August 2021

ARtillery Intelligence

Headworn AR Global Revenue Forecast, 2020-2025

An ARtillery Intelligence Briefing

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Executive Summary

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Introduction

Like many research & intelligence firms, one of the things that ARtillery Intelligence does is market sizing. A few times per year, we go into isolation and bury ourselves deep in financial modeling. This takes the insights and observations we accumulate throughout the year and synthesizes them into revenue estimates for the current and future spatial computing industry (methodology details here).

In covering spatial computing for six years, our sector knowledge base and perspective continue to expand. That occurs on several levels, including insight and access to insider information, all of which informs our forecast models and inputs. Further reinforcing that knowledge position, the daily rigors of editorial production at our sister publication *AR Insider* emboldens our market insights.

Beyond knowledge position and market-sizing process, the focus of these forecasts likewise continues to evolve. Our first market forecast five years ago examined AR, VR and all their revenue subsegments. Last year, we began to produce separate forecasts for AR and VR. Though they share technological underpinnings, their nuanced market dynamics deserve standalone examination.

We continue to double down on that segmentation by focusing this report on *headworn AR* specifically. Given its unique dynamics – in both technology and user adoption patterns – it compels its own focused analysis. This allows us to go deeper on key revenue sources like consumer, corporate & industrial, and AR-enablement software. We did the same earlier this year for mobile AR.

So what did we find out? Our outlook continues to be best characterized as *cautiously optimistic*, especially when compared to several large research firms that turn attention to AR occasionally to publish eyepopping revenue estimates in the hundreds of billions of dollars. By comparison, we're comfortably and confidently in the tens-of-billions range for aggregate mobile AR spending in outer years of this financial outlook.

The burning questions: How is headworn AR pacing? Which subsectors are most opportune? And how is AR primed for the post-Covid era? We answer these questions through numbers & narrative in this slide-based report. The goal, as always, is to empower you with a knowledge position.

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*See ARtillery Intelligence report: Mobile AR Global Revenue Forecast 2020-2025.

What's Included in *Headworn AR Revenues*?

This forecast focuses on headworn AR and its revenue subcategories. These include consumer spending (e.g., AR glasses, content); and enterprise spending (e.g., industrial visualization, experience creation). Key inclusions and exclusions exist throughout these categories.

For example, this report does not cover AR formats that happen on smartphones (see our separate Mobile AR forecast). AR glasses revenue categories tracked in this report include direct hardware and software spending, but not adjacent services such as enterprise consulting and carrier data. See more examples below.

All revenue figures correlate to the full-year (end of year) total of the identified year.

Included

AR Glasses Hardware: e.g., HoloLens, Nreal Light
Consumer AR Digital Goods: e.g., Apps, in-app purchases
Corporate & Industrial AR: e.g., Software for AR-assisted assembly, maintenance and tech support
Headworn AR Creation & Enablement Software: e.g., Unity, 8th Wall, Vuforia
Hearables Software: e.g., Audio AR apps

Not Included

Network Data: e.g., Telco-delivered data usage for AR
Professional Services: e.g., Enterprise AR consulting
App & Experience Creation Overhead: e.g., Developer salaries, agency fees
AR Glasses Components: The sale of component parts for AR glasses such as display and optical systems.
Hearables hardware: e.g., AirPod sales*

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*We track these revenues (see breakdown later in this report) but do not count them towards AR revenues.

Key Takeaways

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Key Takeaways

Global Headworn AR Revenue Estimates

Global headworn AR revenue is projected to grow from **U.S. $1.59 billion** in 2020 to **U.S. $17.7 billion** in 2025, a **61.8 percent** compound annual growth rate (CAGR). This estimate consists of headworn AR consumer and enterprise spending and their revenue subsegments. Enterprise spending holds a commanding revenue share in 2021 (**$4.63 billion**) versus consumer spending (**$45.7 million**). Spending share will shift to consumer-based categories over time as consumers acclimate to AR glasses. Consumer markets are generally larger than enterprise markets based on population sizes, however enterprise-spending often leads in early days of emerging technologies, which is the case with headworn AR. Consumer spending share growth will also be accelerated by Apple's projected market entrance*, which could create a classic Apple "halo effect" that raises all boats. As is the case across the global economy, headworn AR subsectors were impacted unevenly by the Covid-19 global pandemic. Global manufacturing constraints impacted consumer shipments, but that impact was minimal due to low demand levels to begin with. Greater impact in 2021 has been seen through Microsoft's 10-year $22 billion contract with the U.S. Army to provide battle-geared HoloLens units. This spending is amortized over time and reflected in this five-year forecast, causing a considerable enterprise AR spending inflection in 2021.

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*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Key Takeaways

Headworn-AR Devices Estimates

AR Headsets are projected to grow in unit sales from **250,000** in 2020 to **4.03 million** in 2025. That correlates to an installed base of **8.53 million** units in market by 2025. This is favorable growth but is eclipsed by smartphones – the standard for ubiquitous hardware – by a margin of **421-1**. Headworn AR hardware figures include enterprise and consumer uses, the former leading in early years with **227,000** units sold in 2020, growing to **1.87 million** units in 2025. Consumer shipments will trail that of enterprises in early years but pull ahead in later years with **2.16 million units** projected in 2025. This will result from improving standards and specs for consumer-grade smart glasses (size, weight, style, etc.). It will be further accelerated through Apple's market entrance* and halo effect. On the enterprise side, growth will continue to be driven by strong ROI metrics for AR-guided productivity in areas like assembly, maintenance and field service. Sector growth will also be driven in the near term by military applications, including the U.S. Army's recently-expanded contract with Microsoft for HoloLens-deployed training and combat. Meanwhile, supply chain constraints for HoloLens 2 have slowed its momentum to some degree. Greater market share has been collectively won by lower-tech AR headsets that guide front-line workers in various ways through (non-immersive) heads up displays. These include Google Glass Enterprise Edition and Realwear's AR hardware.

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*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Key Takeaways

Headworn-AR Consumer Spending Estimates

Headworn AR consumer spending is projected to grow from **U.S. $20.77 million** in 2020 to **U.S. $1.67 billion** in 2025, a **140 percent** compound annual growth rate (CAGR). This includes hardware and software/content that consumers pay for. Primary revenue subcategories are AR glasses and the software-based experiences that run on those glasses. Like many technology products, hardware comes first and leads in revenue share, which is then outpaced by software spend. This happens as a larger installed base of in-market hardware accumulates; and as software average revenue per user (ARPU) grows. This is a common pattern for emerging consumer technology, such as smartphone hardware and software (app) sales. Whereas consumer *mobile* AR software revenues are dominated by in-app purchases,* AR glasses software will include a mix of app purchases and recurring content subscriptions (like in VR). Consumer headworn AR software revenue models will likely be defined by Apple as it gains consumer AR market share following its market entrance**. The work it's done to seed AR demand and developer competency with ARkit will anchor its position as a central hub for AR experiences that run on (and drive demand for) its AR hardware. That will include a wide range of use cases that it motivates developers to build including gaming, education, utilities, media and commerce.

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*See ARtillery Intelligence report: Mobile AR Global Revenue Forecast 2020-2025.
**See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Key Takeaways

Headworn-AR Enterprise Spending Estimates

Headworn AR enterprise spending is projected to grow from **U.S. $1.59 billion** in 2020 to **U.S. $15.8 billion** in 2025, a **58.6 percent** compound annual growth rate (CAGR). This includes AR hardware and software that enterprises pay for, such as AR headsets, software that runs on those headsets, and developer platforms to create immersive experiences. The leading subdivision today is enterprise AR productivity. This helps enterprises achieve operational efficiencies through visualization software for line-of-sight or live-guided support in assembly, maintenance, and tech support functions. It also includes software that helps enterprises (or software vendors that serve them) author AR experiences that fit the above description. Enterprise AR's demand stems from its strong business case and broad applicability. It can include everything from assembly to heavy-equipment maintenance to IT support. These functions span several industries and verticals, causing a sizeable addressable market. Growth so far has been slowed by typical adoption barriers and organizational inertia, but case studies continue to validate strong ROI, indicating that cultural resistance will eventually give way. Meanwhile, another adoption accelerant has emerged: Covid-era dynamics. Global lockdowns and constraints compelled enterprise AR productivity as remote AR support aligns with social distancing. This has boosted short-term traction, while exposing the technology and accelerating its longer-term adoption.

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Key Takeaways

Audio AR (Hearables) Spending Estimates

The Audio AR market is projected to grow from almost nothing today to **U.S. $242.8 million** in 2025. This total includes consumer spending on audio AR apps and experiences that are purpose-built for hearable devices such as Apple AirPods. Spending totals *do not* include hearables hardware, as these are existing consumer purchases on which AR's use is secondary (for now). Audio AR software's market does however *correlate* to the hardware installed base, which will grow from **122 million** units in 2020 to **251 million** units in 2025. Though that hardware is increasingly prevalent and culturally accepted, audio AR apps haven't yet been built and marketed widely. We believe that will change over the next 2-3 years as Apple creates developer kits for hearables, similar to what it's already done with iOS-orbiting SDKs like WatchOS, tvOS and ARkit. Apple will be motivated to do so by the continued revenue performance of wearables, and its ongoing need to diversify revenue in the face of decelerating iPhone sales.* Audio AR could also align with Apple's visual AR plans by creating a more holistic system of sensory augmentation that engenders a multi-device ecosystem play (classic Apple). That includes AR glasses, Watch and AirPods as an expanding *wearables suite*. Like Apple's rumored AR glasses, audio AR apps could boost the iPhone's value by relying on it for compute power as well as sensor fusion. For example, the iPhone IMU can enable textured, intelligent and situationally-relevant audio content.

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*See ARtillery Intelligence Report: Wearables: Paving the Way for AR Glasses

Revenue Overview

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Headworn AR Revenue Estimates

- Global headworn AR revenue will grow from U.S. $1.59 billion in 2020 to U.S. $17.7 billion in 2025, a 61.8% compound annual growth rate (CAGR).

- This sum consists of headworn AR consumer and enterprise spending.
  - Consumer spending includes AR glasses, and content/apps that run on those glasses (content subscriptions, premium apps, in-app purchases).
  - Enterprise spending includes headworn AR-based enterprise purchases, including headsets, software that runs on those headsets, and enabling tech. The latter includes experience creation software (e.g., Unity).

- Enterprise spending holds a commanding revenue share in 2021 ($4.63 billion) versus consumer spending ($45.7 million).
  - Enterprise spending usually leads emerging tech sectors in early days.
  - Over time, revenue shifts to consumer markets due to population sizes.

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Headworn AR Revenue Estimates

- The consumer-AR spending shift will also happen as AR technology improves, consumers acclimate, and as Apple's projected hardware launches.
  - Apple's proven ability to mainstream emerging technologies will give it a leading position and market share of consumer AR hardware spending.
  - This will also cause a classic Apple "halo effect" that benefits all AR hardware players as it stimulates market demand at all levels.*

- As is the case across the global economy, headworn AR subsectors have been impacted unevenly by the ongoing Covid-19 pandemic.
  - The pandemic's impact on hardware supply chains will be minimal for consumer AR headsets because demand is so low to begin with.
  - Impact on enterprise AR could be a net-positive as remote AR support enables companies to practice social distancing. This Covid-pressured adoption could expose AR's benefits and accelerate long-term traction.

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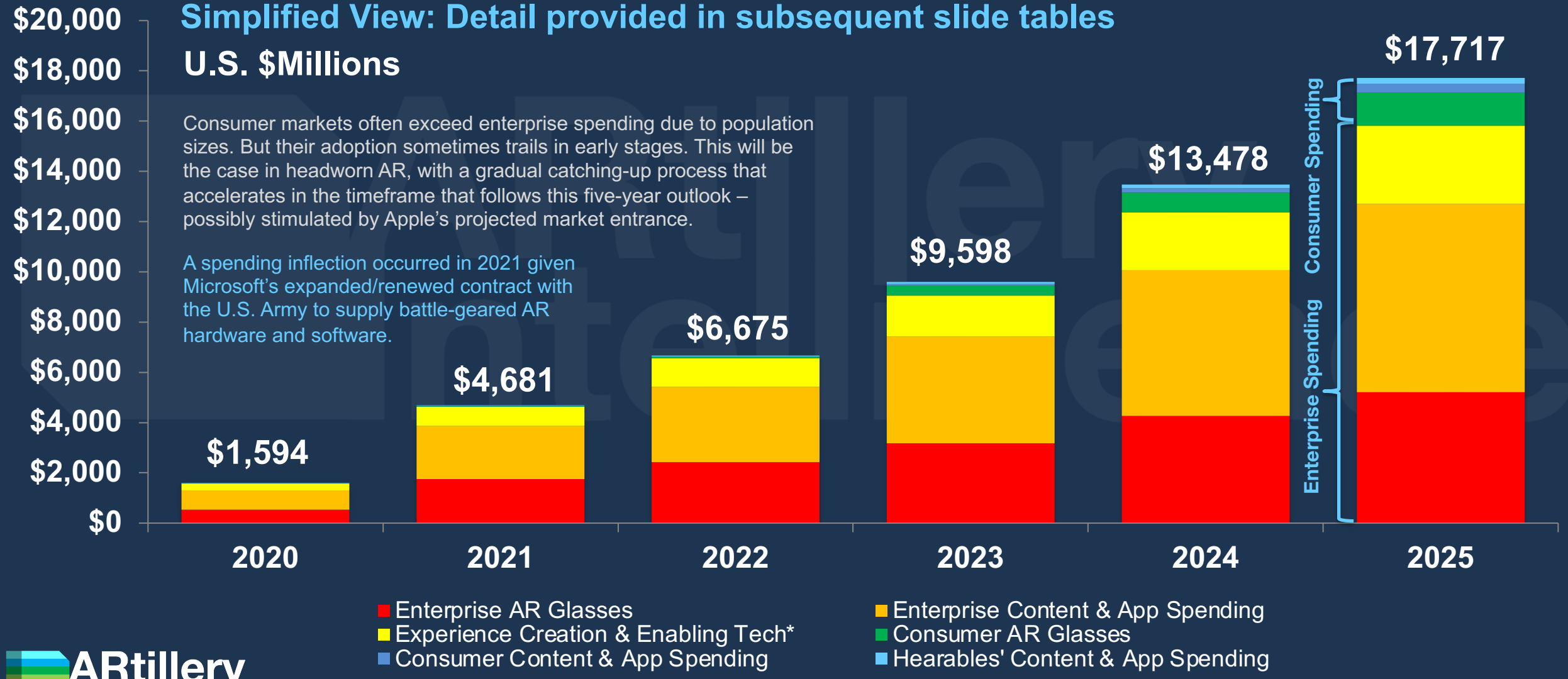
*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Headworn AR Revenue Estimates

Consumer & Enterprise AR Glasses Revenues, by Source

Simplified View: Detail provided in subsequent slide tables



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*Includes platform revenue for consumer and enterprise experience creation (bought/licensed by enterprises/developers).

Headworn AR Revenue Estimates

Consumer & Enterprise AR Glasses Revenues, by Source

U.S. $Millions

	Enterprise AR Glasses	Enterprise Content & App Spending	Experience Creation & Enabling Tech	Consumer AR Glasses	Consumer Content & App Spending	Hearables' Content & App Spending	Total
2020	$539	$763	$271	$19	$2	$0	$1,594
2021	$1,745	$2,124	$766	$40	$5	$0	$4,681
2022	$2,426	$2,996	$1,132	$75	$13	$33	$6,675
2023	$3,182	$4,246	$1,629	$400	$60	$81	$9,598
2024	$4,263	$5,804	$2,300	$794	$162	$155	$13,478
2025	$5,206	$7,497	$3,101	$1,323	$347	$243	$17,717

Enterprise Spending

Consumer Spending

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*Includes platform revenue for consumer and enterprise experience creation (bought/licensed by enterprises/developers).

Headworn AR Devices

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Headworn AR Device Outlook

- AR Headsets will grow in unit sales from 250K in 2020 to 4.03 million in 2025.
  - This correlates to an installed base of 8.53 million units in market by 2025.
  - This is favorable growth but is still eclipsed by smartphones 421-1
  - This includes enterprise and consumer hardware, the former leading with 227,000 estimated units sold in 2020, growing to 1.87 million units in 2025.
  - Consumer AR glasses shipments trail that of enterprises in early years but will pull ahead in later years with 2.16 million units projected in 2025.

- Consumer AR glasses spending will be accelerated by Apple's market entrance* and halo effect, as noted.
  - Apple's revenue share will start slow given consumer acclimation periods, and its hardware's lower price point relative to heftier enterprise hardware.
  - There will also be success stories in specific vertical markets such as Tilt Five's AR gaming-focused approach.**

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*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail
**See ARtillery Intelligence article: Tilt Five Signals AR Gaming's Future

Headworn AR Device Outlook

- Enterprise growth will continue to be driven by strong ROI for AR-guided productivity, though organizational inertia continues to dampen adoption.*
- Enterprise adoption will also be driven by military spending such as the U.S. Army's contract with Microsoft for HoloLens-deployed training and combat.
  - Supply chain constraints for HoloLens 2 have caused its momentum to slow in enterprise areas outside of its U.S. Army contract.
- Greater market share has been collectively won by lower-tech AR headsets that guide front-line workers through (non-immersive) heads-up displays.
  - These include Google Glass Enterprise Edition and Realwear's AR hardware.
  - Enterprise AR spending is otherwise weighted towards smartphone-based deployments, covered separately in our Mobile AR forecast.**

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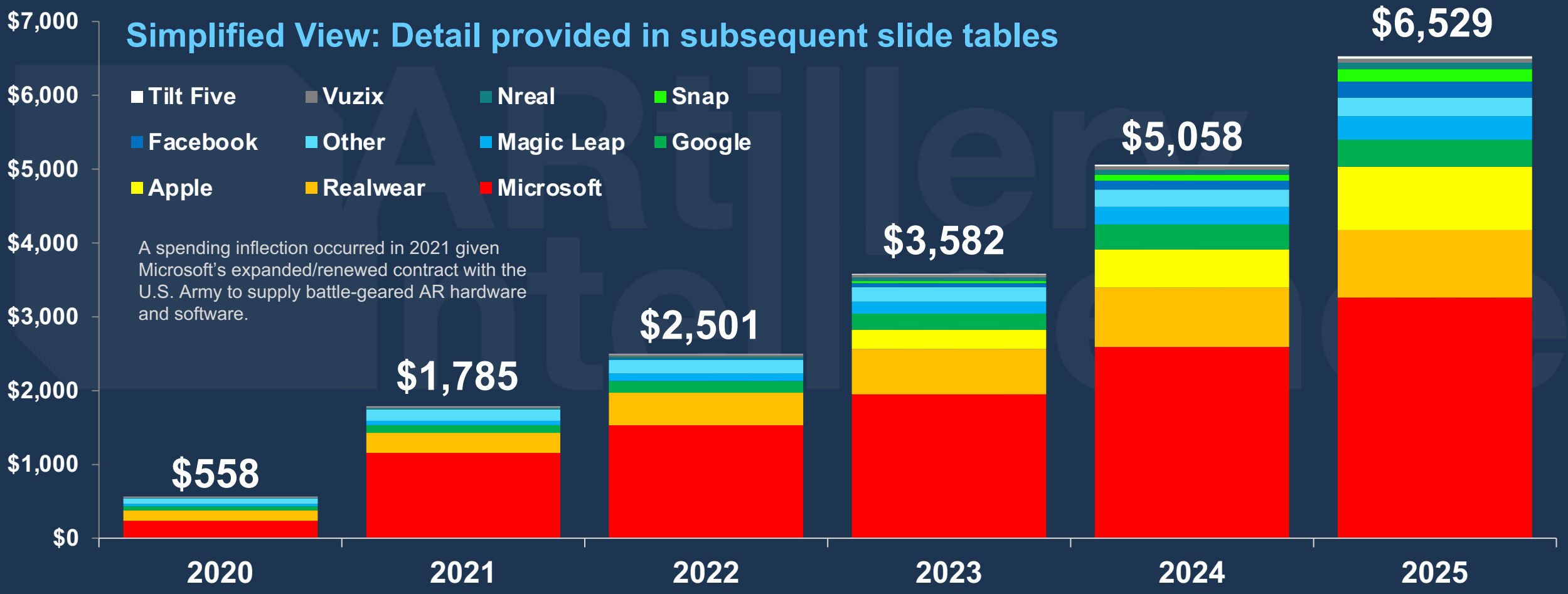
*See ARtillery Intelligence report: Enterprise AR Best Practices & Case Studies.
**See ARtillery Intelligence report: Mobile AR Global Revenue Forecast 2020-2025.

AR Glasses Revenue Estimates

AR Glasses Annual Revenue* by Brand

U.S. $Millions



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*This chart covers annual sales in U.S. dollars, so market shares are impacted by hardware prices. See separate slide for annual sales in units.

