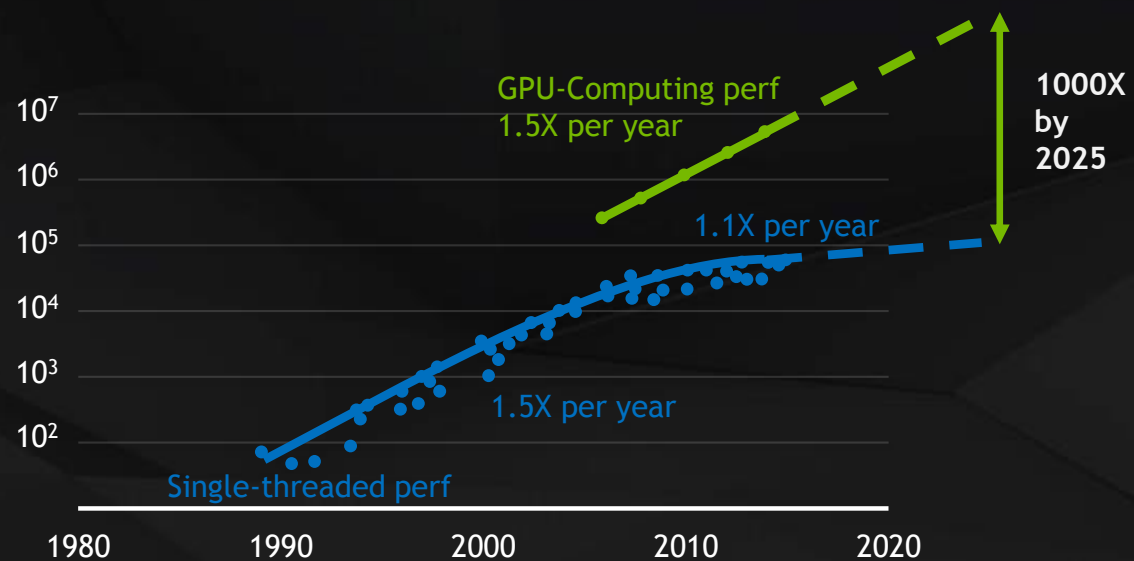
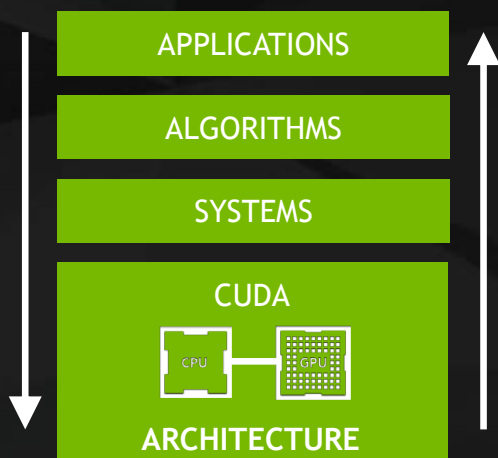
HAPTIC FEEDBACK

Gaming as an Example

- Motor Cortex is Fast
 - Cortex to muscle - 10's of ms
- Hiding Latency May Trick the Visual System
 - But, you're late on the activity



RISE OF GPU COMPUTING



Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten New plot and data collected for 2010-2015 by K. Rupp

