Private Wireless Market Update for MFA August 2022

MFA MOBILE EXPERTS

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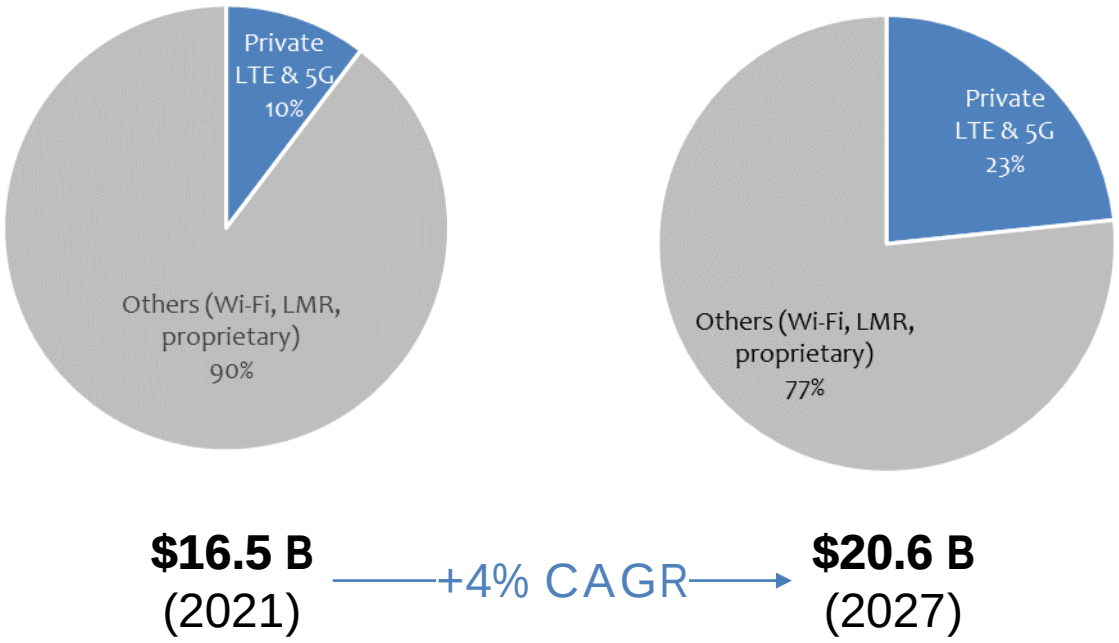
Executive Summary