AR Glasses Revenue Estimates

AR Glasses Annual Revenue* by Brand

U.S. $Millions

	Microsoft	Realwear	Apple	Google	Magic Leap	Other	Facebook	Snap	Nreal	Vuzix	Tilt Five	Total
2020	$236	$144	$0	$52	$33	$77	$0	$0	$3	$10	$2	$558
2021	$1,155	$273	$0	$101	$63	$151	$0	$0	$18	$20	$4	$1,785
2022	$1,532	$437	$0	$161	$102	$186	$15	$0	$29	$33	$6	$2,501
2023	$1,948	$617	$259	$221	$158	$201	$51	$31	$46	$37	$13	$3,582
2024	$2,589	$805	$520	$336	$242	$234	$117	$84	$66	$45	$21	$5,058
2025	$3,260	$914	$859	$362	$321	$252	$217	$169	$88	$55	$31	$6,529

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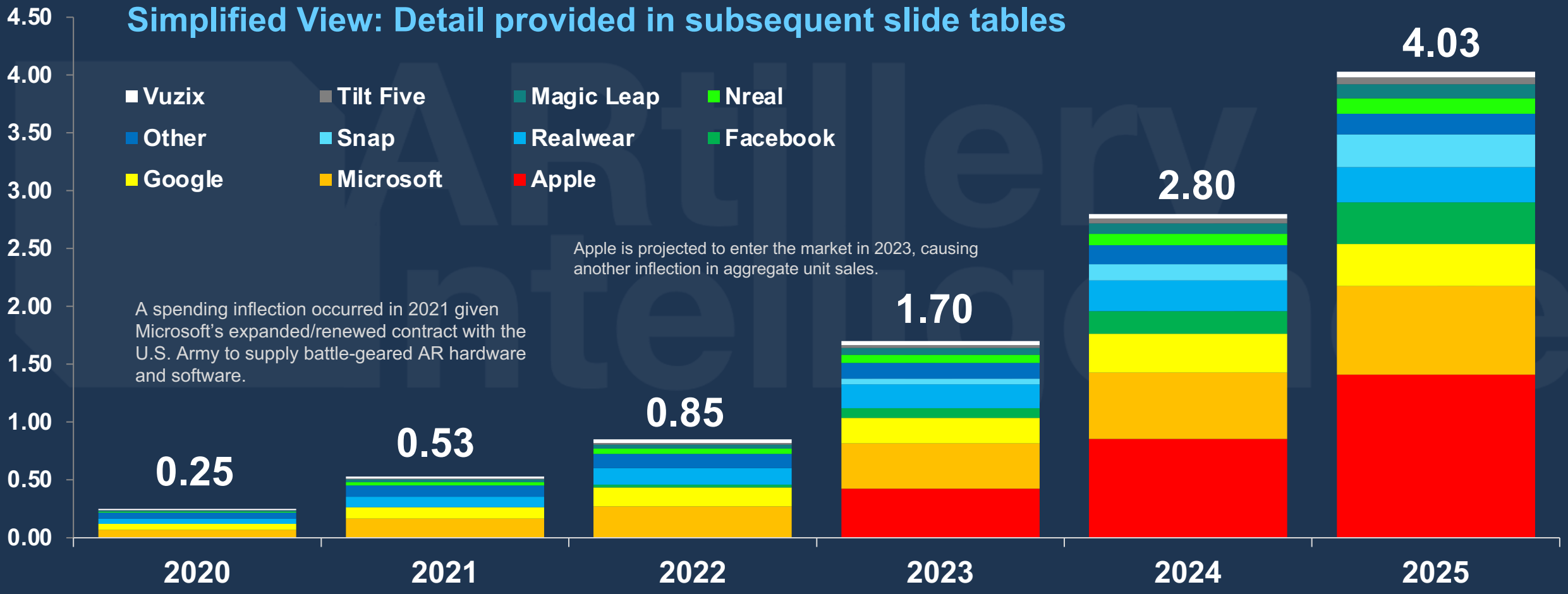
*This chart covers annual sales in U.S. dollars, so market shares are impacted by hardware prices. See separate slide for annual sales in units.

AR Glasses Sales Estimates

AR Glasses Annual Unit Sales* by Brand

Millions of Units



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*This chart covers annual sales in units. See separate charts for revenue estimates and installed bases.

AR Glasses Sales Estimates

AR Glasses Annual Unit Sales* by Brand

Millions of Units

	Apple	Microsoft	Google	Facebook	Realwear	Snap	Other	Nreal	Magic Leap	Tilt Five	Vuzix	Total
2020	0.00	0.07	0.05	0.00	0.05	0.00	0.05	0.01	0.01	0.00	0.01	0.25
2021	0.00	0.16	0.10	0.00	0.09	0.00	0.10	0.03	0.02	0.01	0.02	0.53
2022	0.00	0.27	0.16	0.03	0.14	0.00	0.12	0.04	0.04	0.01	0.03	0.85
2023	0.43	0.39	0.22	0.09	0.20	0.05	0.14	0.07	0.06	0.03	0.03	1.70
2024	0.85	0.57	0.34	0.20	0.27	0.14	0.16	0.10	0.09	0.04	0.04	2.80
2025	1.41	0.77	0.36	0.36	0.30	0.28	0.18	0.13	0.12	0.06	0.05	4.03

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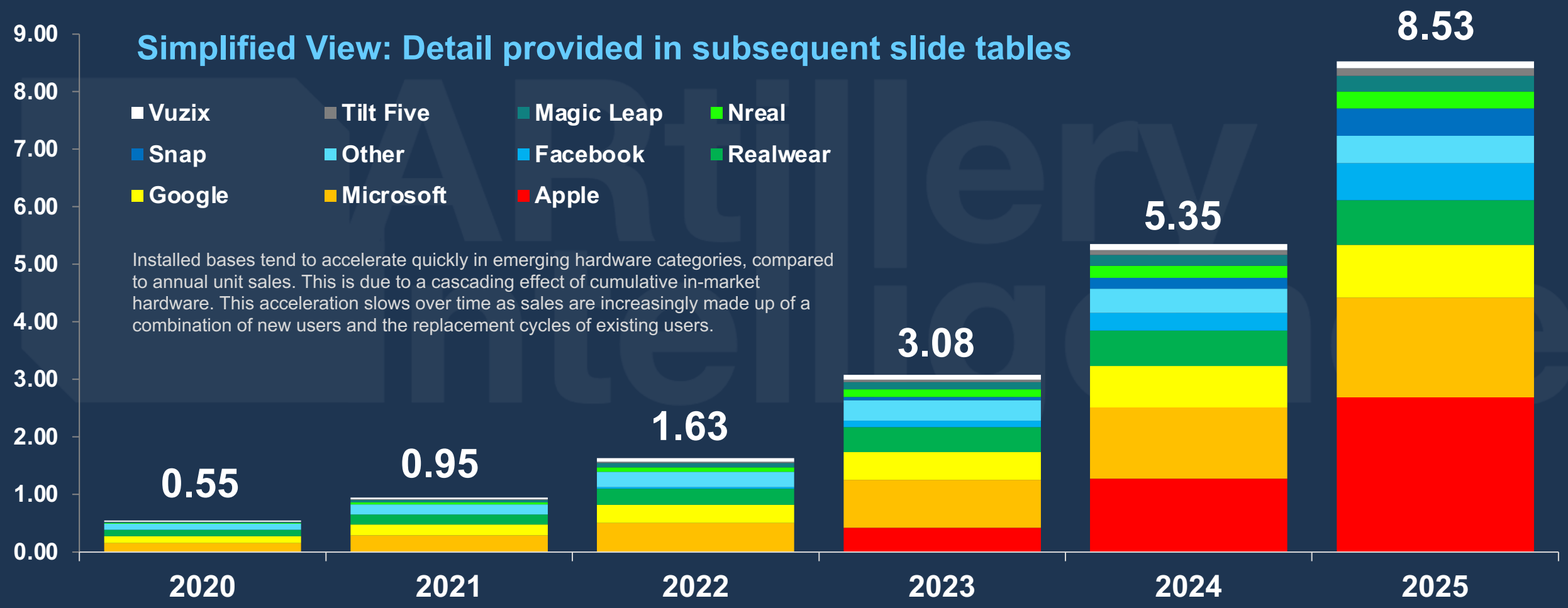
*This chart covers annual sales in units. See separate charts for revenue estimates and installed bases.

AR Glasses Sales Estimates

AR Glasses Installed Base* by Brand

Millions of Units



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*This chart covers cumulative installed base. See separate slide for annual unit-sales figures.

AR Glasses Sales Estimates

AR Glasses Installed Base* by Brand

Millions of Units

	Apple	Microsoft	Google	Realwear	Facebook	Other	Snap	Nreal	Magic Leap	Tilt Five	Vuzix	Total
2020	0.00	0.16	0.12	0.11	0.00	0.11	0.00	0.01	0.02	0.00	0.02	0.55
2021	0.00	0.29	0.19	0.17	0.00	0.17	0.00	0.03	0.04	0.01	0.03	0.95
2022	0.00	0.50	0.31	0.28	0.03	0.27	0.00	0.08	0.07	0.02	0.06	1.63
2023	0.43	0.83	0.48	0.44	0.11	0.36	0.05	0.14	0.12	0.05	0.08	3.08
2024	1.28	1.24	0.72	0.61	0.31	0.42	0.19	0.21	0.19	0.08	0.10	5.35
2025	2.69	1.73	0.92	0.77	0.64	0.48	0.47	0.30	0.27	0.13	0.12	8.53

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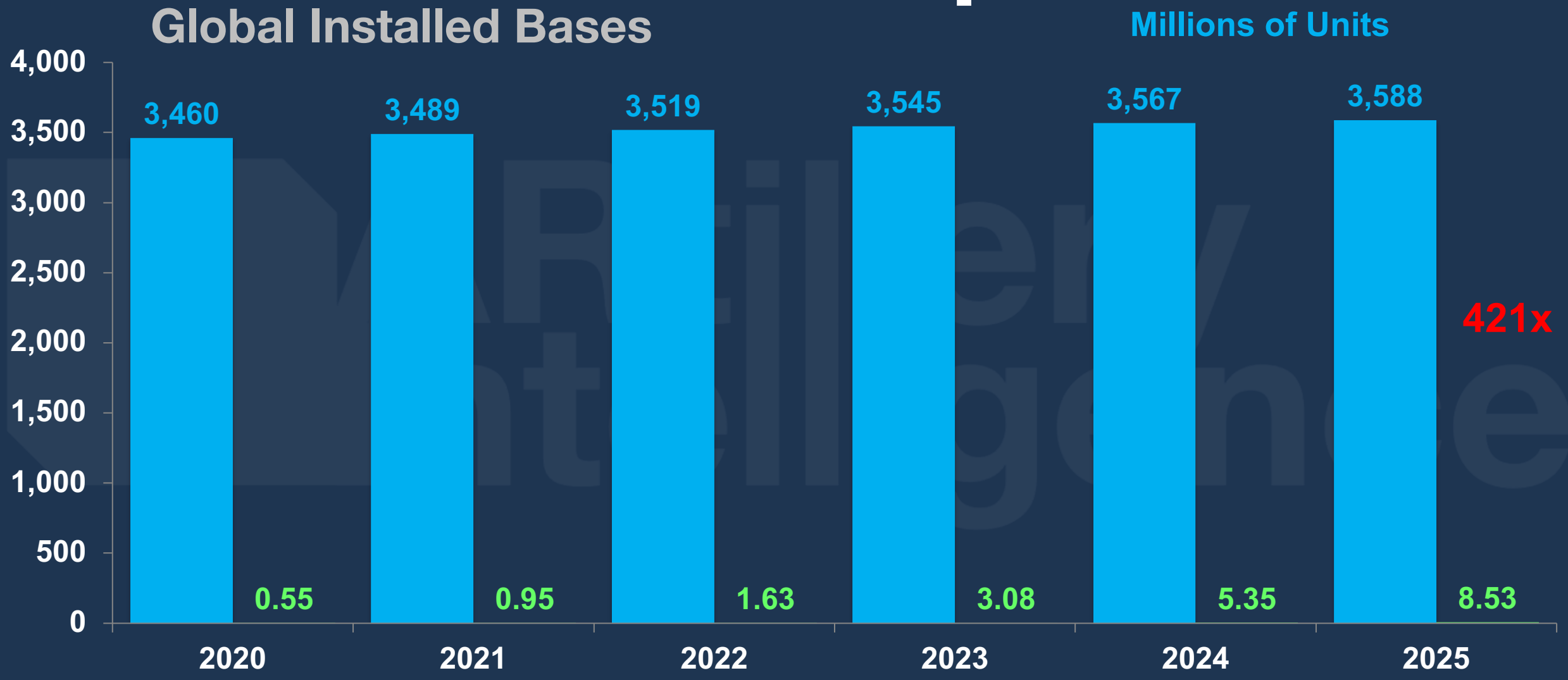
*This chart covers cumulative installed base. See separate slide for annual unit-sales figures.

AR Glasses: In Perspective



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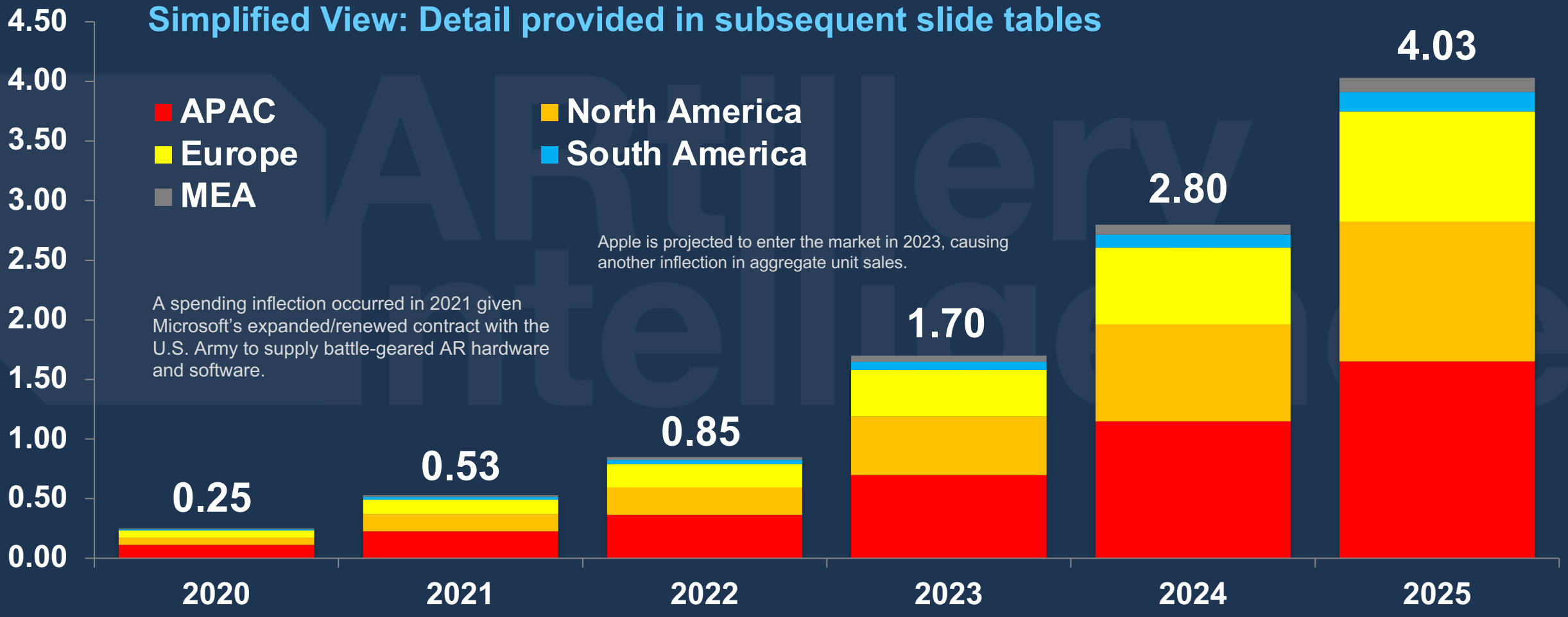
AR Glasses Sales Estimates

AR Glasses Unit Sales by Region

Millions of Units



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AR Glasses Sales Estimates

AR Glasses Unit Sales by Region

Millions of Units

	APAC	North America	Europe	South America	MEA	Total
2020	0.11	0.06	0.06	0.01	0.01	0.25
2021	0.23	0.14	0.12	0.02	0.02	0.53
2022	0.37	0.23	0.20	0.03	0.03	0.85
2023	0.70	0.49	0.39	0.07	0.05	1.70
2024	1.15	0.81	0.64	0.11	0.08	2.80
2025	1.65	1.17	0.93	0.16	0.12	4.03

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Consumer Spending

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Headworn AR Consumer Spending

- Headworn AR consumer spending is projected to grow from U.S. $20.8 million in 2020 to U.S. $1.67 billion in 2025, a 140% compound annual growth rate.
  - This includes hardware and software that consumers pay for, such as AR glasses and the software-based experiences that run on those glasses.
  - Though *mobile AR* is dominated by in-app purchases,* AR glasses will include a mix of app purchases and content subscriptions (like in VR).

- Like many emerging tech products historically, hardware dominates revenue share in early years, which is then outpaced by software over time.
  - This happens as a larger installed base of in-market hardware accumulates; and as software average revenue per user (ARPU) grows.
  - An escalating hardware base also attracts software development, which boosts content libraries and, in turn, drives more hardware sales.
  - This common pattern will likely be seen in consumer headworn AR.

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*See ARtillery Intelligence report: Mobile AR Global Revenue Forecast 2020-2025.

Headworn AR Consumer Spending

- Apple's entrance will impact the fate of the consumer-based headworn AR sector, due to its proven ability to mainstream emerging tech.
  - If Apple is able to sell the units that are projected in this forecast, its classic "halo effect" could accelerate sales across the sector.
  - As is often the case after Apple mainstreams a product, many lower-cost alternatives will benefit, such as hardware from Nreal and others.*
- Software revenue models will also be defined by Apple as it quickly gains consumer AR market share following its market entrance.
  - The work it's done to seed AR demand and developer competency with ARkit will anchor Apple's position as a central hub for AR experiences.
  - That will include a wide range of use cases that it motivates developers to build, including gaming, education, utilities, media and commerce.
  - There will also be success in focused vertical approaches such as Tilt Five.

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*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Headworn AR Consumer Spending

- As for what "Apple Glass" will be and do, several market signals indicate its likely orientation. We've incorporated this thinking into market projections.
  - Early versions of Apple's AR hardware will likely prioritize *wearability* over graphical intensity – with the latter developing in future generations.*
  - Apple's design sensibilities and fiduciary drive to appeal to massive markets will compel *smarter sunglasses* or even *corrective eyewear*.
  - This translates to heads-up displays (HUD) that feature informational overlays (e.g., messaging alerts) and fusion with other Apple wearables.

- The above distinction also must be made for AR glasses in general, as there's a wide range of modalities and feature sets on the *wearability* spectrum.
  - The broad designation of "AR glasses" can include spatially-intelligent and sensor-heavy hardware like HoloLens; and "lighter" HUD-based AR.
  - The latter will continue to expand as the consumer AR category grows.