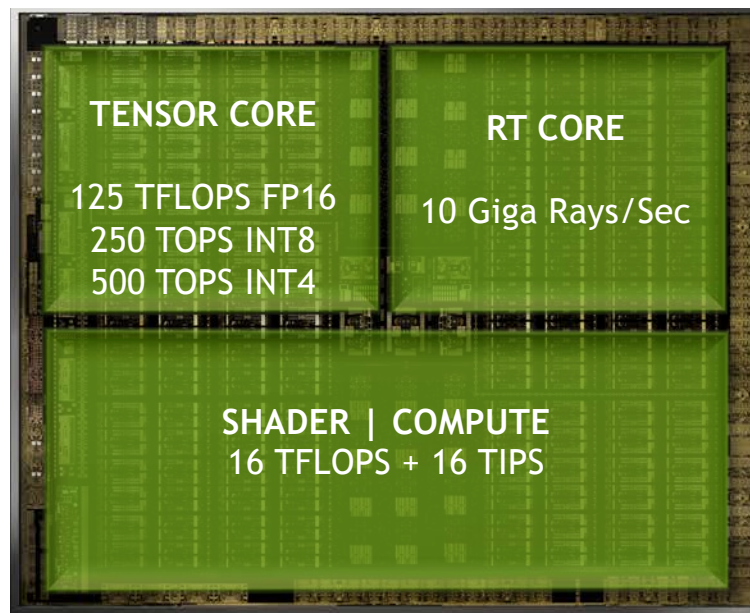
A GIANT LEAP

PASCAL



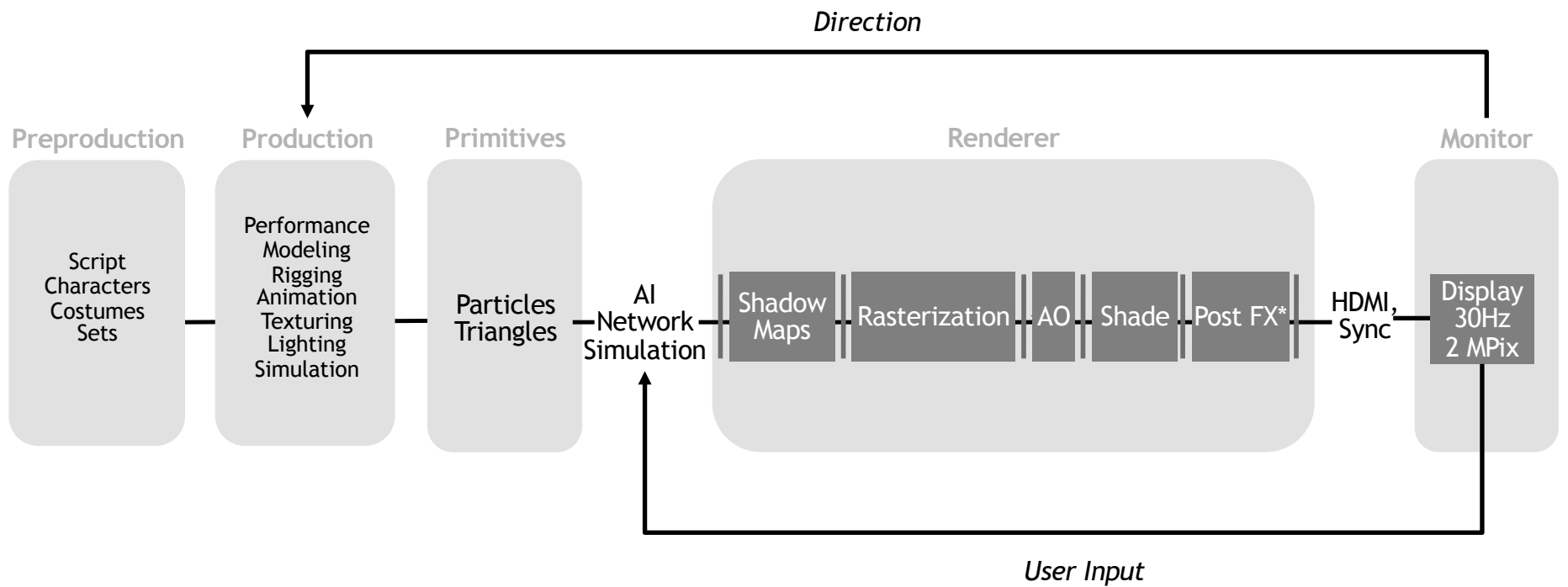
11.8 Billion xstr | 471 mm² | 24 GB 10GHz

TURING



18.6 Billion xstr | 754 mm² | 48+48 GB 14GHz

3D GAME SYSTEM IS CHANGING WITH TURING



THE TALE OF TWO EDGES

What is the 5G Topology? And, When?

- 4G
 - US - 60ms
 - Others - 30ms
- 5G
 - Sub 60ms inner ring
 - 5ms outer ring
- Nested Latencies
 - Geometry 5ms, Haptics 10-20ms, GI 40ms, etc...