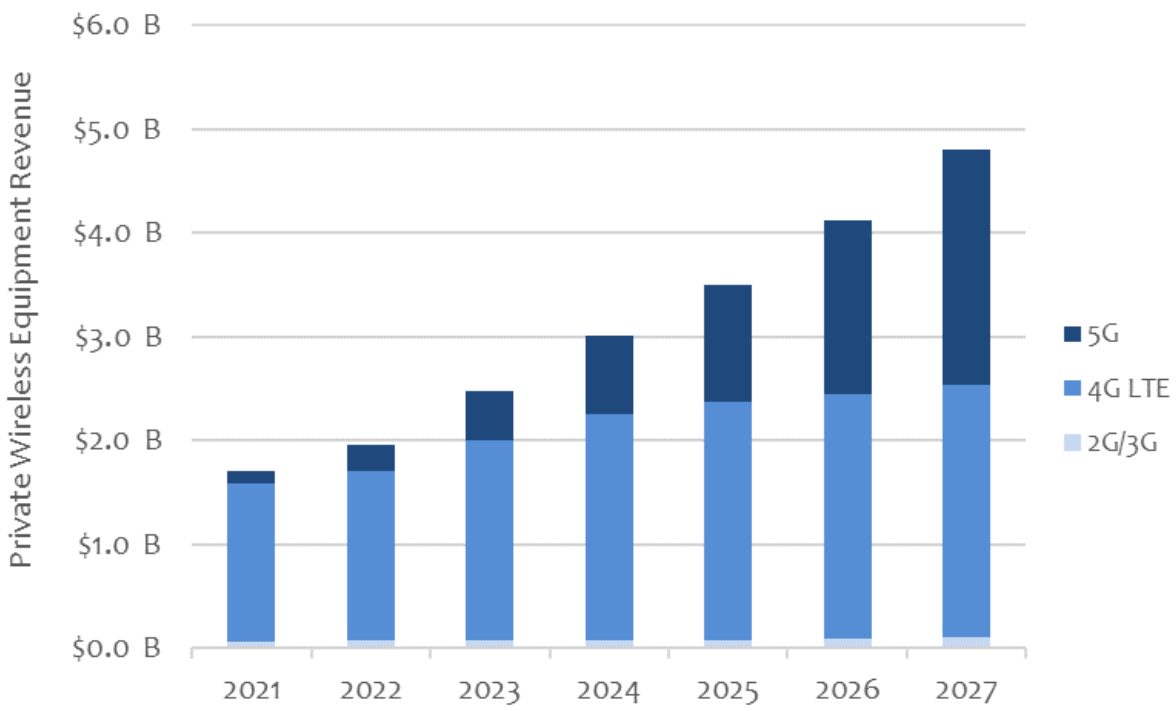
1. Private Cellular equipment market is forecast to grow 12-15% this year to $1.9B and ramp higher (~20% CAGR over the next five years) as industrial device ecosystem scales in the next 2-3 years
2. Taking a cue from early actions in Germany, USA, Japan, and UK, additional regulators are making available dedicated private 5G spectrum in the mid-band (3-4 GHz) and millimeter wave (24-29 GHz) - e.g., Korea, France, Taiwan, India, etc.
3. While the number of private 5G networks is growing, in terms of value, LTE makes up 85% of private cellular equipment market today. Private 5G equipment market is forecast to exceed the Private LTE segment during 2027-2028
4. Private Cellular equipment market is composed of: RAN (40-45%), Core (10-15%), Transport (15-20%), and End Devices (25-30%).
5. Private Cellular RAN market will grow from over $800M this year to over $2.0B in 2027
6. Public Sector (public safety, military, smart city, and other gov't programs), Transportation (airports, shipping ports, railways), and Utility segments represent the top three vertical segments for private cellular. In five years, Manufacturing is projected to represent the largest vertical market for private cellular (mostly 5G).
7. APAC represents the largest region for private cellular today (mostly from large-scale public projects), but Europe is expected to represent the largest market in the next five years with strong interests from large manufacturers. North America is another major market with large defense programs, broadband infrastructure, and other gov't initiatives driving enterprise interests across multiple industries.
8. Most private cellular network deployments are enterprise-driven today. Over time, we expect almost 50% of private cellular network deployment and consumption will be "as-a-service" model from mobile operators, cloud service providers (e.g., AWS, Google, Microsoft), or traditional managed service providers (MSPs)
9. As of end of June 2022, Mobile Experts estimates that over 2,800 private LTE and 5G networks have been cumulatively deployed globally.

LTE and 5G is a fast-growing segment of a broader Private Wireless equipment market



- The broader private wireless equipment market encompassing cellular, Wi-Fi, LMR, and other proprietary technologies is steadily growing at below 4% CAGR
- Private cellular is not new. LTE and variants like GSM-R had been utilized in critical infrastructure applications such as in mining, transportation, and others for many years.
- Digital transformation across multiple industries is driving an increasing application of private LTE and 5G for reliable connectivity and business-critical applications requiring advanced features such as URLLC
- Increasing availability of dedicated spectrum for private 5G is driving wider experimentation and adoption
- Asa result, the Private Cellular market is forecast to make up close to 25% of the broader Private Wireless market in five years – from a 10% share today

Private 5G is fast-growing, but LTE is dominant



- Reliable connectivity use cases, i.e., most enterprise use cases today, can be met with LTE
- Private LTE and 5G markets will cross over during 2027-2028
- Private 5G market will pick up pace as industrial 5G device ecosystem scales in 2-3 years