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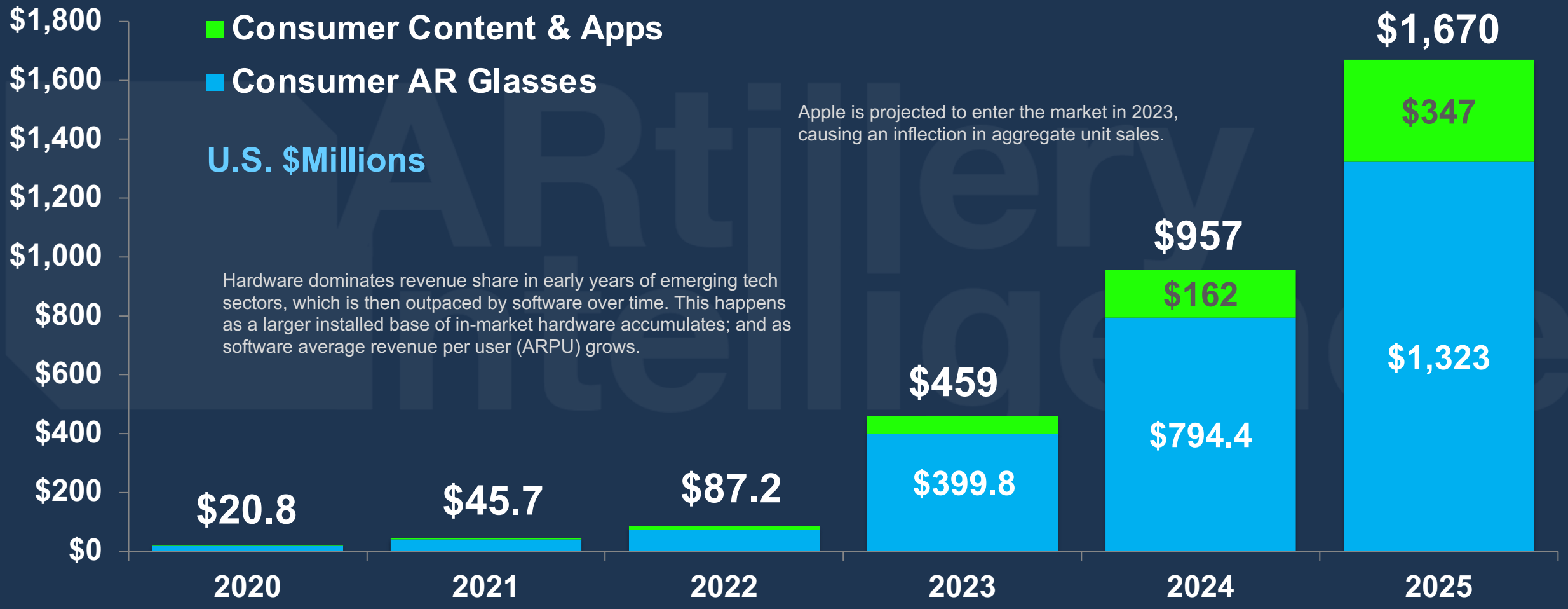
*See ARtillery Intelligence report: Smart Glasses: The Road to AR's Holy Grail

Consumer AR Glasses Estimates

Consumer AR Glasses Hardware & Software Revenue



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Consumer Spending Hardware Estimates

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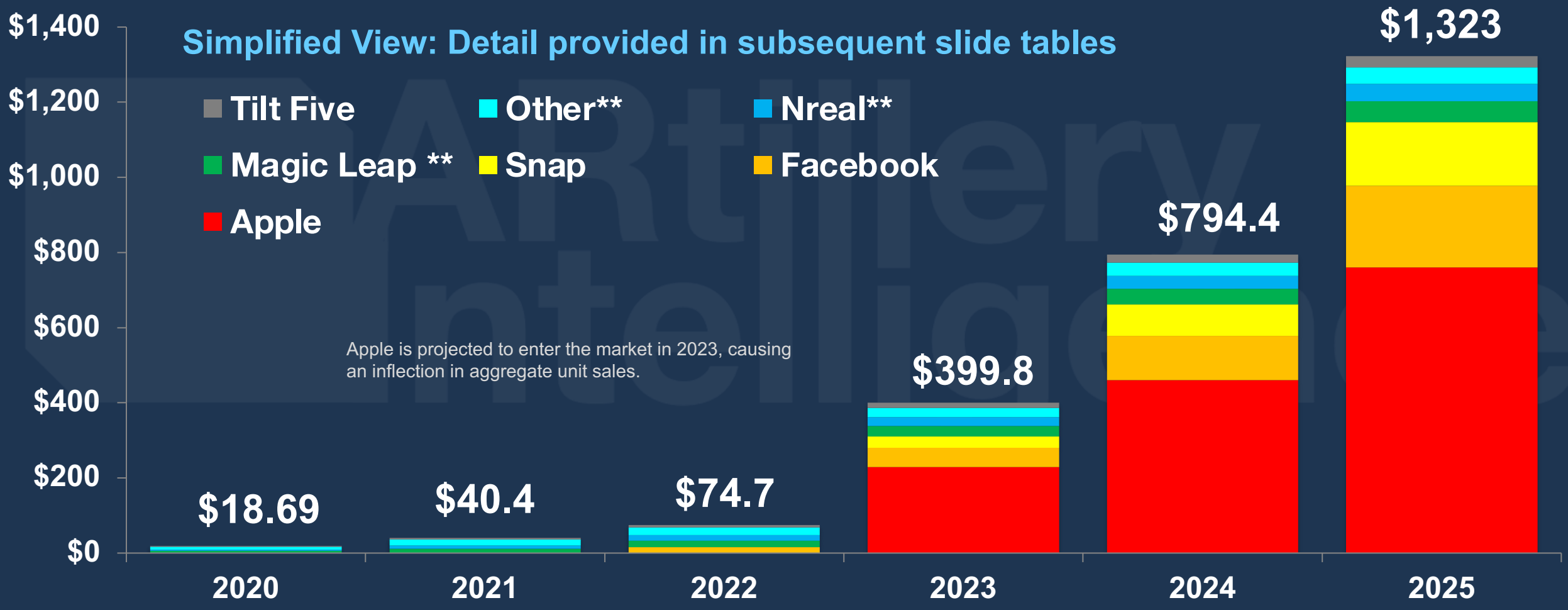
Consumer AR Glasses Estimates

Consumer AR Hardware* Annual Revenues

U.S. $Millions



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* This chart covers annual sales in U.S. dollars. See separate slide for annual sales in units.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast.

Consumer AR Glasses Estimates

Consumer AR Hardware* Annual Revenues

U.S. $Millions

	Apple	Facebook	Snap	Magic Leap**	Nreal**	Other**	Tilt Five	Total
2020	$0.00	$0.00	$0.00	$5.74	$3.32	$7.73	$1.90	$18.69
2021	$0.0	$0.0	$0.0	$10.9	$9.4	$16.1	$4.0	$40.4
2022	$0.0	$15.3	$0.0	$17.6	$15.0	$20.4	$6.5	$74.7
2023	$229	$51	$31	$27	$24	$25	$13	$399.8
2024	$460	$117	$84	$42	$35	$35	$21	$794.4
2025	$760	$217	$169	$55	$46	$44	$31	$1,323

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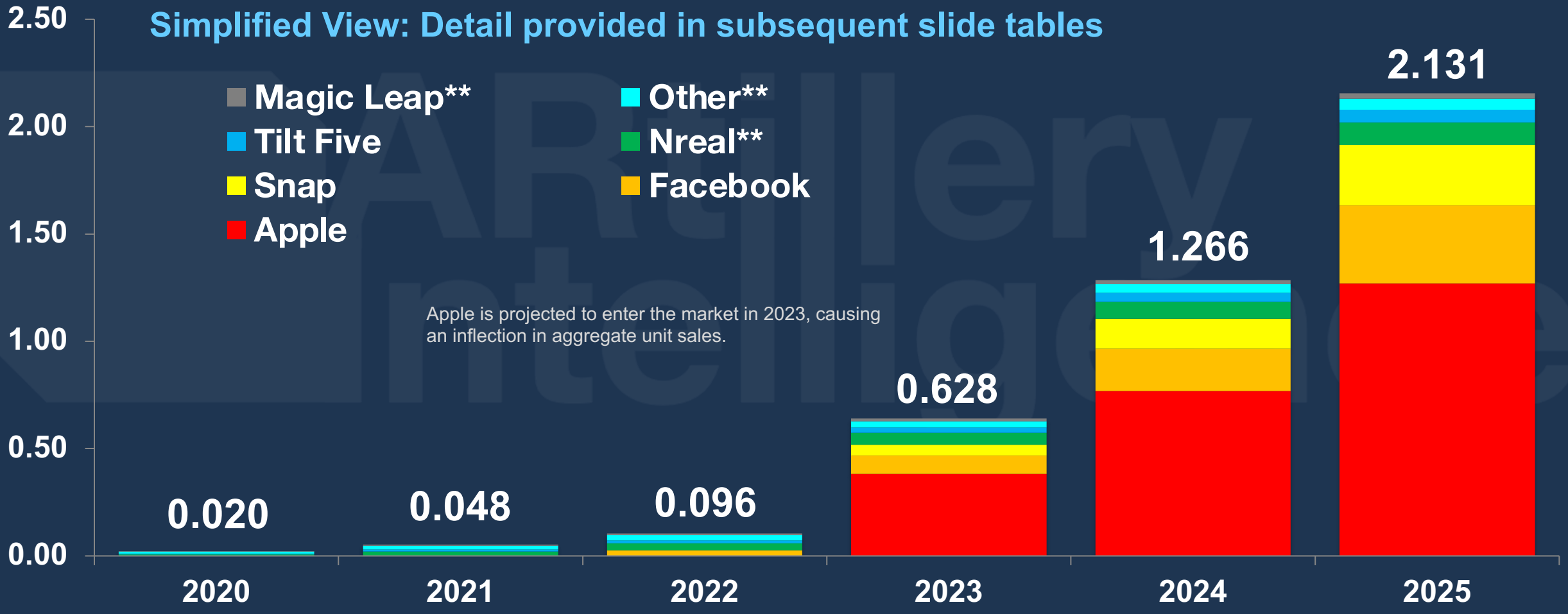
* This chart covers annual sales in U.S. dollars. See separate slide for annual sales in units.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast.

Consumer AR Glasses Estimates

Consumer AR Glasses* Annual Unit Sales

Millions of Units



ARtillery Intelligence

*This chart covers annual sales in units. See separate charts for revenue estimates and installed bases.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast.

Consumer AR Glasses Estimates

Consumer AR Glasses* Annual Unit Sales

Millions of Units

	Apple	Facebook	Snap	Magic Leap**	Nreal**	Other**	Tilt Five	Total
2020	0.000	0.000	0.000	0.008	0.004	0.009	0.003	0.020
2021	0.000	0.000	0.000	0.021	0.008	0.019	0.005	0.048
2022	0.000	0.026	0.000	0.034	0.013	0.024	0.008	0.096
2023	0.383	0.085	0.051	0.054	0.026	0.029	0.012	0.628
2024	0.769	0.196	0.140	0.078	0.042	0.041	0.018	1.266
2025	1.269	0.363	0.282	0.105	0.060	0.051	0.024	2.131

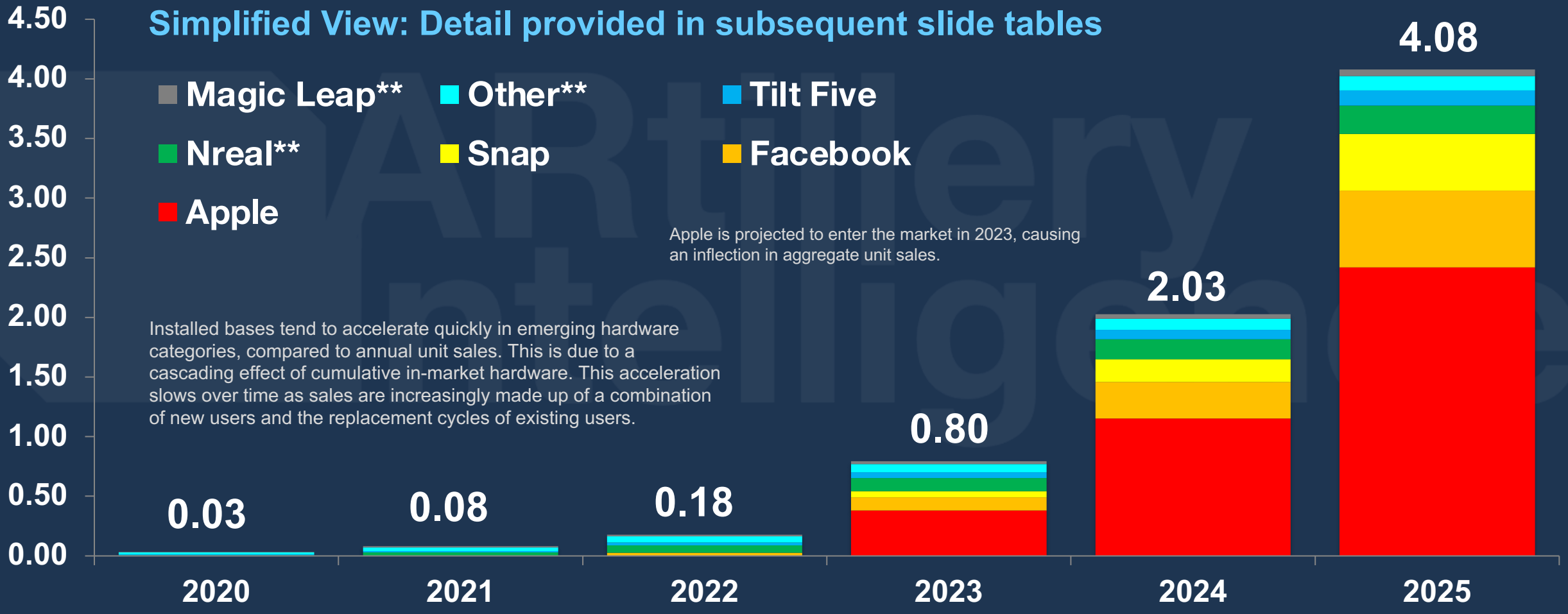
ARtillery Intelligence

*This chart covers annual sales in units. See separate charts for revenue estimates and installed bases.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast.

Consumer AR Glasses Estimates

Consumer AR Glasses* Installed Base* by Brand

Millions of Units



ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast

Consumer AR Glasses Estimates

Consumer AR Glasses* Installed Base* by Brand

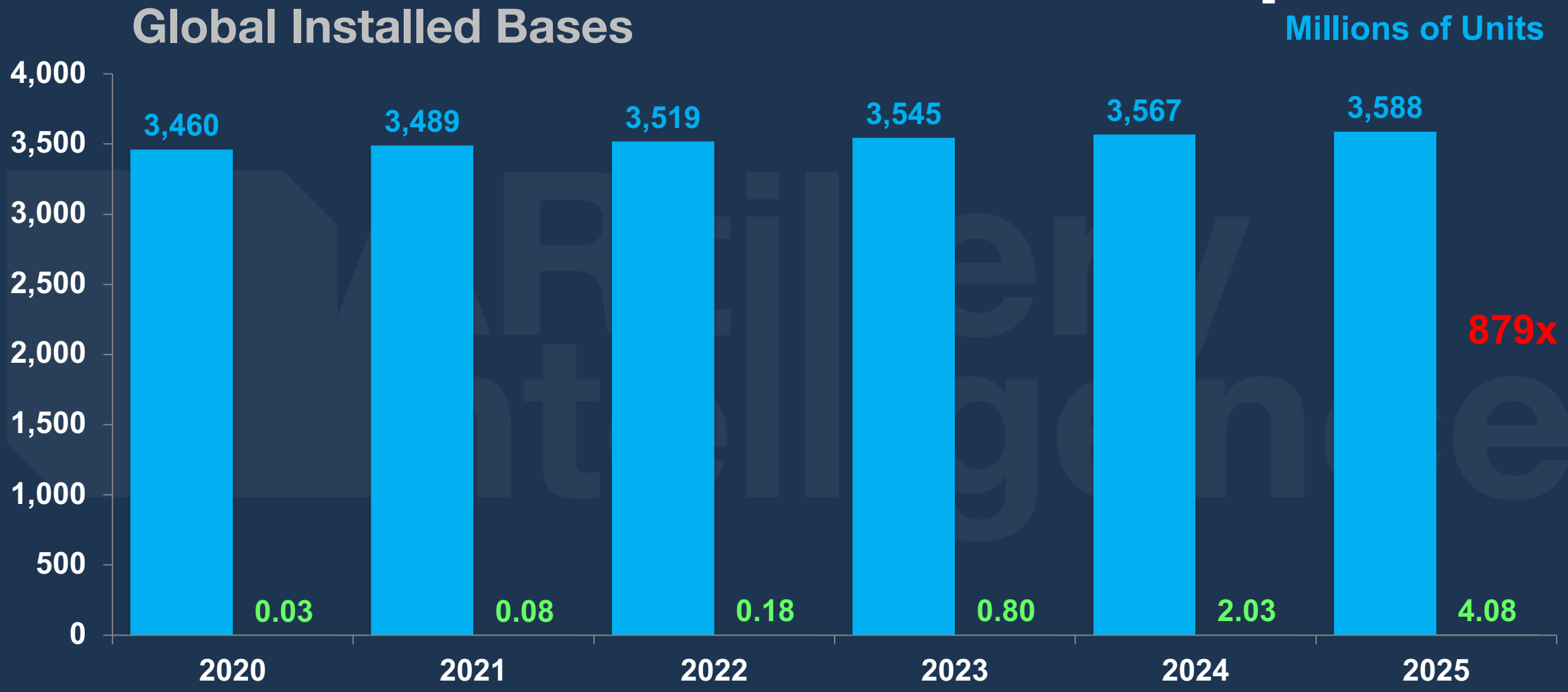
Millions of Units

	Apple	Facebook	Snap	Magic Leap**	Nreal**	Other**	Tilt Five	Total
2020	0.000	0.000	0.000	0.008	0.004	0.020	0.004	0.03
2021	0.000	0.000	0.000	0.029	0.012	0.032	0.008	0.08
2022	0.000	0.026	0.000	0.063	0.024	0.052	0.015	0.18
2023	0.383	0.111	0.051	0.110	0.046	0.072	0.024	0.80
2024	1.151	0.307	0.191	0.167	0.080	0.094	0.038	2.03
2025	2.421	0.644	0.473	0.238	0.128	0.121	0.054	4.08

ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.
**These vendors have (or are projected to have) enterprise-targeted hardware as well, which is included in the enterprise spending section of this forecast.

Consumer AR Glasses: In Perspective



ARtillery Intelligence

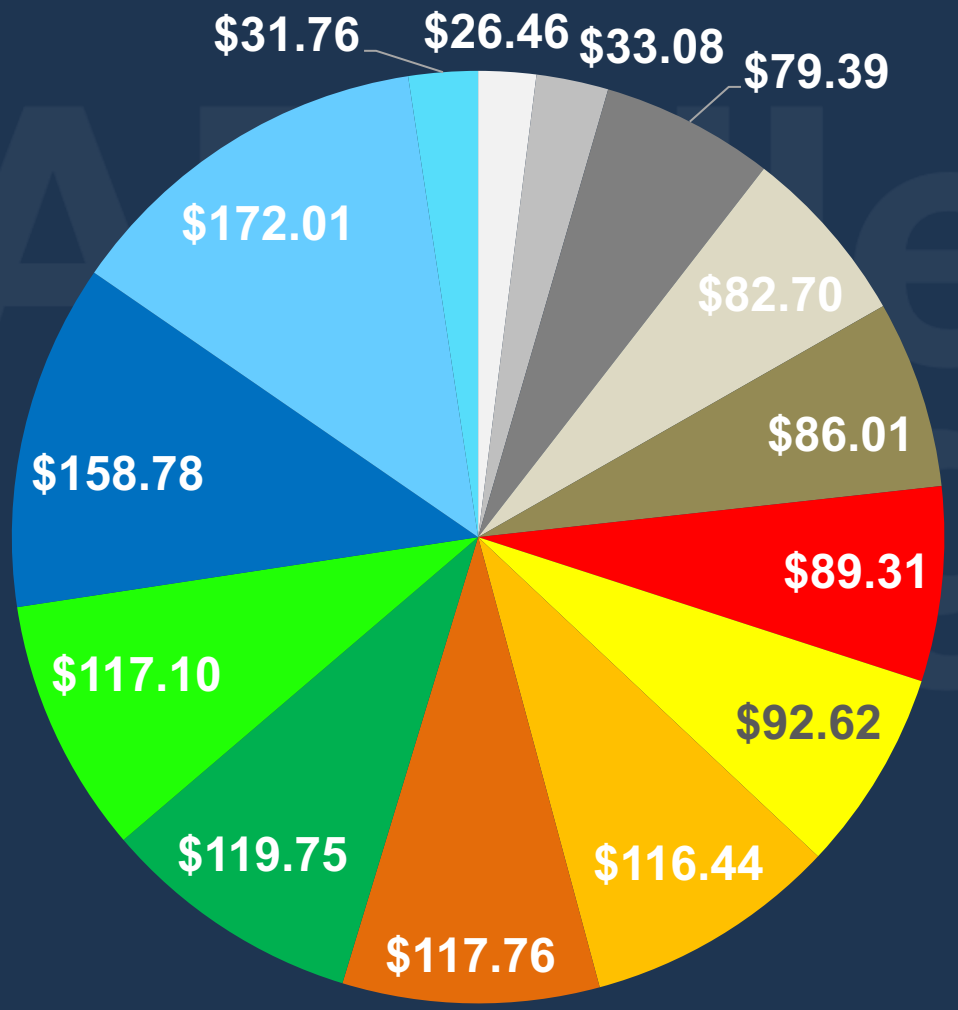
Consumer AR Glasses Estimates

Consumer AR Glasses Hardware Spending* by Use Case

2025

U.S. $Millions

*These figures measure spending estimates based on the primary intended usage for AR hardware.