5G + VR/AR/VGPU AT THE EDGE IS A SIGNIFICANT OPPORTUNITY

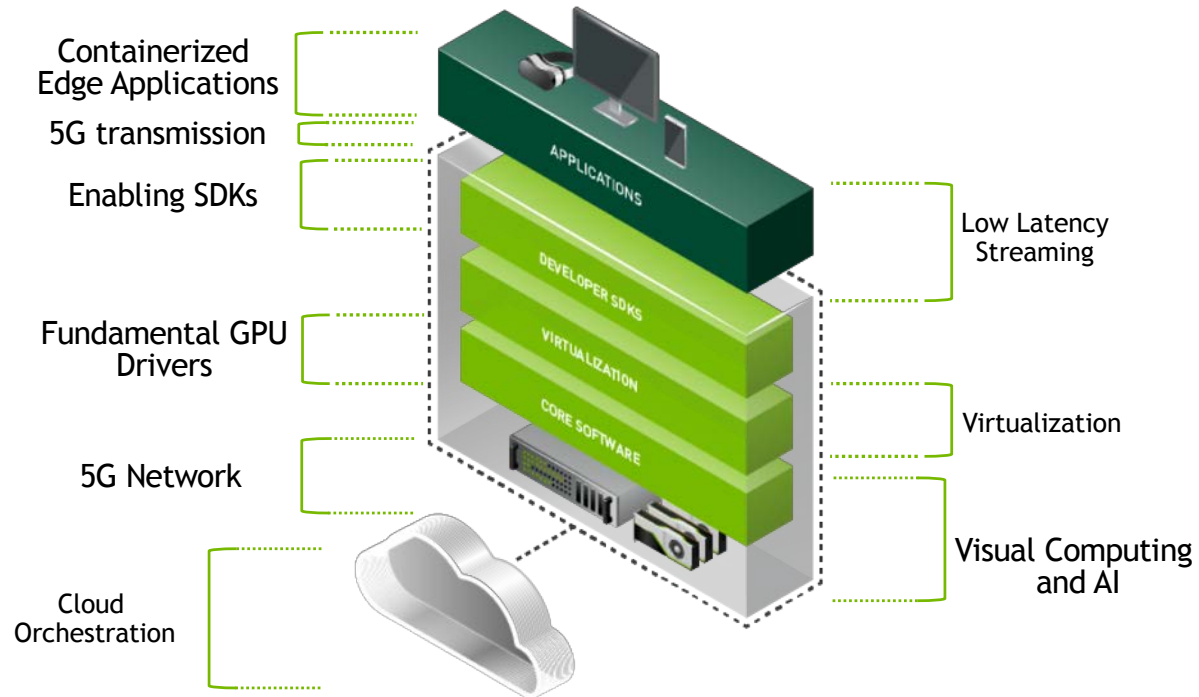
Requirements:

- Ultra Low Latency
- High Bandwidth
- Cutting-edge Compute
- Cost Effective Delivery
- Valuable Use Cases



THE CHALLENGE - AR/VR/vGPU 5G EDGE STACK IS COMPLEX

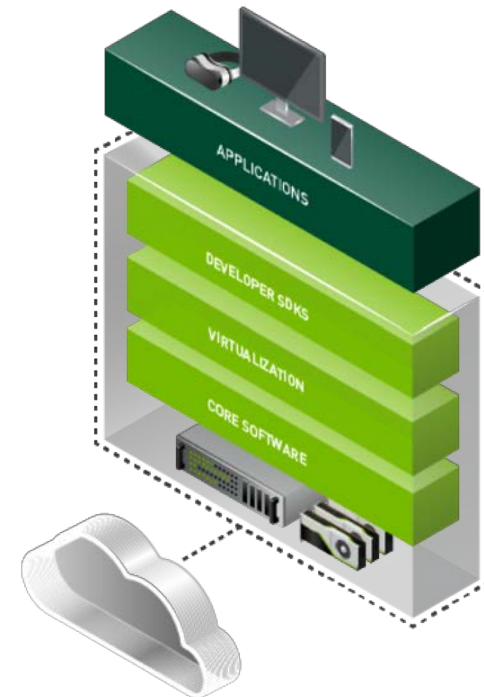
Software/Hardware Stack Demands a Diverse Effort



MISSION AND NEEDS OF THE DEVKIT

Mission: A Learning Environment for Edge Providers/Users

- Limited-lifetime and Quantity POC Development/Learning Environment
- Define Next Gen. (GTM) Software/Hardware Stacks
- Run multiple stacks





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