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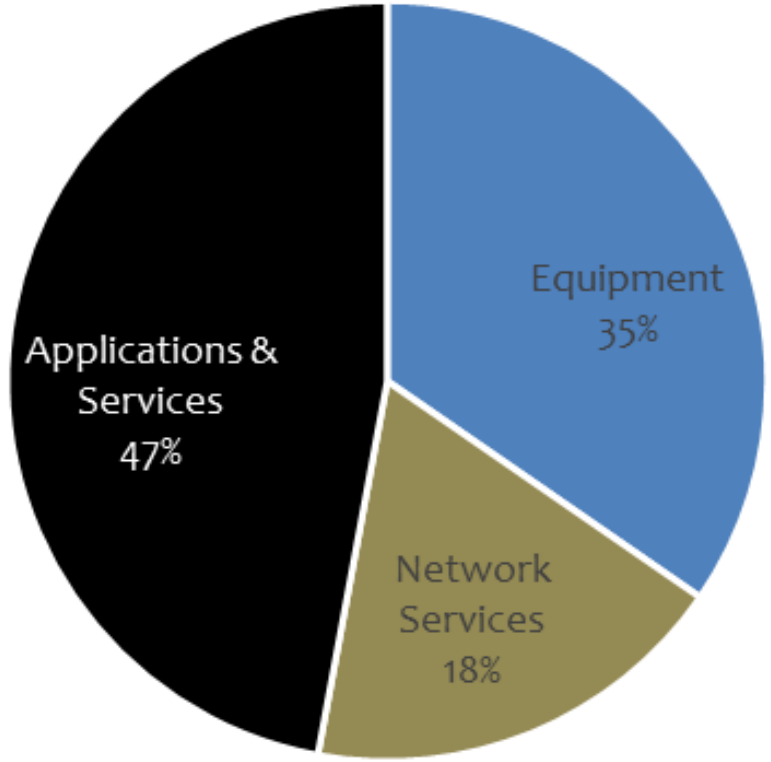
A Broader View of the Private Cellular Market

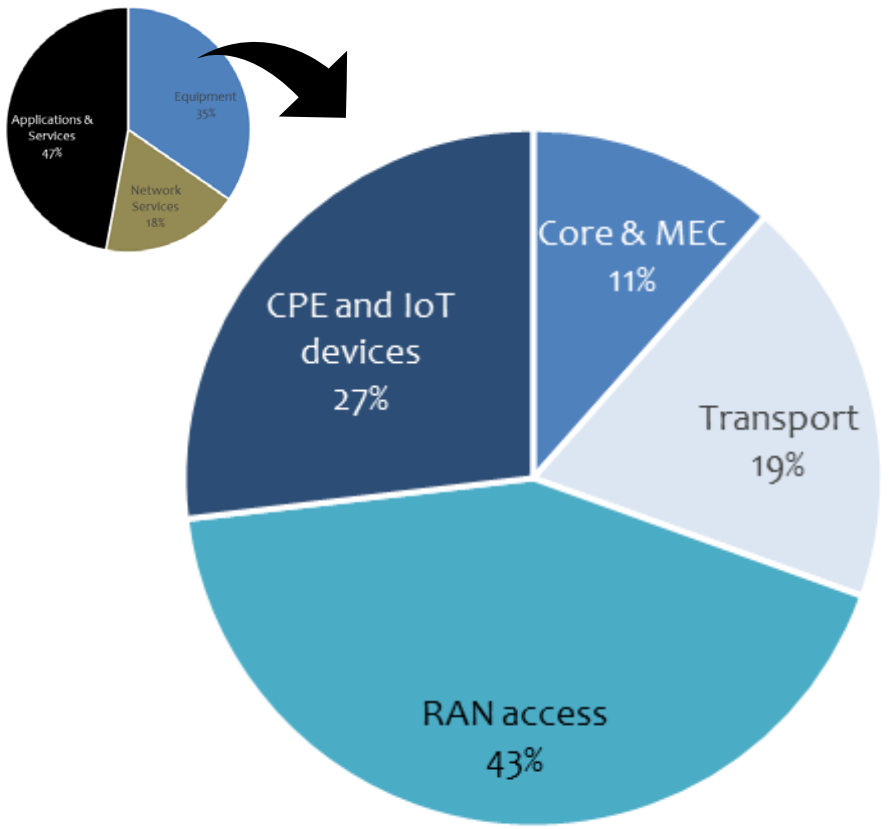
- Private Cellular market has an outsized Services component, in addition to equipment sales
- Depending on specific industry, application services (e.g., connecting ERP system to underlying applications running on private wireless networks) may constitute 40-60% of the Private Cellular market – and will likely grow in importance and size
- Today, network services (e.g., design and professional services, integration and technical support, managed services, etc.) and application software and services make up ~70% of total private cellular market.
- The share of Services component will grow over time as private cellular networks and applications increase