- Sports & Outdoor
- Food & Beverage
- Travel & Events
- Knowledge & Education
- Home Improvement & Décor
- Shopping & Commerce
- Home & Tech Support
- Health & Wellness
- Mapping, Navigation & Local Search
- Social
- Gaming
- Media & Entertainment
- Personal Computing & Productivity
- Other

ARtillery Intelligence

Consumer AR Glasses Estimates

Consumer AR Glasses Hardware Spending* by Use Case

U.S. $Millions

	Sports & Outdoor	Food & Beverage	Travel & Events	Knowledge & Education	Home Improvement & Décor	Shopping & Commerce	Home & Tech Support	Health & Wellness	Mapping, Navigation & Local Search	Social	Gaming	Media & Entertainment	Personal Computing & Productivity	Other	Total
2020	$0.37	$0.47	$1.12	$1.17	$1.21	$1.26	$1.31	$1.07	$1.03	$1.68	$2.06	$2.24	$2.43	$1.26	$18.69
2021	$0.81	$1.01	$2.43	$2.53	$2.63	$2.73	$2.83	$2.32	$2.22	$3.64	$4.45	$4.85	$5.25	$2.73	$40.42
2022	$1.49	$1.87	$4.48	$4.67	$4.86	$5.04	$5.23	$4.33	$4.41	$6.72	$7.84	$8.96	$9.71	$5.08	$74.70
2023	$8.00	$9.99	$23.99	$24.99	$25.99	$26.99	$27.99	$27.19	$27.59	$35.98	$39.98	$47.97	$51.97	$21.19	$399
2024	$15.89	$19.86	$47.67	$49.65	$51.64	$53.62	$55.61	$61.96	$62.76	$71.50	$75.47	$95.33	$103.27	$30.19	$794
2025	$26.46	$33.08	$79.39	$82.70	$86.01	$89.31	$92.62	$116.44	$117.76	$119.75	$117.10	$158.78	$172.01	$31.76	$1,323

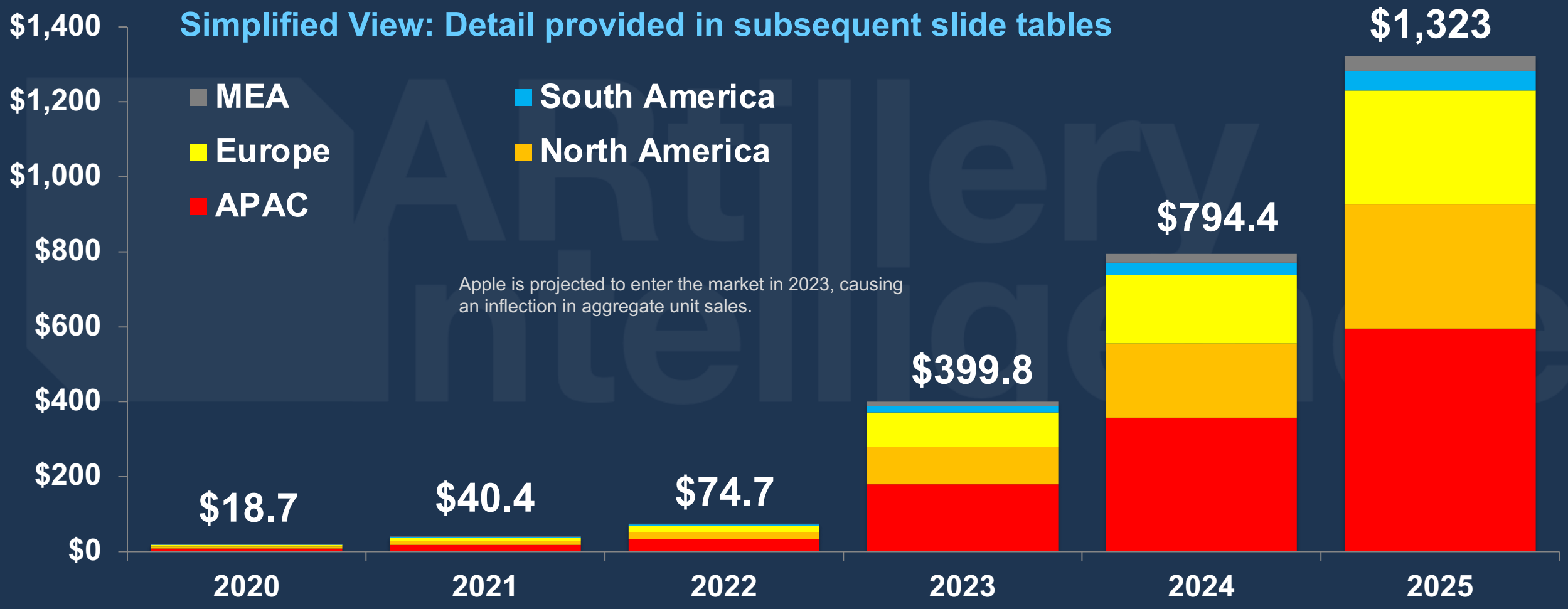
ARtillery Intelligence

*These figures measure spending estimates based on the primary intended usage for AR hardware.

Consumer AR Glasses Estimates

Consumer AR Glasses Hardware Spending, by Region

U.S. $Millions



ARtillery Intelligence

Consumer AR Glasses Estimates

Consumer AR Glasses Hardware Spending, by Region

U.S. $Millions

	APAC	North America	Europe	South America	MEA	Total
2020	$8.41	$4.67	$4.30	$0.75	$0.56	$18.7
2021	$18.19	$10.10	$9.30	$1.62	$1.21	$40.4
2022	$33.61	$18.67	$17.18	$2.99	$2.24	$74.7
2023	$179.90	$99.95	$91.95	$15.99	$11.99	$399.8
2024	$357.49	$198.61	$182.72	$31.78	$23.83	$794.4
2025	$595.42	$330.79	$304.33	$52.93	$39.69	$1,323

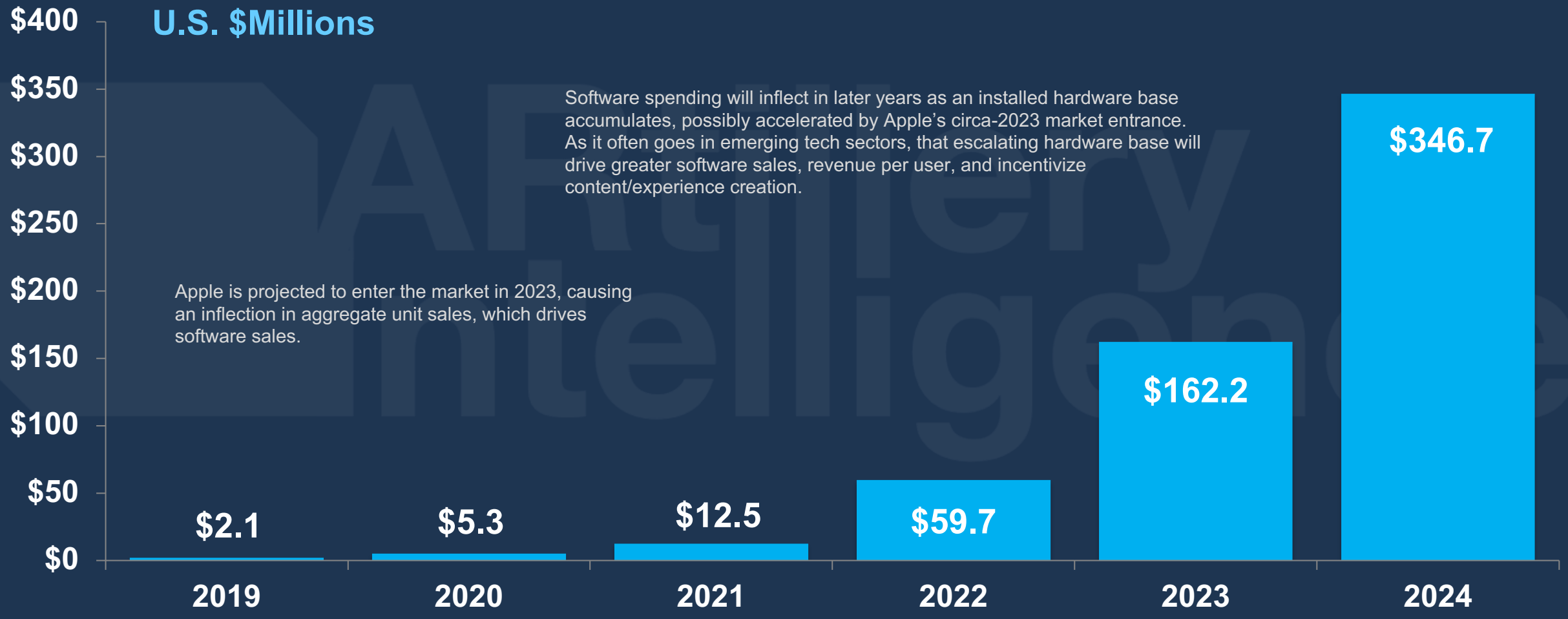
ARtillery Intelligence

Consumer Spending Software Estimates

ARtillery Intelligence

Consumer AR Glasses Software

Consumer AR Glasses Software Spending Estimates



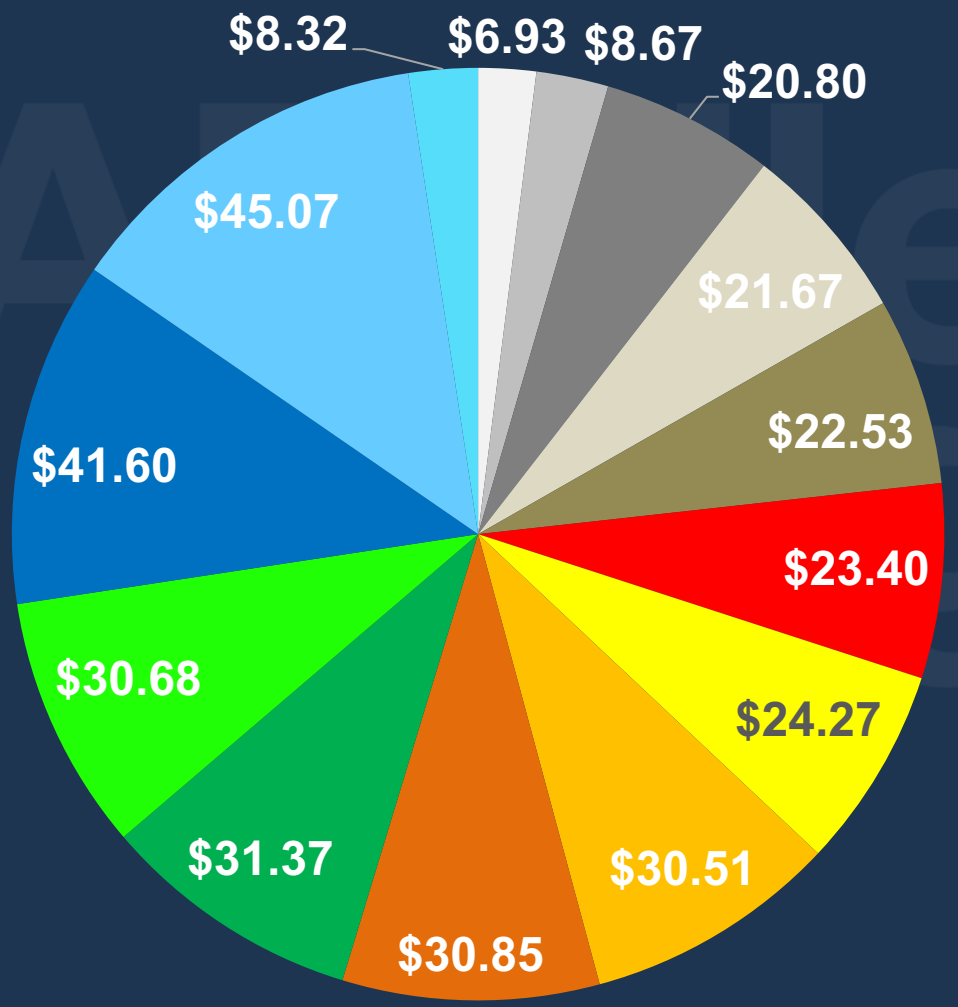
ARtillery Intelligence

Consumer AR Glasses Software

Consumer AR Glasses Software Estimates, by Use Case

2025

U.S. $Millions



ARtillery Intelligence

Consumer AR Glasses Software

Consumer AR Glasses Software Estimates, by Use Case

U.S. $Millions

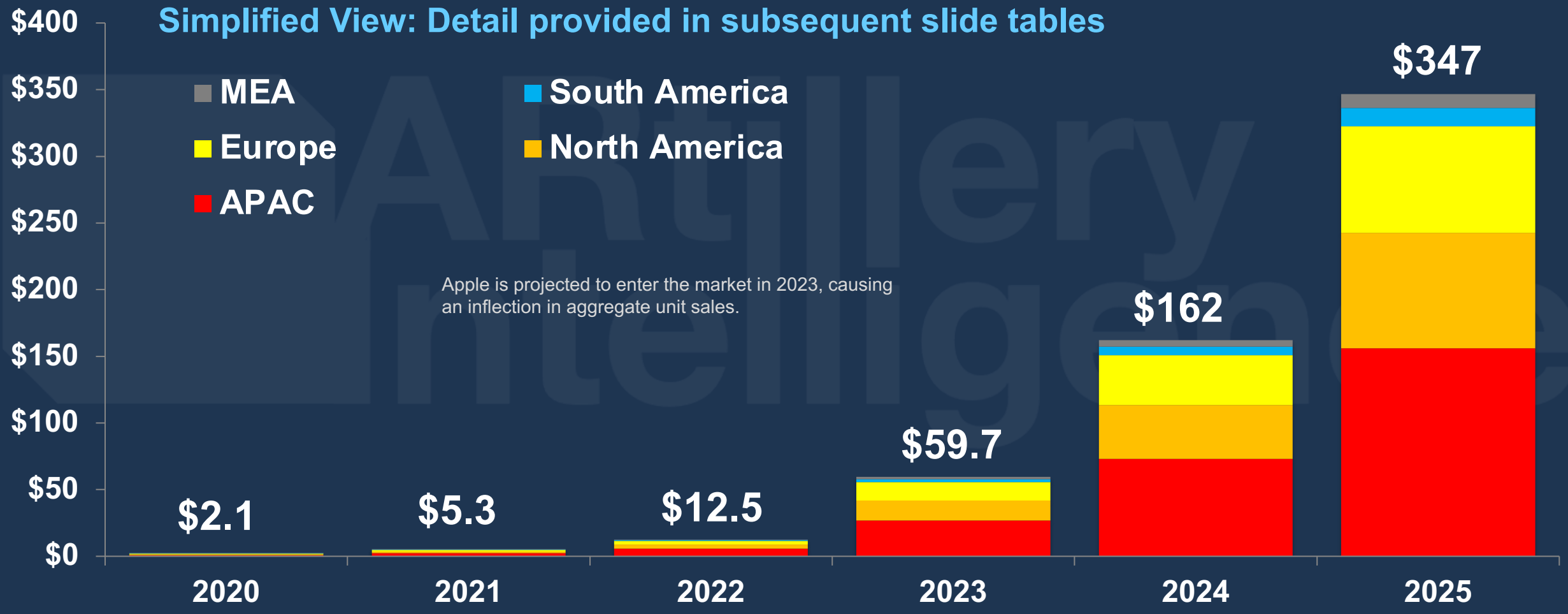
	Sports & Outdoor	Food & Beverage	Travel & Events	Knowledge & Education	Home Improvement & Décor	Shopping & Commerce	Home & Tech Support	Health & Wellness	Mapping, Navigation & Local Search	Social	Gaming	Media & Entertainment	Personal Computing & Productivity	Other	Total
2020	$0.04	$0.05	$0.13	$0.13	$0.14	$0.14	$0.15	$0.12	$0.11	$0.19	$0.23	$0.25	$0.27	$0.14	$2.09
2021	$0.11	$0.13	$0.32	$0.33	$0.34	$0.35	$0.37	$0.30	$0.29	$0.47	$0.58	$0.63	$0.68	$0.35	$5.26
2022	$0.25	$0.31	$0.75	$0.78	$0.82	$0.85	$0.88	$0.73	$0.74	$1.13	$1.32	$1.51	$1.63	$0.85	$12.54
2023	$1.19	$1.49	$3.58	$3.73	$3.88	$4.03	$4.18	$4.06	$4.12	$5.37	$5.97	$7.16	$7.76	$3.16	$59.69
2024	$3.24	$4.05	$9.73	$10.14	$10.54	$10.95	$11.35	$12.65	$12.81	$14.60	$15.41	$19.46	$21.08	$6.16	$162.18
2025	$6.93	$8.67	$20.80	$21.67	$22.53	$23.40	$24.27	$30.51	$30.85	$31.37	$30.68	$41.60	$45.07	$8.32	$346.68

ARtillery Intelligence

Consumer AR Glasses Software

Consumer AR Glasses Software Estimates, by Region

U.S. $Millions



ARtillery Intelligence

Consumer AR Glasses Software

Consumer AR Glasses Software Estimates, by Region

U.S. $Millions

	APAC	North America	Europe	South America	MEA	Total
2020	$0.94	$0.52	$0.48	$0.08	$0.06	$2.1
2021	$2.37	$1.31	$1.21	$0.21	$0.16	$5.3
2022	$5.64	$3.14	$2.88	$0.50	$0.38	$12.5
2023	$26.86	$14.92	$13.73	$2.39	$1.79	$59.7
2024	$72.98	$40.55	$37.30	$6.49	$4.87	$162
2025	$156.01	$86.67	$79.74	$13.87	$10.40	$347

ARtillery Intelligence

Enterprise Spending

ARtillery Intelligence

Headworn AR Enterprise Estimates

- Headworn AR enterprise spending will grow from U.S. $1.57 billion in 2020 to U.S. $15.8 billion in 2025, a 58.6% compound annual growth rate (CAGR).
  - This includes AR headsets, software that runs on that hardware, and developer platforms (e.g., Unity) to create immersive experiences.
  - The latter includes software that enables both enterprise *and* consumer experience creation – the latter known as *B2B2C*.

- Among enterprise AR revenue subdivisions, hardware and software are fairly-even in early years, with software gaining pace in later years.
  - This is a common pattern in emerging tech markets (see consumer AR section) as hardware often comes first and establishes an installed base.
  - Software sales (e.g., annual licenses) then accelerate as they build on a cumulative base of in-market hardware.

ARtillery Intelligence

Headworn AR Enterprise Estimates

- **The leading software revenue category is enterprise productivity & planning.**
  - This involves visualization software for line-of-sight or live-guided support in areas like assembly, maintenance, and tech support.
  - That's followed by software that helps enterprises (or software vendors that serve them) author AR experiences that fit the above description.
  - Revenue potential stems from a strong business case and applicability across enterprise verticals and use cases (quantified later in this report).

- **Despite these advantages, enterprise AR spending on headworn AR has been slowed by organizational/cultural barriers and adoption inertia.***
  - This will continue to be enterprise AR's biggest challenge, leading to the dreaded "pilot purgatory," which causes full AR deployments to stall.
  - Case studies* continue to validate strong ROI, signaling that cultural resistance will eventually give way to the technology's inevitable benefits.

ARtillery Intelligence

*See ARtillery Intelligence report: Enterprise AR Best Practices & Case Studies.

Headworn AR Enterprise Estimates

- **Another adoption accelerant will be Covid-era digital transformation**
  - Global lockdowns and other constraints compel enterprise AR as formats like remote AR visualization enable social-distancing productivity.
  - Though these factors applied more during the height of 2020 Covid-inflicted lockdowns, post-covid "hybrid" models may compel AR.
  - Furthermore, accelerated transformation during Covid could end up benefiting enterprise AR through elevated exposure to the technology.

- **Enterprise AR's greatest revenue inflection results from military spending.**
  - Microsoft secured an expanded contract with the U.S. Army in Q2 to supply battle-geared AR hardware and software for $22 billion over 10 years*.
  - This contract causes a notable jump in aggregate AR sales, which we've amortized over the life of the contract, including roughly 120,000 incremental HoloLens units (and supporting software) per year.

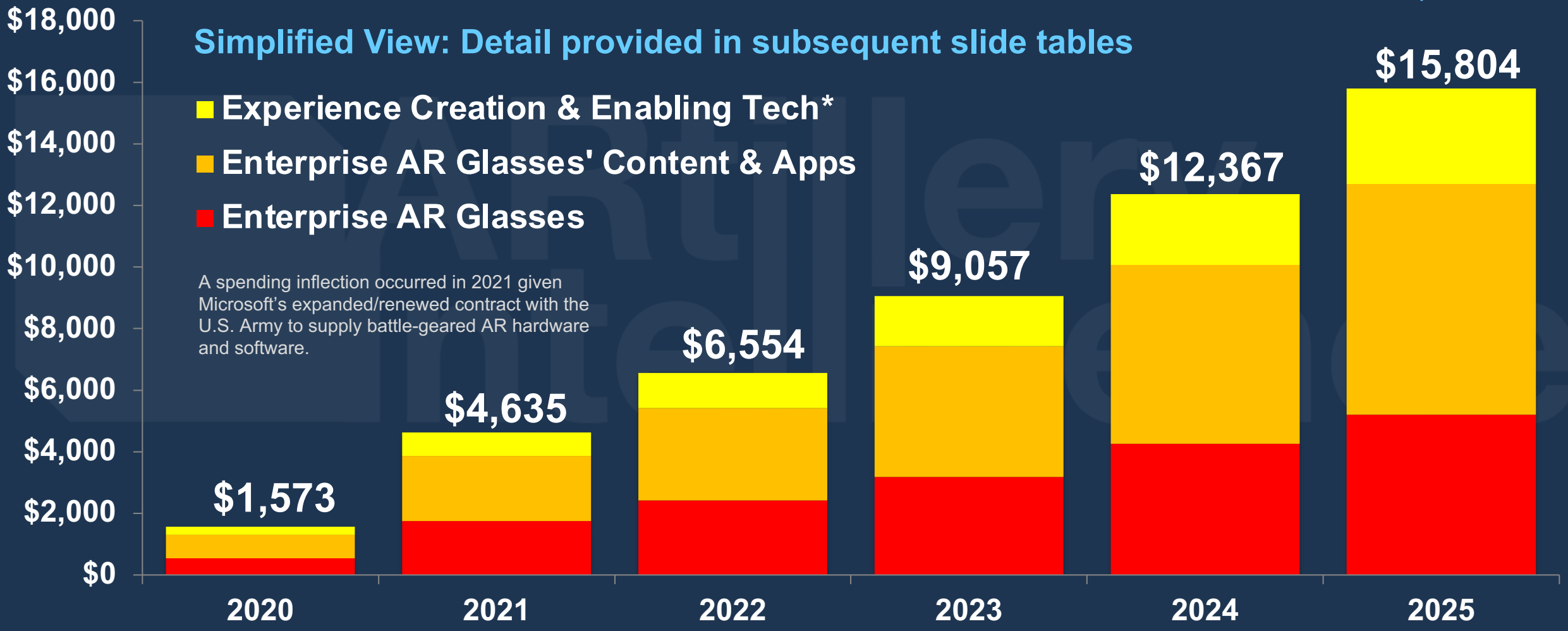
ARtillery Intelligence

*See ARtillery Intelligence article: Did the U.S. Army Double the Size of the AR Market?

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware & Software Revenue

U.S. $Millions



ARtillery Intelligence

*Includes platform revenue for consumer and enterprise experience creation (bought by enterprises and developers).

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware & Software Revenue

U.S. $Millions

	Enterprise AR Glasses	Enterprise AR Glasses' Content & Apps	Experience Creation & Enabling Tech*	Total
2020	$539	$763	$271	$1,573
2021	$1,745	$2,124	$766	$4,635
2022	$2,426	$2,996	$1,132	$6,554
2023	$3,182	$4,246	$1,629	$9,057
2024	$4,263	$5,804	$2,300	$12,367
2025	$5,206	$7,497	$3,101	$15,804

ARtillery Intelligence

*Includes platform revenue for consumer and enterprise experience creation (bought by enterprises and developers).

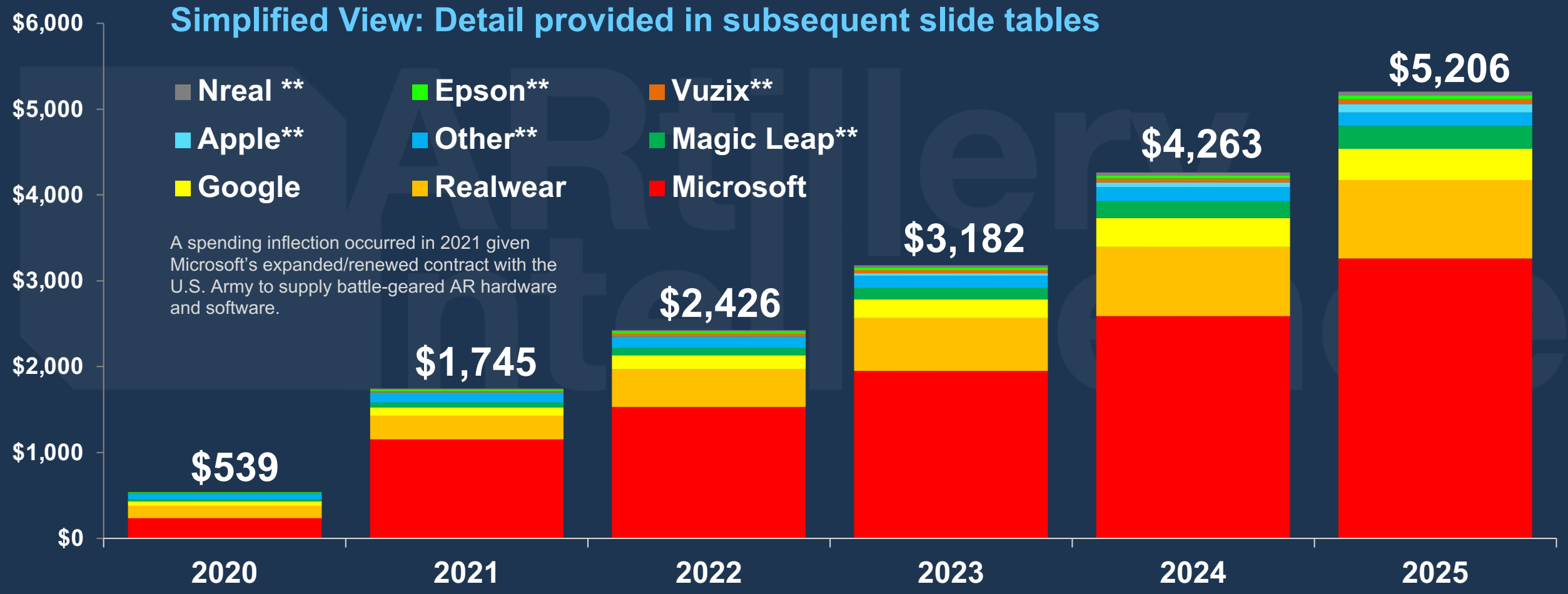
Enterprise Spending Hardware Estimates

ARtillery Intelligence

Enterprise AR Glasses Estimates

Enterprise AR Glasses Annual Revenues* by Brand

U.S. $Millions



ARtillery Intelligence

*This chart covers annual sales in U.S. dollars, so market shares are impacted by hardware prices. See separate slide for annual sales in units.

**These vendors have (or are projected to have) consumer-targeted hardware, which is included in the consumer spending section of this forecast.

Enterprise AR Glasses Estimates

Enterprise AR Glasses Annual Revenues* by Brand

U.S. $Millions

	Microsoft	Realwear	Google	Magic Leap**	Other**	Apple**	Vuzix**	Epson**	Nreal**	Total
2020	$236.3	$143.7	$52.4	$27.5	$60.2	$0.0	$10.2	$8.8	$0.0	$539
2021	$1,155.0	$272.6	$100.6	$52.4	$118.3	$0.0	$20.4	$17.0	$8.5	$1,745
2022	$1,532.0	$437.1	$161.3	$84.0	$138.4	$0.0	$32.7	$27.3	$13.6	$2,426
2023	$1,948.5	$617.1	$220.8	$130.7	$143.7	$29.7	$37.4	$32.4	$21.7	$3,182
2024	$2,589	$805	$336	$200	$159	$60	$45	$39	$31	$4,263
2025	$3,260	$914	$362	$265	$160	$99	$55	$48	$42	$5,206

ARtillery Intelligence

*This chart covers annual sales in U.S. dollars, so market shares are impacted by hardware prices. See separate slide for annual sales in units.

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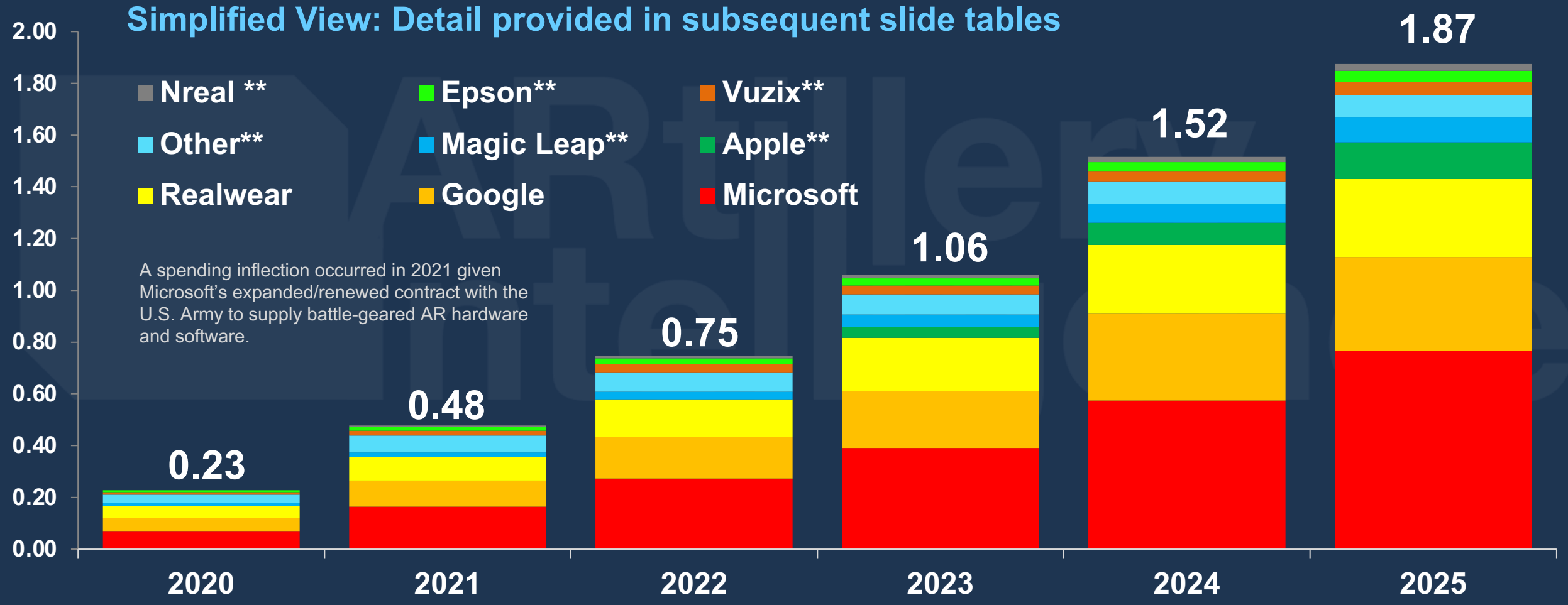
Enterprise AR Glasses Estimates

Enterprise AR Glasses Annual Unit Sales* by Brand

Millions of Units



ARtillery Intelligence

*This chart covers annual unit sales. See separate slides for cumulative installed base and revenue.
**These vendors have (or are projected to have) consumer-targeted hardware, which is included in the consumer spending section of this forecast.

Enterprise AR Glasses Estimates

Enterprise AR Glasses Annual Unit Sales* by Brand

Millions of Units

	Microsoft	Google	Realwear	Apple**	Magic Leap**	Other**	Vuzix**	Epson**	Nreal **	Total
2020	0.0675	0.0525	0.0475	0.0000	0.0100	0.0326	0.0093	0.0079	0.0000	0.23
2021	0.1643	0.1007	0.0901	0.0000	0.0191	0.0641	0.0186	0.0153	0.0053	0.48
2022	0.2720	0.1615	0.1445	0.0000	0.0306	0.0749	0.0298	0.0245	0.0085	0.75
2023	0.3910	0.2210	0.2040	0.0425	0.0476	0.0778	0.0340	0.0291	0.0136	1.06
2024	0.5740	0.3360	0.2660	0.0854	0.0728	0.0862	0.0406	0.0353	0.0196	1.52
2025	0.7657	0.3627	0.3023	0.1411	0.0967	0.0864	0.0504	0.0435	0.0262	1.87

ARtillery Intelligence

*This chart covers annual unit sales. See separate slides for cumulative installed base and revenue.
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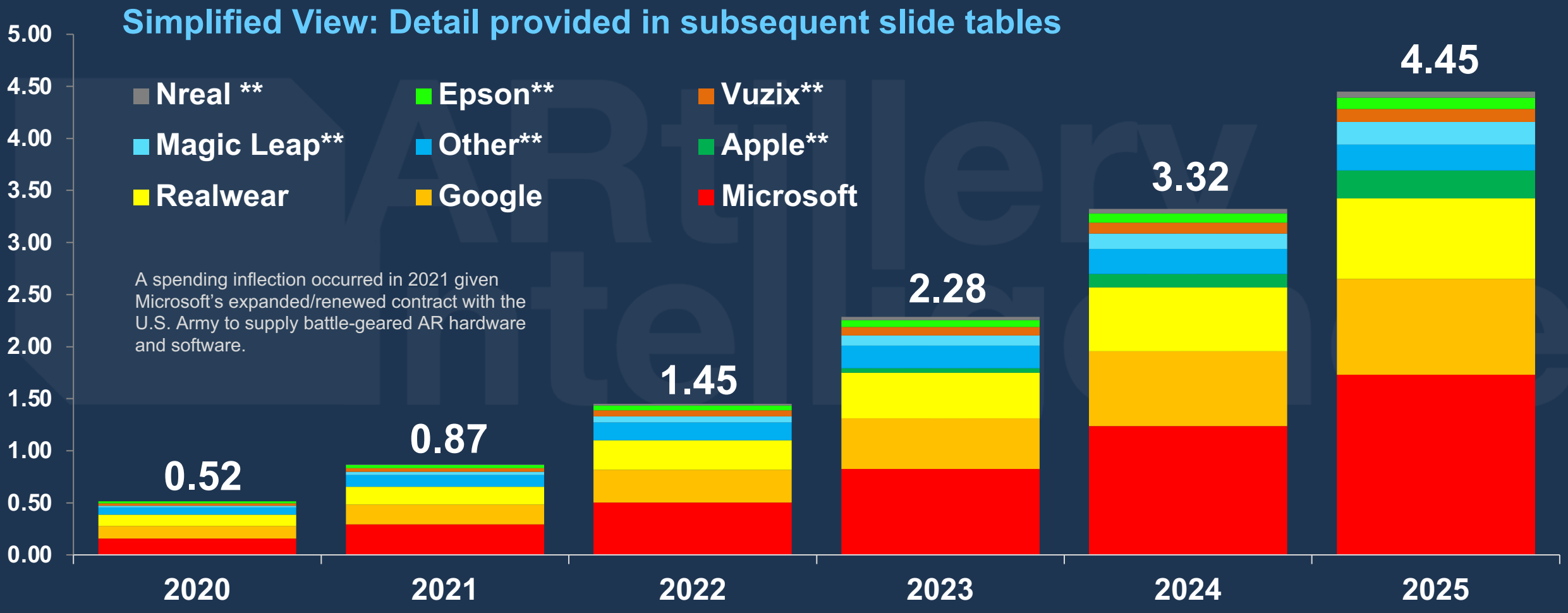
Enterprise AR Glasses Estimates

Enterprise AR Glasses Installed Base* by Brand

Millions of Units



ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.
**These vendors have (or are projected to have) consumer-targeted hardware, which is included in the consumer spending section of this forecast.

Enterprise AR Glasses Estimates

Enterprise AR Glasses Installed Base* by Brand

Millions of Units

	Microsoft	Google	Realwear	Apple**	Magic Leap**	Other**	Vuzix**	Epson**	Nreal **	Total
2020	0.1582	0.1185	0.1105	0.0000	0.0691	0.0162	0.0227	0.0200	0.0000	0.52
2021	0.2913	0.1906	0.1733	0.0000	0.1113	0.0332	0.0341	0.0300	0.0053	0.87
2022	0.5038	0.3147	0.2821	0.0000	0.1716	0.0597	0.0576	0.0476	0.0138	1.45
2023	0.8273	0.4832	0.4386	0.0425	0.2168	0.0973	0.0823	0.0688	0.0274	2.28
2024	1.2370	0.7185	0.6145	0.1279	0.2389	0.1510	0.1044	0.0888	0.0417	3.32
2025	1.7307	0.9197	0.7723	0.2690	0.2505	0.2171	0.1250	0.1079	0.0594	4.45

ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.
**These vendors have (or are projected to have) consumer-targeted hardware, which is included in the consumer spending section of this forecast.

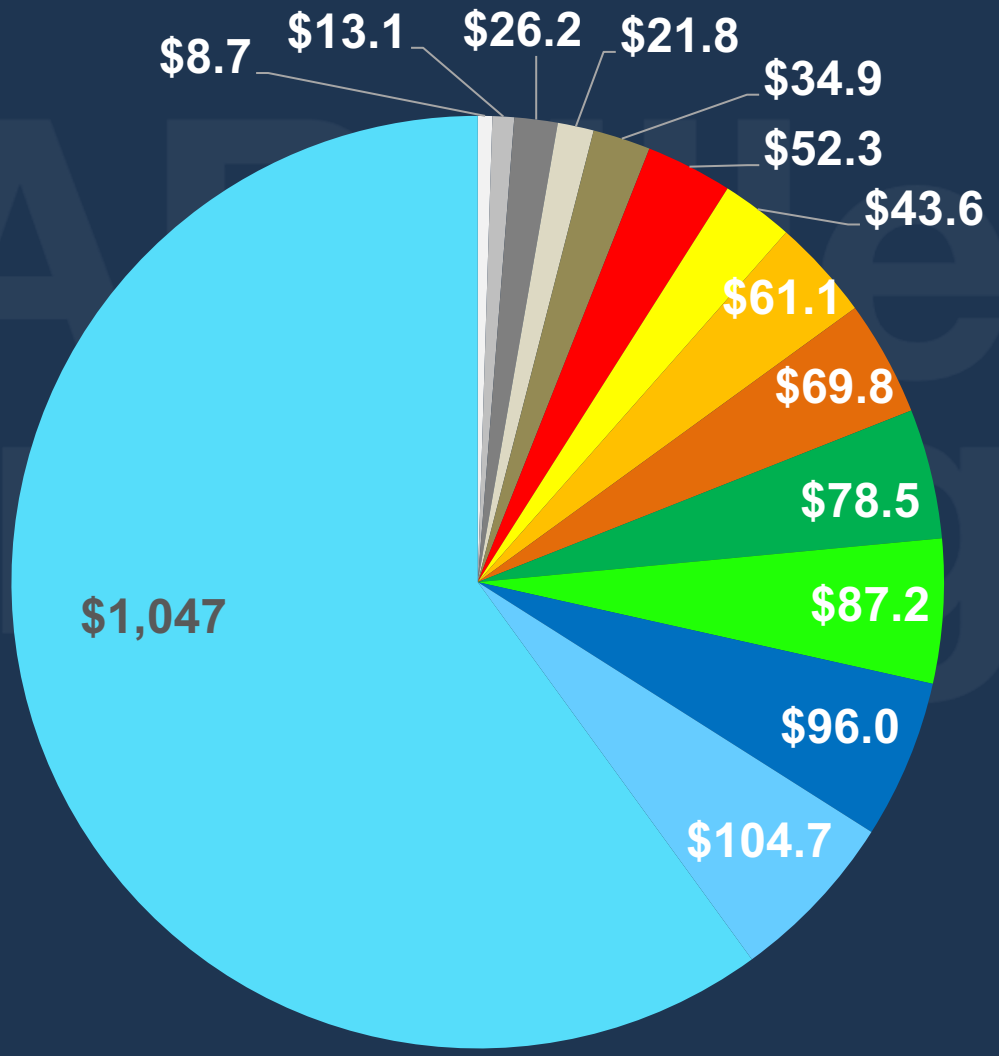
Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Vertical

2021

U.S. $Millions

A spending inflection occurred in 2021 given Microsoft's expanded/renewed contract with the U.S. Army to supply battle-geared AR hardware and software.



ARtillery Intelligence

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Vertical

U.S. $Millions

	Retail	Real Estate	Education	Finance	Other Corporate/ Commercial	Healthcare	Other Industrial	Telecom	Transportation	AEC	Aviation & Aerospace	Automotive	Oil, Gas & Utilities	Government/ Military	Total
2020	$5.39	$10.78	$13.47	$16.17	$21.56	$32.34	$26.95	$35.03	$37.73	$40.42	$43.12	$45.81	$48.51	$161.70	$539
2021	$8.72	$13.09	$26.17	$21.81	$34.89	$52.34	$43.62	$61.07	$69.79	$78.51	$87.24	$95.96	$104.68	$1,046.84	$1,745
2022	$12.13	$18.20	$36.40	$42.46	$60.66	$84.92	$72.79	$97.05	$109.19	$121.32	$133.45	$145.58	$157.71	$1,334.49	$2,426
2023	$15.91	$23.86	$47.73	$71.59	$95.46	$127.27	$111.37	$143.18	$159.09	$175.00	$190.91	$206.82	$222.73	$1,590.93	$3,182
2024	$21.32	$31.98	$63.95	$138.56	$170.53	$213.17	$191.85	$234.48	$255.80	$277.12	$298.44	$319.75	$341.07	$1,705.34	$4,263
2025	$26.03	$39.05	$78.09	$195.23	$234.27	$286.33	$260.30	$312.36	$338.39	$364.42	$390.45	$416.48	$442.51	$1,822.12	$5,206

ARtillery Intelligence

Enterprise Adoption Drivers

Factors Influencing Vertical-Specific Enterprise AR Adoption

ARtillery Intelligence

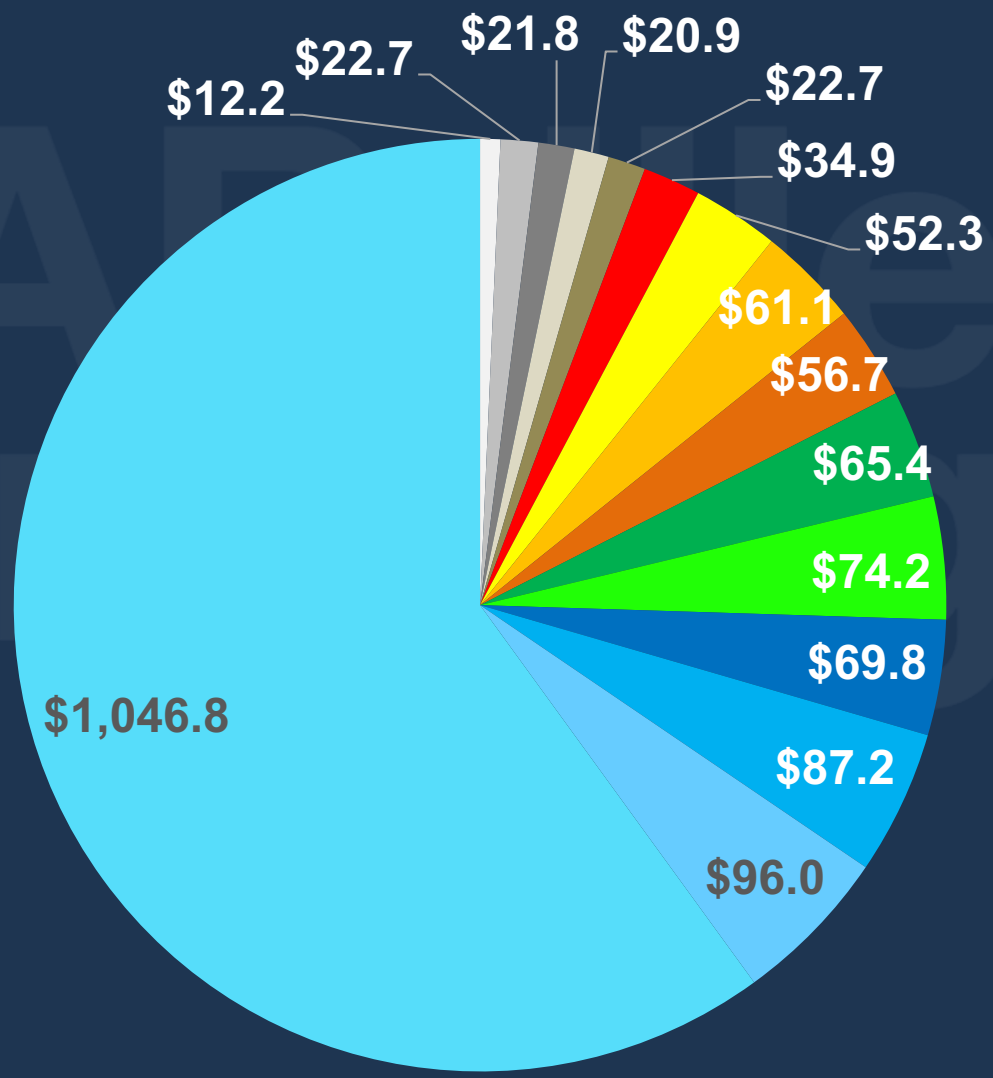
Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Use Case

2021

U.S. $Millions

A spending inflection occurred in 2021 given Microsoft's expanded/renewed contract with the U.S. Army to supply battle-geared AR hardware and software.



- Instruction & Education
- Other Corporate & Commercial
- Advanced imaging (including Surgical)
- Data Visualizaiton
- Other Field & Industrial
- Warehousing & Logistics
- Spatial Planning (AEC & Real Estate)
- Corporate & Industrial Sales
- Productivity & Virtual Desktop
- Product Design & Collaboration
- Field Services & Tech Support
- Maintenance & Repair
- Industrial Assembly
- Training & Knowledge Transfer
- Tactical & Combat

ARtillery Intelligence

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Use Case

U.S. $Millions

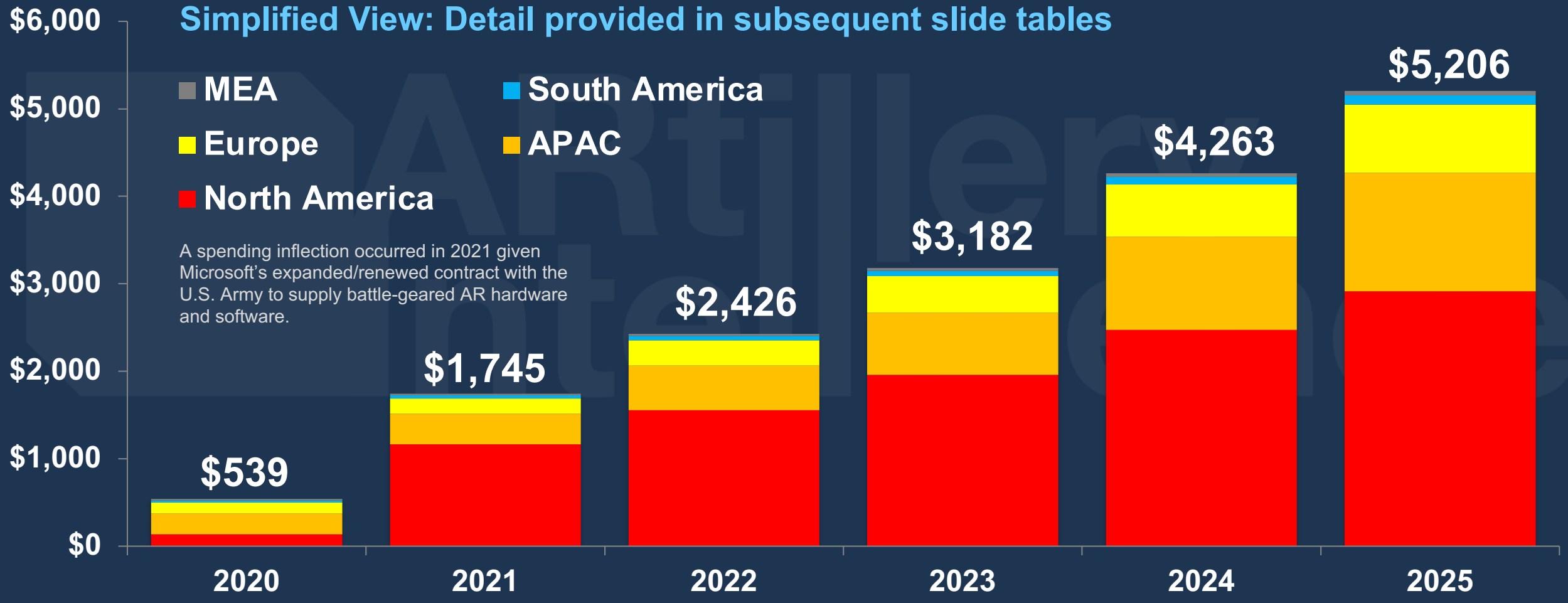
	Instruction & Education	Other Corporate & Commercial	Advanced Imaging (incl. Surgical)	Data Visualization	Other Field & Industrial	Warehousing & Logistics	Spatial Planning (AEC & Real Estate)	Corporate & Industrial Sales	Productivity & Virtual Desktop	Product Design & Collaboration	Field Services & Tech Support	Maintenance & Repair	Industrial Assembly	Training & Knowledge Transfer	Tactical & Combat	Total
2020	$8.08	$10.78	$12.13	$13.47	$18.86	$24.25	$28.30	$32.34	$33.69	$35.03	$36.38	$37.73	$40.42	$45.81	$161.70	$539
2021	$12.21	$22.68	$21.81	$20.94	$22.68	$34.89	$52.34	$61.07	$56.70	$65.43	$74.15	$69.79	$87.24	$95.96	$1,046	$1,745
2022	$16.98	$31.54	$30.33	$24.26	$48.53	$60.66	$84.92	$97.05	$90.99	$103.12	$115.25	$109.19	$133.45	$145.58	$1,334	$2,426
2023	$22.27	$41.36	$55.68	$47.73	$79.55	$95.46	$111.37	$127.27	$143.18	$151.14	$167.05	$175.00	$182.96	$190.91	$1,590	$3,182
2024	$29.84	$55.42	$74.61	$63.95	$149.22	$170.53	$191.85	$213.17	$234.48	$245.14	$266.46	$277.12	$287.78	$298.44	$1,705	$4,263
2025	$36.44	$67.68	$91.11	$78.09	$182.21	$208.24	$260.30	$312.36	$338.39	$325.38	$351.41	$364.42	$377.44	$390.45	$1,822	$5,206

ARtillery Intelligence

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Region

U.S. $Millions



ARtillery Intelligence

Enterprise AR Glasses Estimates

Enterprise AR Glasses Hardware Spending, by Region

U.S. $Millions

	APAC	North America	Europe	South America	MEA	Total
2020	$134.75	$242.55	$123.97	$21.56	$16.17	$539
2021	$1,164.61	$348.95	$174.47	$34.89	$21.81	$1,745
2022	$1,552.87	$509.53	$291.16	$48.53	$24.26	$2,426
2023	$1,956.85	$715.92	$413.64	$63.64	$31.82	$3,182
2024	$2,472.75	$1,065.84	$596.87	$85.27	$42.63	$4,263
2025	$2,915.38	$1,353.57	$780.91	$104.12	$52.06	$5,206

ARtillery Intelligence

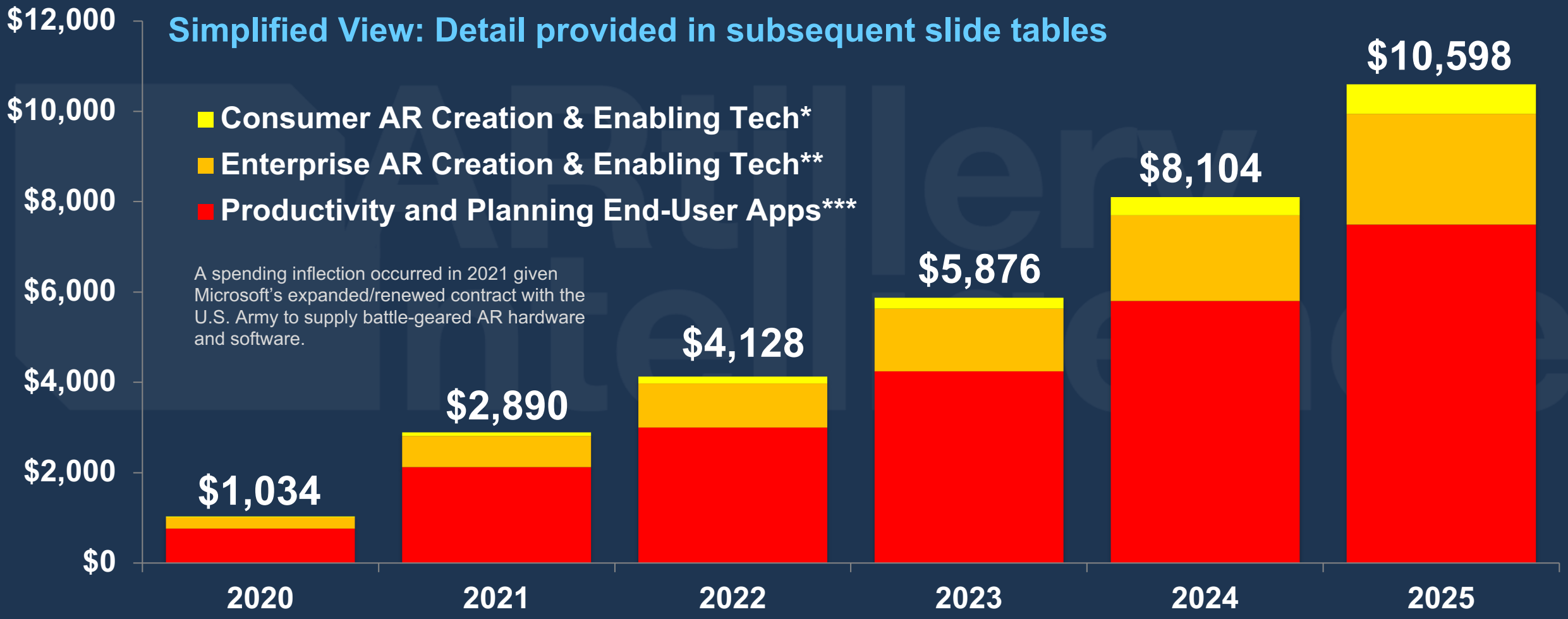
Enterprise Spending Software Estimates

ARtillery Intelligence

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates, by Product

U.S. $Millions



ARtillery Intelligence

*Though consumers are the end-user, enterprises and developers are the users/customers of these software platforms (B2B2C).
**This measures spending on AR experience-creation software for enterprise use cases such as industrial productivity.
***This measures spending on finished AR software that is installed and used on deployed AR headsets.

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates, by Product

U.S. $Millions

	Productivity and Planning End-User Apps***	Enterprise AR Creation & Enabling Tech**	Consumer AR Creation & Enabling Tech*	Total
2020	$763	$249	$22	$1,034
2021	$2,124	$693	$73	$2,890
2022	$2,996	$978	$153	$4,128
2023	$4,246	$1,386	$243	$5,876
2024	$5,804	$1,895	$405	$8,104
2025	$7,497	$2,448	$653	$10,598

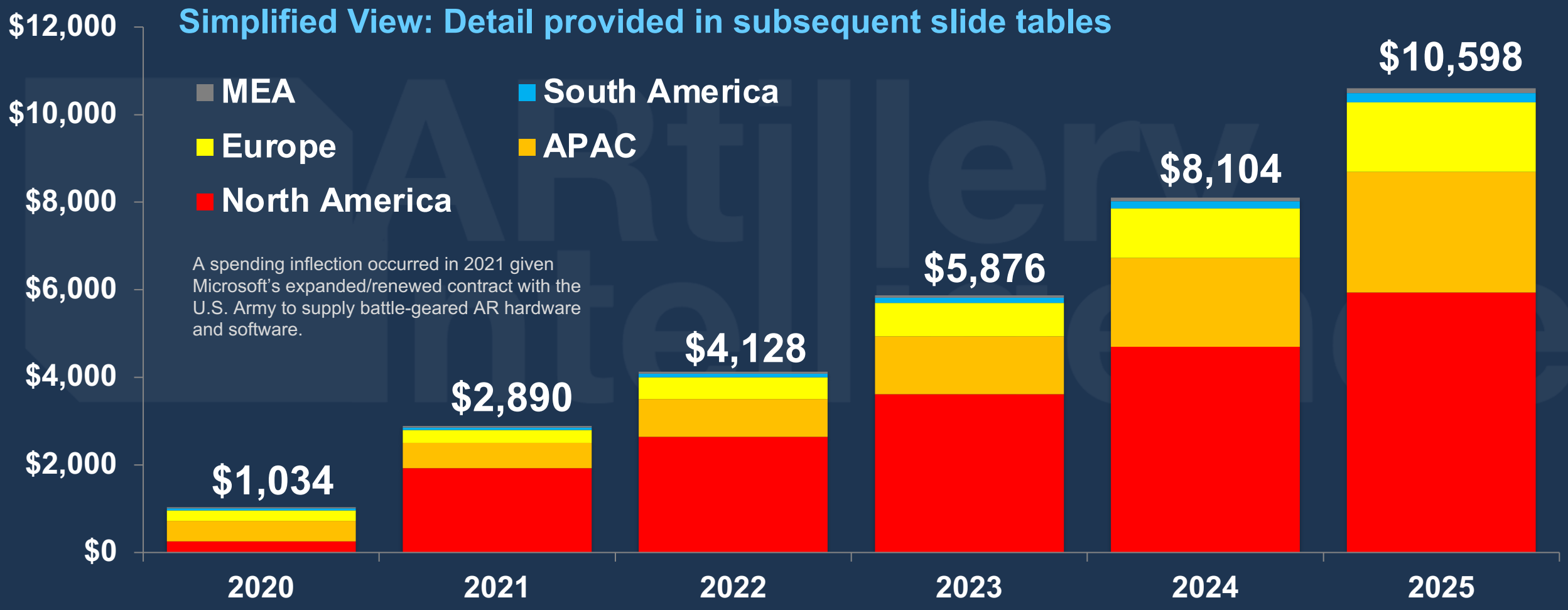
ARtillery Intelligence

*Though consumers are the end-user, enterprises and developers are the users/customers of these software platforms (B2B2C).
**This measures spending on AR experience-creation software for enterprise use cases such as industrial productivity.
***This measures spending on finished AR software that is installed and used on deployed AR headsets.

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates, by Region

U.S. $Millions



ARtillery Intelligence

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates, by Region

U.S. $Millions

	APAC	North America	Europe	South America	MEA	Total
2020	$258.52	$465.33	$237.84	$41.36	$31.02	$1,034
2021	$1,929.16	$578.03	$289.01	$57.80	$36.13	$2,890
2022	$2,641.75	$866.82	$495.33	$82.55	$41.28	$4,128
2023	$3,613.45	$1,321.99	$763.82	$117.51	$58.76	$5,876
2024	$4,700.05	$2,025.88	$1,134.50	$162.07	$81.04	$8,104
2025	$5,934.78	$2,755.43	$1,589.67	$211.96	$105.98	$10,598

ARtillery Intelligence

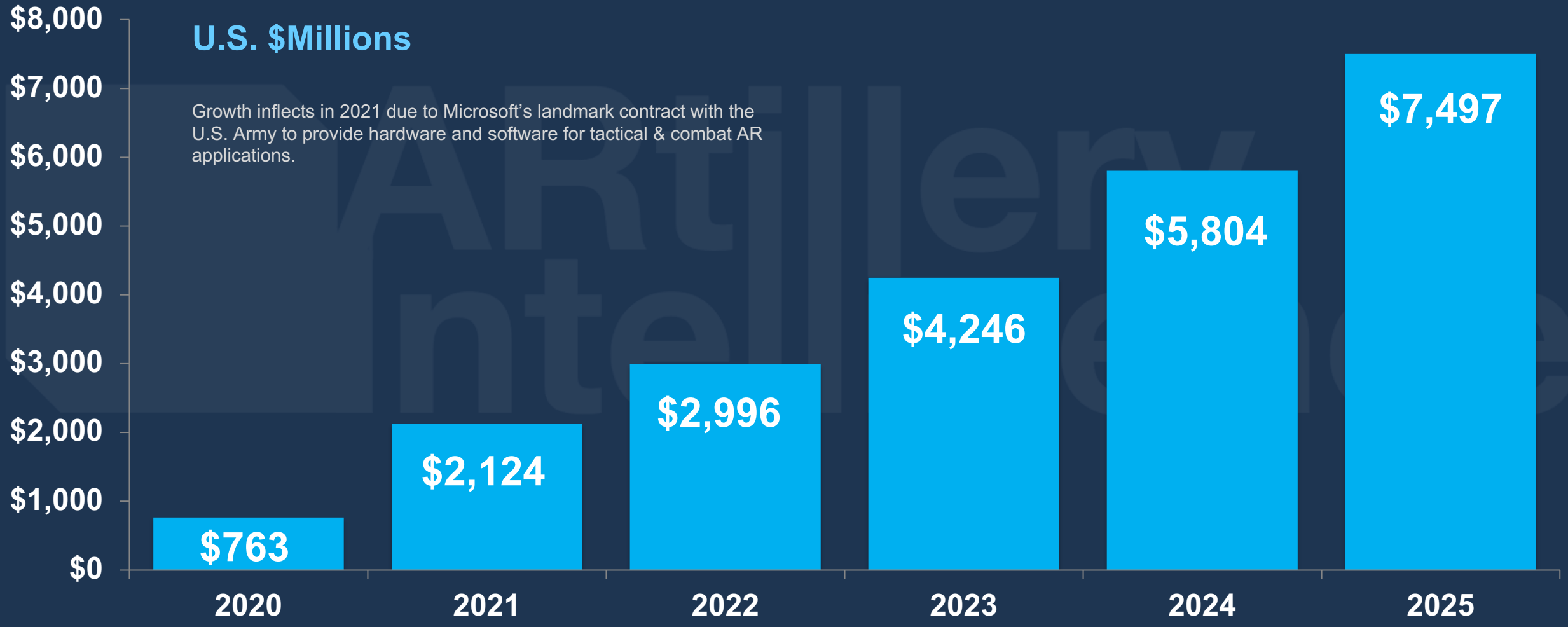
Enterprise Spending

Productivity & Planning Software

ARtillery Intelligence

Productivity & Planning Apps

Estimated Spending on Headworn AR Productivity*



ARtillery Intelligence

*This measures spending on finished AR software that is installed and used on deployed AR headsets, usually sold as a software license.

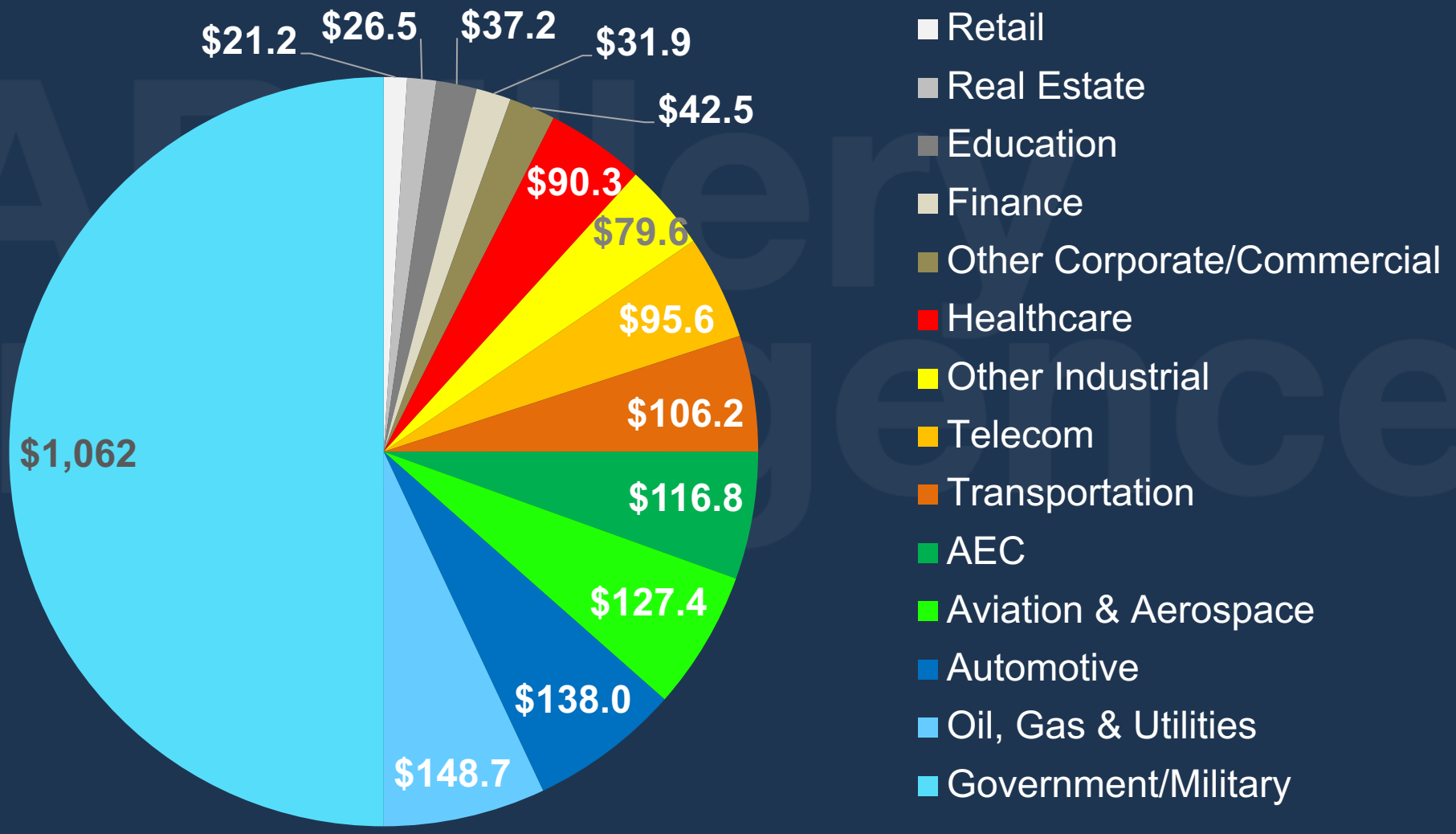
Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates,* by Vertical

2021

U.S. $Millions

These vertical breakdowns occur within the sub-segment of enterprise AR spending designated as *productivity and planning* software (does not include other areas of enterprise AR software spending such as experience creation and enabling tech).



ARtillery Intelligence

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates,* by Vertical

U.S. $Millions

	Retail	Real Estate	Education	Finance	Other Corporate/ Commercial	Healthcare	Other Industrial	Telecom	Transportation	AEC	Aviation & Aerospace	Automotive	Oil, Gas & Utilities	Government/ Military	Total
2020	$7.63	$15.26	$19.07	$22.88	$30.51	$45.77	$38.14	$49.58	$53.40	$57.21	$61.02	$64.84	$68.65	$228.84	$763
2021	$21.24	$26.55	$37.16	$31.85	$42.47	$90.25	$79.64	$95.56	$106.18	$116.80	$127.42	$138.04	$148.66	$1,061	$2,124
2022	$29.96	$37.45	$44.94	$82.40	$67.41	$127.34	$134.83	$149.81	$164.79	$179.77	$194.75	$209.73	$224.72	$1,348	$2,996
2023	$42.46	$53.08	$63.69	$116.77	$138.00	$201.69	$212.31	$233.54	$254.77	$276.00	$297.23	$318.46	$339.69	$1,698	$4,246
2024	$58.04	$72.55	$87.06	$217.65	$246.67	$333.73	$348.24	$377.26	$406.28	$435.30	$464.32	$493.34	$522.36	$1,741	$5,804
2025	$74.97	$93.71	$112.46	$318.63	$356.11	$468.57	$487.31	$524.80	$562.28	$599.77	$637.25	$674.74	$712.22	$1,874	$7,497

ARtillery Intelligence

These vertical breakdowns occur within the sub-segment of enterprise AR spending designated as *productivity and planning* software (does not include other areas of enterprise AR software spending such as experience creation and enabling tech).

Enterprise Adoption Drivers

Factors Influencing Vertical-Specific Enterprise AR Adoption

ARtillery Intelligence

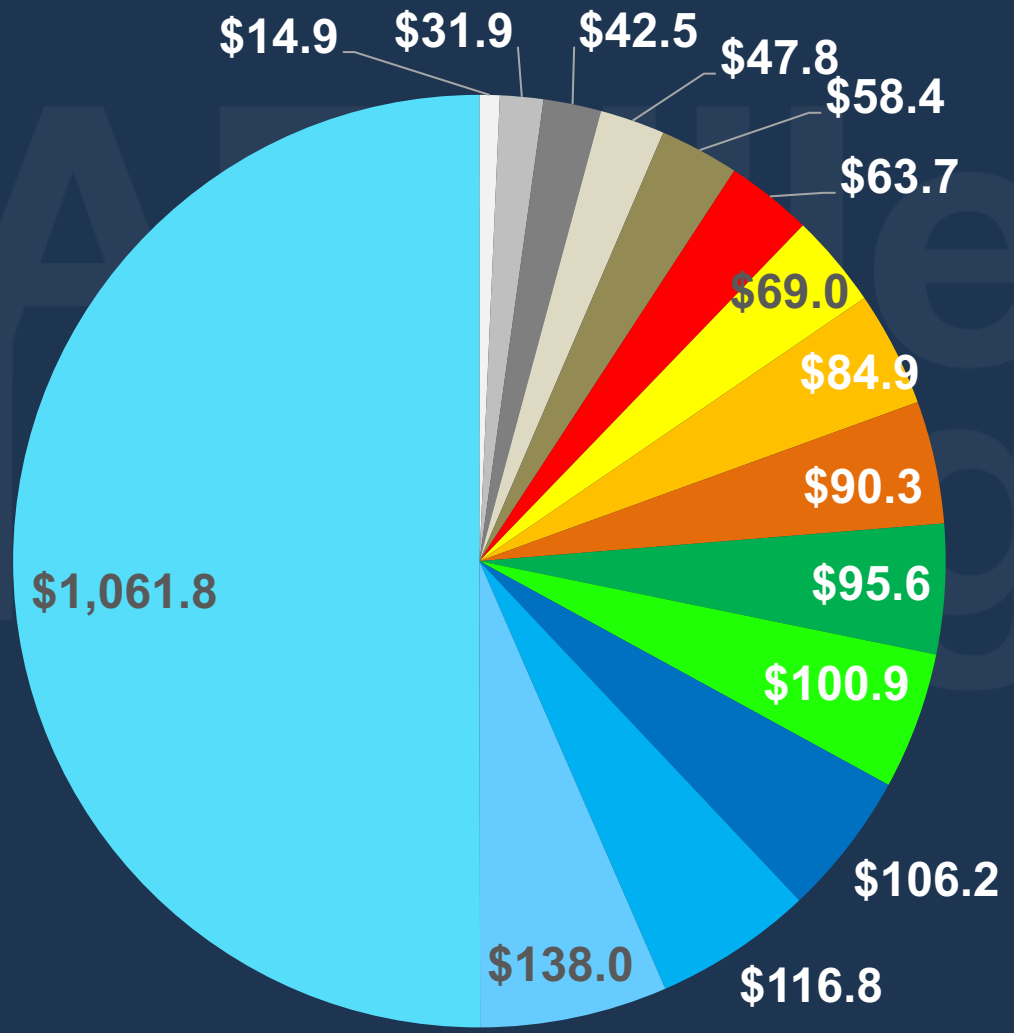
Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates,* by Use Case

2021

U.S. $Millions

These use case breakdowns occur within the sub-segment of enterprise AR spending designated as *productivity and planning* software (does not include other areas of enterprise AR software spending such as experience creation and enabling tech).



- Instruction & Education
- Other Corporate & Commercial
- Advanced imaging (including Surgical)
- Data Visualizaiton
- Other Field & Industrial
- Warehousing & Logistics
- Spatial Planning (AEC & Real Estate)
- Corporate & Industrial Sales
- Productivity & Virtual Desktop
- Product Design & Collaboration
- Field Services & Tech Support
- Maintenance & Repair
- Industrial Assembly
- Training & Knowledge Transfer
- Tactical & Combat

ARtillery Intelligence

Enterprise AR Glasses Software

Enterprise AR Glasses Software Estimates,* by Use Case

U.S. $Millions

	Instruction & Education	Other Corporate & Commercial	Advanced imaging (incl. Surgical)	Data Visualization	Other Field & Industrial	Warehousing & Logistics	Spatial Planning (AEC & Real Estate)	Corporate & Industrial Sales	Productivity & Virtual Desktop	Product Design & Collaboration	Field services & Tech Support	Maintenance & Repair	Industrial Assembly	Training & Knowledge Transfer	Tactical & Combat	Total
2020	$11.44	$15.26	$17.16	$19.07	$26.70	$34.33	$40.05	$45.77	$47.68	$49.58	$51.49	$53.40	$57.21	$64.84	$228.84	$763
2021	$14.87	$31.85	$42.47	$47.78	$58.40	$63.71	$69.02	$84.95	$90.25	$95.56	$100.87	$106.18	$116.80	$138.04	$1,061	$2,123
2022	$20.97	$44.94	$59.92	$67.41	$97.38	$104.87	$112.36	$134.83	$142.32	$149.81	$157.30	$164.79	$179.77	$209.73	$1,348	$2,995
2023	$29.72	$63.69	$84.92	$95.54	$159.23	$169.85	$180.46	$212.31	$222.92	$233.54	$244.16	$254.77	$276.00	$318.46	$1,698	$4,244
2024	$58.04	$87.06	$116.08	$130.59	$261.18	$290.20	$304.71	$348.24	$333.73	$377.26	$362.75	$406.28	$464.32	$522.36	$1,741	$5,804
2025	$74.97	$112.46	$149.94	$168.68	$374.85	$412.34	$431.08	$487.31	$468.57	$524.80	$506.05	$562.28	$637.25	$712.22	$1,874	$7,497

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These use case breakdowns occur within the sub-segment of enterprise AR spending designated as *productivity and planning* software (does not include other areas of enterprise AR software spending such as experience creation and enabling tech).

Enterprise Spending

Creation & Enablement Software

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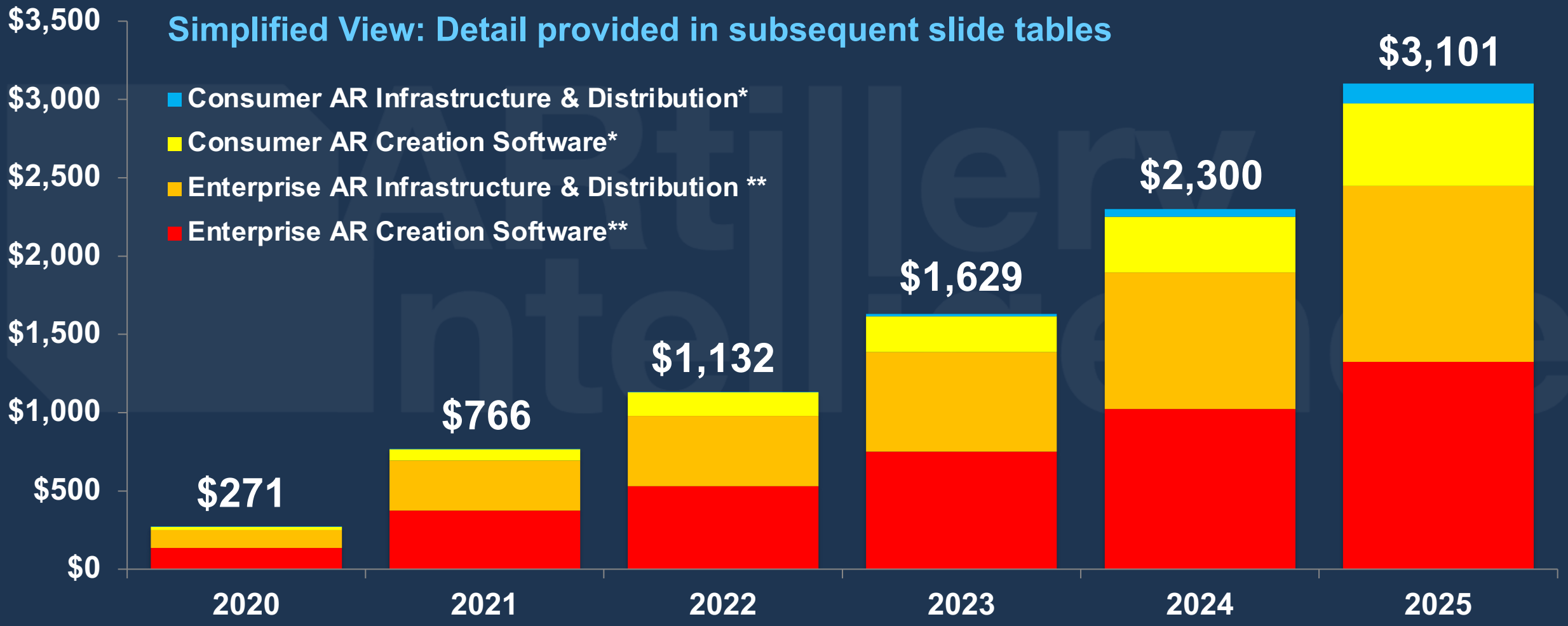
AR Creation & Enablement

U.S. $Millions

Software Estimates for AR Glasses UX Creation & Distribution



*Though consumers are the end-user, enterprises and developers are the users/customers of these software products (B2B2C).
**This measures spending on AR enablement software for enterprise use cases such as industrial productivity.

Enterprise AR Glasses Software

Software Estimates for AR Glasses UX Creation & Distribution

U.S. $Millions

	Enterprise AR Creation Software**	Enterprise AR Infrastructure & Distribution **	Consumer AR Creation Software*	Consumer AR Infrastructure & Distribution*	Total
2020	$134.6	$114.4	$21.9	$0.3	$271
2021	$374.8	$318.5	$72.2	$1.0	$766
2022	$529	$449	$151	$3	$1,132
2023	$749	$637	$228	$15	$1,629
2024	$1,024	$871	$355	$50	$2,300
2025	$1,323	$1,125	$528	$125	$3,101

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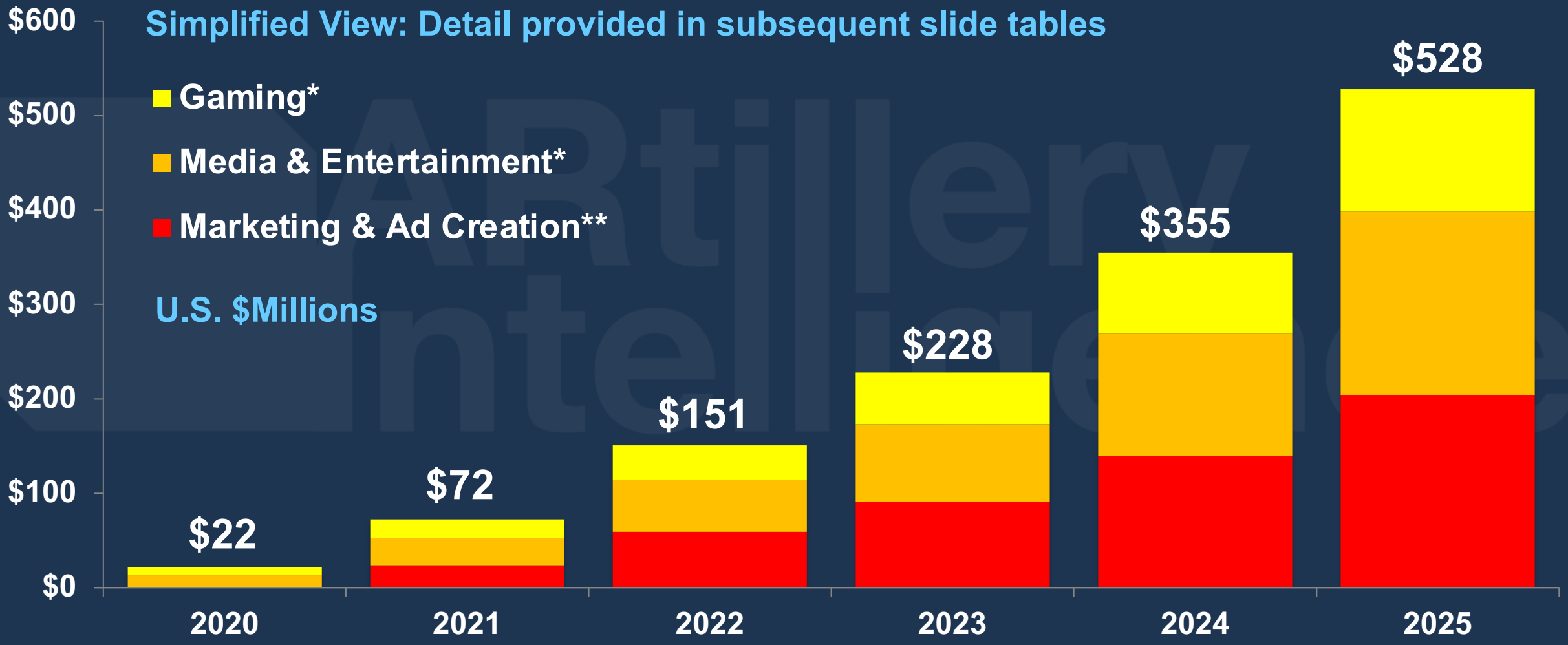
*Though consumers are the end-user, enterprises and developers are the users/customers of these software products (B2B2C).
**This measures spending on AR enablement software for enterprise use cases such as industrial productivity.

Headworn AR Media Creation

Estimated spending on Consumer AR Creation Software



*Though consumers are the end-user, enterprises and developers are the users/customers of these software products (B2B2C).
* Includes software only (doesn't include AR creation overhead such as developer salaries or agency fees).
** Spending on AR ad *creation* software is separate from – but related to – spending on AR ad *placement*.

Headworn AR Media Creation

Estimated spending on Consumer AR Creation Software

U.S. $Millions

	Marketing & Ad Creation**	Media & Entertainment*	Gaming*	Total
2020	$0	$13	$9	$22
2021	$24	$29	$19	$72
2022	$59	$55	$37	$151
2023	$91	$82	$55	$228
2024	$140	$129	$86	$355
2025	$204	$194	$129	$528

ARtillery Intelligence

*Though consumers are the end-user, enterprises and developers are the users/customers of these software products (B2B2C).
* Includes software only (doesn't include AR creation overhead such as developer salaries or agency fees).
** Spending on AR ad *creation* software is separate from – but related to – spending on AR ad *placement*.

Audio AR (Hearables)

ARtillery Intelligence

Audio AR (Hearables) Spending

- Audio AR will grow from almost nothing today to U.S. $243 million in 2025. This includes consumer spending on audio AR apps and experiences.
  - These experiences include situationally-aware apps that provide intelligent audible whispers through hearables like Apple AirPods.

- Like many software sectors in this report, this category's projected growth correlates to the size of the hardware installed base – in this case hearables.
  - Hearables will grow from 122 million units in 2020 to 251 million units by 2025, led by Apple AirPods (and increasingly, AirPods Pro).
  - Lower-cost competitors will grow over time as the hearables market matures and gets commoditized (as often happens in Apple's wake).

- Though hardware unit sales and revenues are tracked in this report as a supporting base for software sales, they aren't counted as *AR revenue*.

ARtillery Intelligence

Audio AR (Hearables) Spending

- Though hearables hardware is increasingly prevalent and culturally accepted, audio AR apps haven't yet been developed and marketed widely.
  - This could change over the next 2-3 years as Apple creates developer kits for hearables, similar to iOS-orbiting SDKs like WatchOS, tvOS and ARkit.
  - This could likewise result in App Store sections/categories for audio AR.

- Apple is motivated by continued wearables revenue performance, and its ongoing need to diversify revenue in the face of decelerating iPhone sales.*
  - Audio AR could also align with its visual AR plans and create a holistic system of sensory augmentation and a multi-device ecosystem play.
  - That includes AR glasses, Watch and AirPods as an expanding *wearables suite* that incentivizes multi-device ownership for optimal experiences.
  - Like Apple's rumored AR glasses, audio AR apps could boost the iPhone's value by relying on it for compute power and sensor fusion.

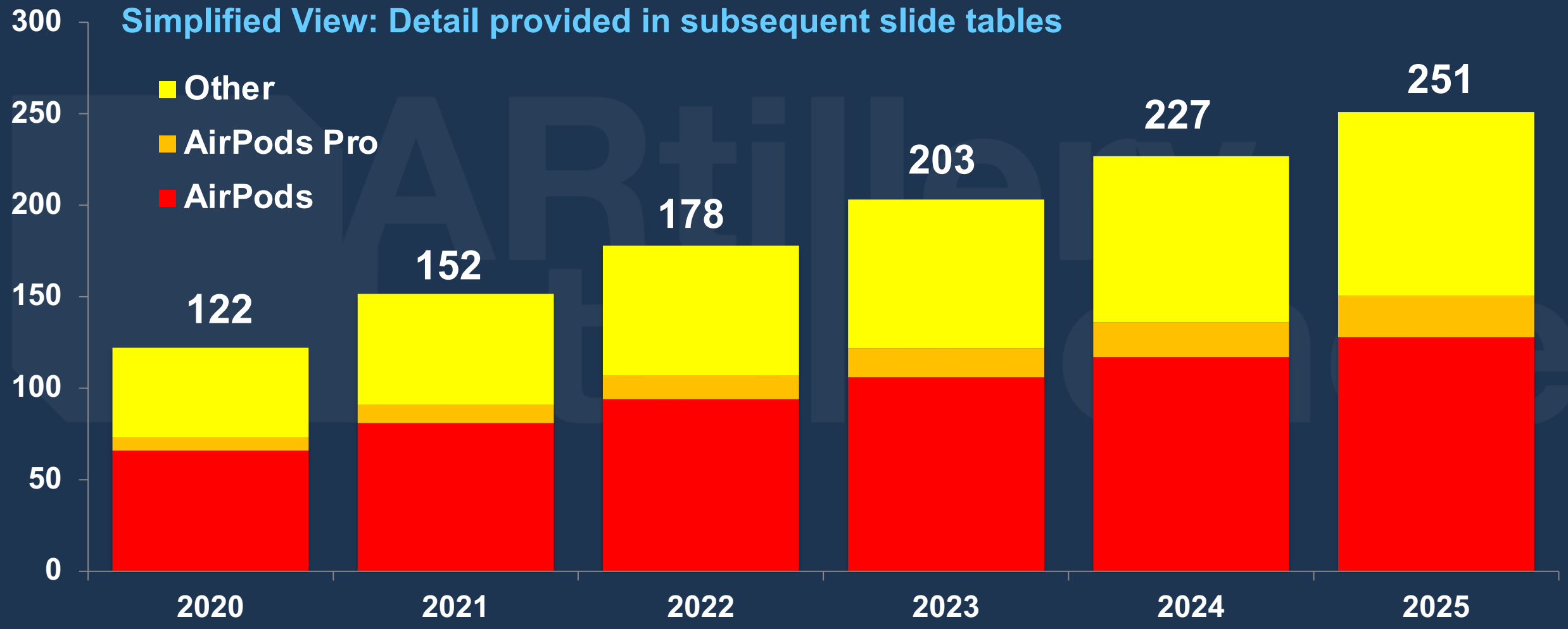
ARtillery Intelligence

*See ARtillery Intelligence Report: Wearables: Paving the Way for AR Glasses

Hearables Hardware Penetration

Consumer Hearables Hardware Unit Sales Estimates*

Millions of Units



ARtillery Intelligence

*This chart covers annual unit sales. See separate slide for year-by-year installed base (cumulative) figures.

Hearables Hardware Penetration

Consumer Hearables Hardware Unit Sales Estimates*

Millions of Units

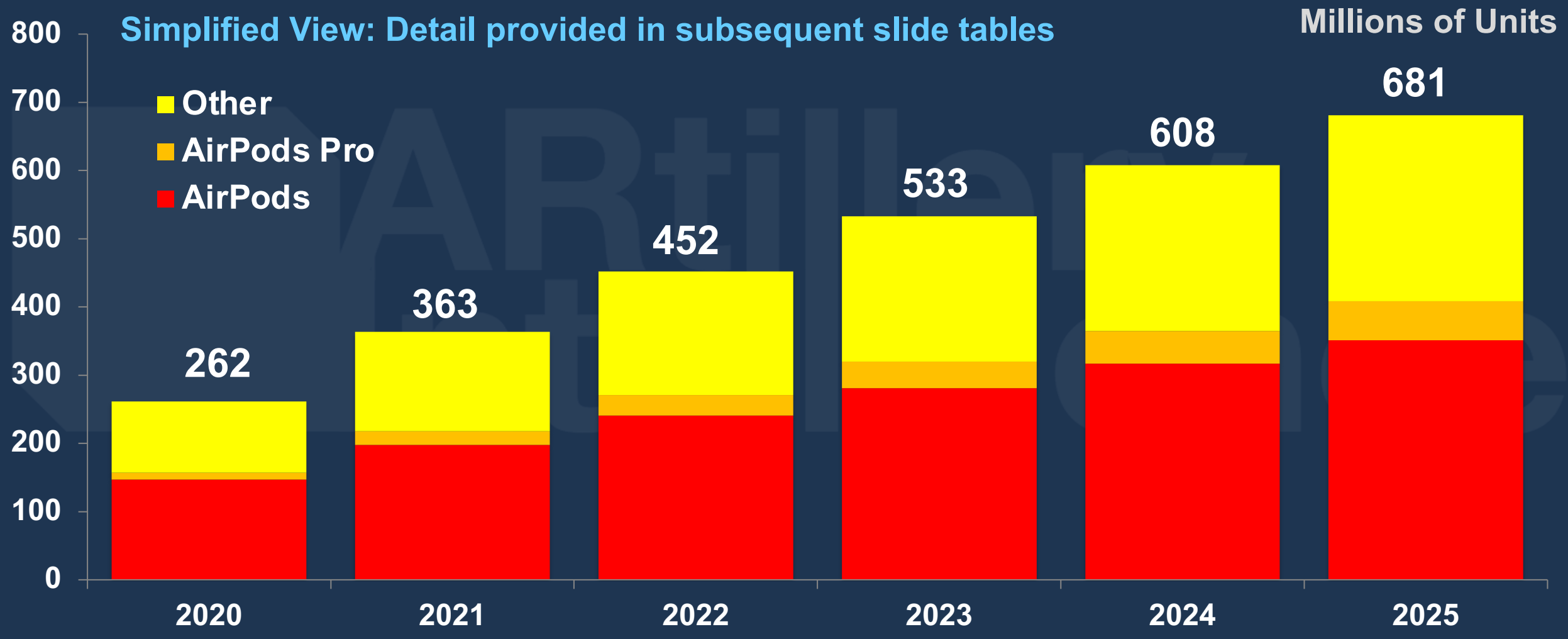
	AirPods	AirPods Pro	Other	Total
2020	66.0	7.3	48.9	122
2021	81.0	10.0	60.7	152
2022	94.0	12.8	71.2	178
2023	106.0	15.8	81.2	203
2024	117.0	19.0	90.7	227
2025	128.0	22.6	100.4	251

ARtillery Intelligence

*This chart covers annual unit sales. See separate slide for year-by-year installed base (cumulative) figures.

Hearables Hardware Penetration

Consumer Hearables Hardware Installed Base Estimates*



ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.

Hearables Hardware Penetration

Consumer Hearables Hardware Installed Base Estimates*

Millions of Units

	AirPods	AirPods Pro	Other	Total
2020	147	10	105	262
2021	198	20	145	363
2022	241	30	181	452
2023	281	39	213	533
2024	317	48	243	608
2025	351	57	272	681

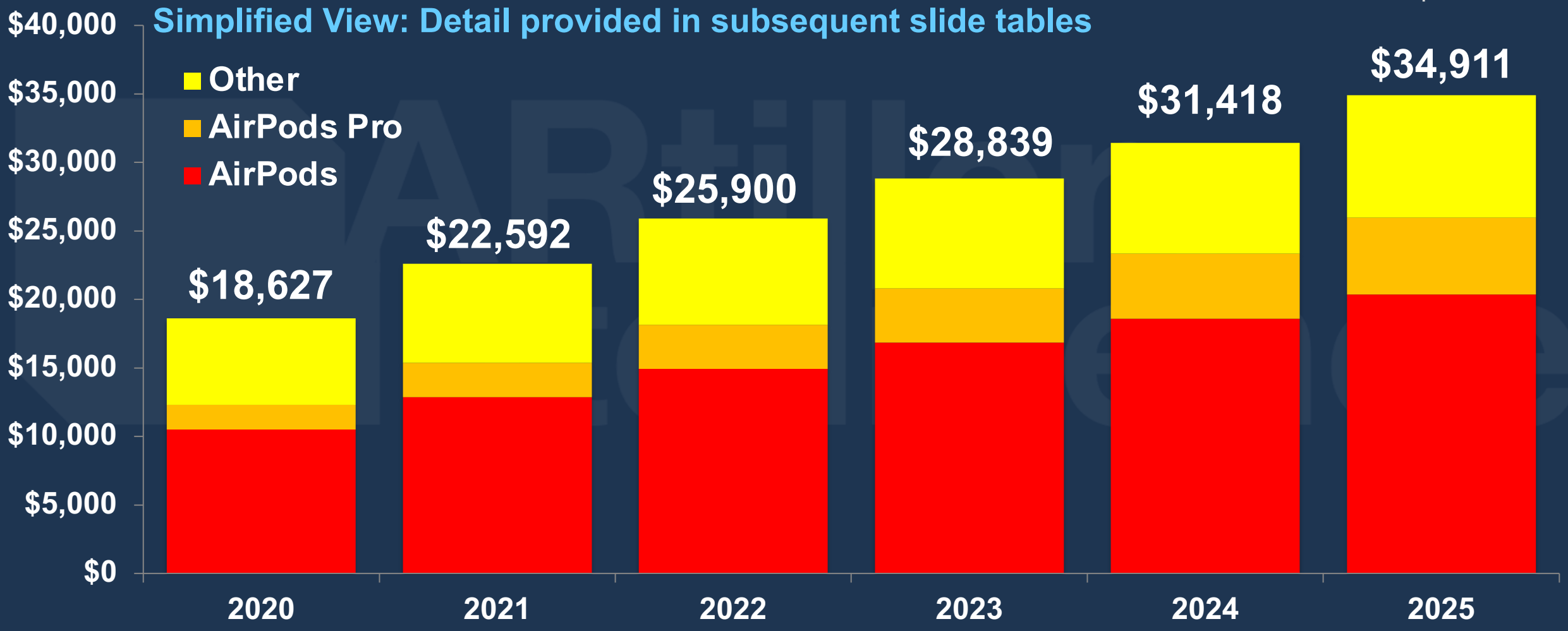
ARtillery Intelligence

*This chart covers cumulative installed base. See separate slide for annual unit sales figures.

Hearables Hardware Penetration

Consumer Hearables Hardware Annual Sales Estimates*

U.S. $Millions



ARtillery Intelligence

*Hearables hardware revenues are tracked here for perspective but aren't counted towards AR revenue totals.

Hearables Hardware Penetration

Consumer Hearables Hardware Annual Sales Estimates*

U.S. $Millions

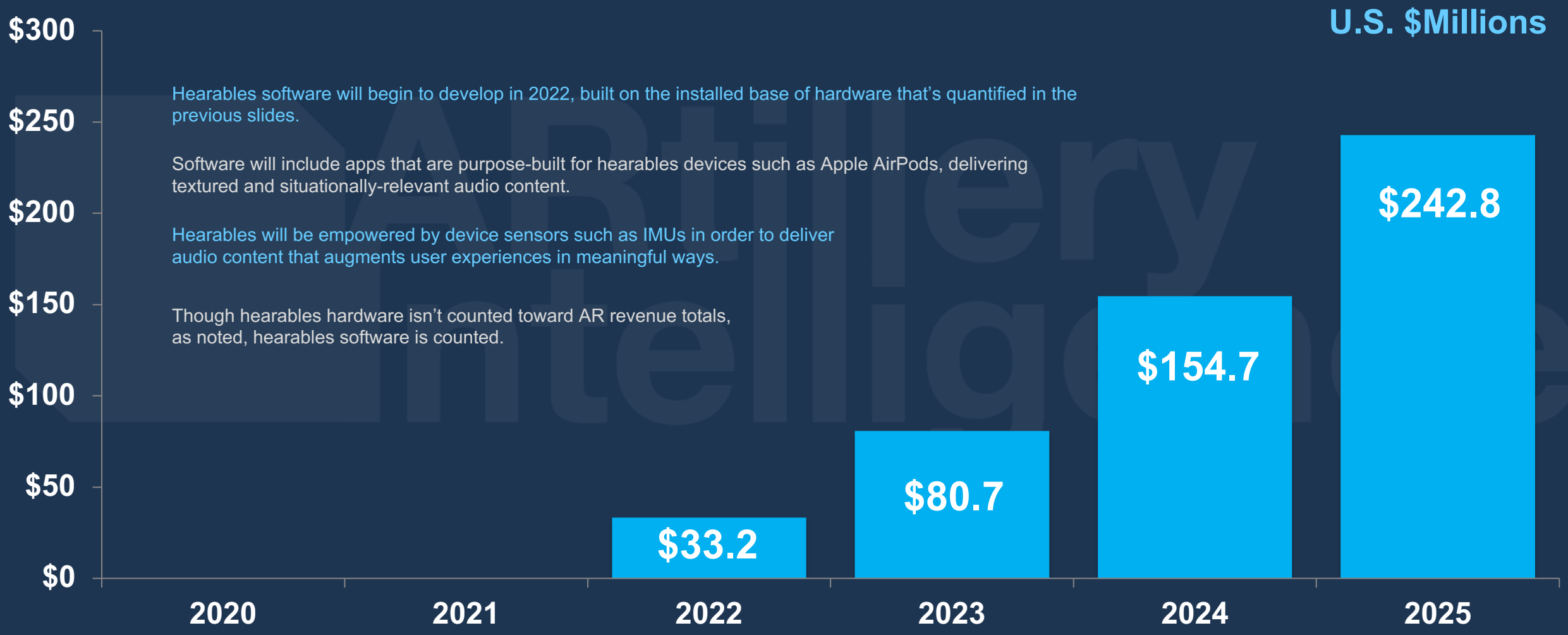
	AirPods	AirPods Pro	Other	Total
2020	$10,494	$1,826	$6,307	$18,627
2021	$12,879	$2,493	$7,220	$22,592
2022	$14,946	$3,192	$7,762	$25,900
2023	$16,854	$3,944	$8,041	$28,839
2024	$18,603	$4,743	$8,072	$31,418
2025	$20,352	$5,624	$8,935	$34,911

ARtillery Intelligence

*Hearables hardware revenues are tracked here for perspective but aren't counted towards AR revenue totals.

Hearables Software Revenue

Consumer Hearables Software Annual Sales Estimates*



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Resources & Reference

ARtillery Intelligence

Next Steps

In addition to standalone and self-contained orientation, this forecast lays the groundwork for continued ARtillery Intelligence narratives.

With the foundation of this data set, several subsequent reports and articles will be developed in the coming months that each drill down into the dynamics and drivers of the revenue categories quantified in this report. The story is not over…

Work also now begins on the next forecast in our coverage of the spatial computing spectrum, including mobile AR and VR. These forecasts are interlinked and strengthen each other, where the *whole is greater than the sum of its parts*.

We encourage questions and coverage suggestions here.

ARtillery Intelligence

About ARtillery Intelligence

ARtillery Intelligence chronicles the evolution of spatial computing (AR & VR). Through writings and multimedia, it provides deep and analytical views into the industry's biggest players, opportunities and strategies.

Run by analysts and former journalists, coverage is grounded in a disciplined and journalistic approach. It also maintains a business angle: Though there are fun and games in spatial computing, cultural, technological and financial implications are primary.

Products include the *AR Insider* publication and the ARtillery PRO research subscription, which together engender a circular flow of knowledge. Research includes monthly narrative reports, market-sizing forecasts, consumer survey data and multi-media, all housed in a robust intelligence vault. Learn more here.

ARtillery Intelligence

About Intelligence Briefings

ARtillery Intelligence Briefings are monthly installments of spatial computing data and analysis. They synthesize original data to reveal opportunities and dynamics of spatial computing sectors. In addition to data, a layer of insights is applied to translate market events and raw figures into concrete insights.

More information, past reports and editorial calendar can be seen here.

About the Author

Mike Boland was one of Silicon Valley's first tech reporters of the Internet age as a staff reporter for Forbes (print) starting in 2000. He has been an industry analyst covering emerging tech since 2005, and is now Chief Analyst of *ARtillery Intelligence* and Editor-in-Chief of *AR Insider.*

Mike is a frequent speaker at industry conferences such as AWE, XRDC and the VR/AR Global Summit. He has authored more than 150 reports and market-sizing forecasts on the tech & media landscape. He contributes regularly to news sources such as *TechCrunch*, *Business Insider* and *Huffington Post*.

A trusted source for tech journalists, his comments have appeared in A-list publications, including *The New Yorker*, *The Wall Street Journal* and *The New York Times*.

Further background, history and credentials can be read here.

ARtillery Intelligence

Forecast Methodology

ARtillery Intelligence follows disciplined best practices in market sizing and forecasting, developed and reinforced through its principles' 16 years of research and intelligence in tech sectors. This includes the past 6 years covering AR & VR as a primary focus.

This report focuses on AR revenue projections in various sub-sectors and product areas. ARtillery Intelligence has built financial models that are customized to the specific dynamics and unit economics of each. These include variables like unit sales, company revenues, pricing trends, market trajectory and several other micro and macro factors that ARtillery Intelligence tracks.

This approach primarily applies a *bottom-up* forecasting methodology, which is secondarily vetted against a *top-down* analysis. Together, confidence is achieved through triangulating revenues and projections in a disciplined way. For more information on what's included and not included in the forecast (a key consideration when evaluating findings) see the next slide.

More about ARtillery Intelligence's market-sizing methodology can be seen here and more on its credentials can be seen here.

Disclosure & Ethics Policy

ARtillery has no financial stake in the companies mentioned in this report, nor was it commissioned to produce its figures. With all market sizing, ARtillery Intelligence remains independent of players and practitioners in the sectors it covers, thus mitigating bias in industry revenue calculations and projections. ARtillery Intelligence's disclosure and ethics policy can be seen in full here.

ARtillery Intelligence

What's Included in *Headworn AR Revenues*?

This forecast focuses on headworn AR and its revenue subcategories. These include consumer spending (e.g., AR glasses, content); and enterprise spending (e.g., industrial visualization, experience creation). Key inclusions and exclusions exist throughout these categories.

For example, this report does not cover AR formats that happen on smartphones (see our separate Mobile AR forecast). AR glasses revenue categories tracked in this report include direct hardware and software spending, but not adjacent services such as enterprise consulting and carrier data. See more examples below.

All revenue figures correlate to the full-year (end of year) total of the identified year.

Included

AR Glasses Hardware: e.g., HoloLens, Nreal Light
Consumer AR Digital Goods: e.g., Apps, in-app purchases
Corporate & Industrial AR: e.g., Software for AR-assisted assembly, maintenance and tech support
Headworn AR Creation & Enablement Software: e.g., Unity, 8th Wall, Vuforia
Hearables Software: e.g., Audio AR apps

Not Included

Network Data: e.g., Telco-delivered data usage for AR
Professional Services: e.g., Enterprise AR consulting
App & Experience Creation Overhead: e.g., Developer salaries, agency fees
AR Glasses Components: The sale of component parts for AR glasses such as display and optical systems.
Hearables hardware: e.g., AirPod sales*

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*We track these revenues (see breakdown later in this report) but do not count them towards AR revenues.

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