* Private Cellular market 2022 aggregate view

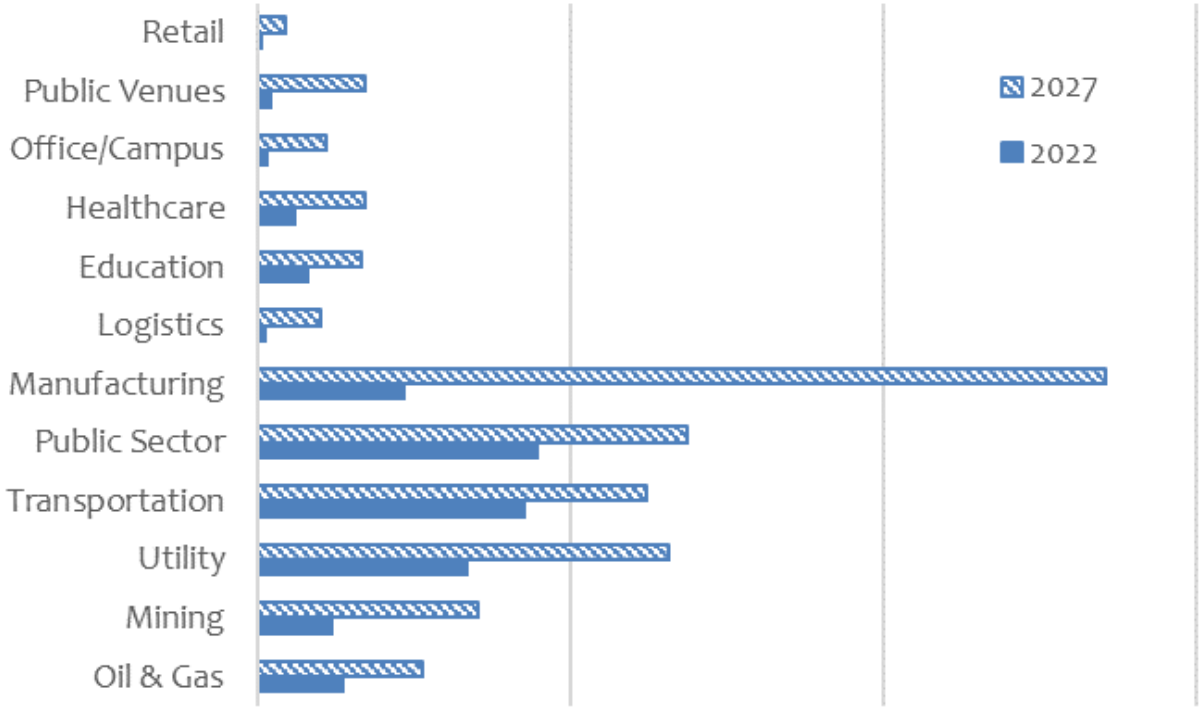
Private LTE and 5G Equipment Market

- RAN (i.e., macro base stations and small cells) constitute 40-45% of the Private Cellular equipment market – forecast to grow from $700M in 2021 to over $2.0 billion in 2027
- End devices, including CPEs and cellular IoT gateways, routers, dongles, etc. make up 25-30% of the Private Cellular market
- EPC, 5G Core and edge computing constitute 10-15% of the Private Cellular equipment market
- Transport, including microwaves and IP/optical networking for connecting access networks to core network make up the remainder



* Private Cellular market 2022 aggregate view

Private Cellular Market by Industry



Private Cellular Equipment Revenue	CAGR (2021-2027)
Oil & Gas	15%
Mining	25%
Utility	13%
Transportation	9%
Public Sector	8%
Manufacturing	39%
Logistics	50%
Education	15%
Healthcare	22%
Office/Campus	46%
Public Venues	76%
Retail	71%
Others	16%
Total	**19%**

* Private Cellular equipment market includes Core, RAN, Transport, and End Device sales

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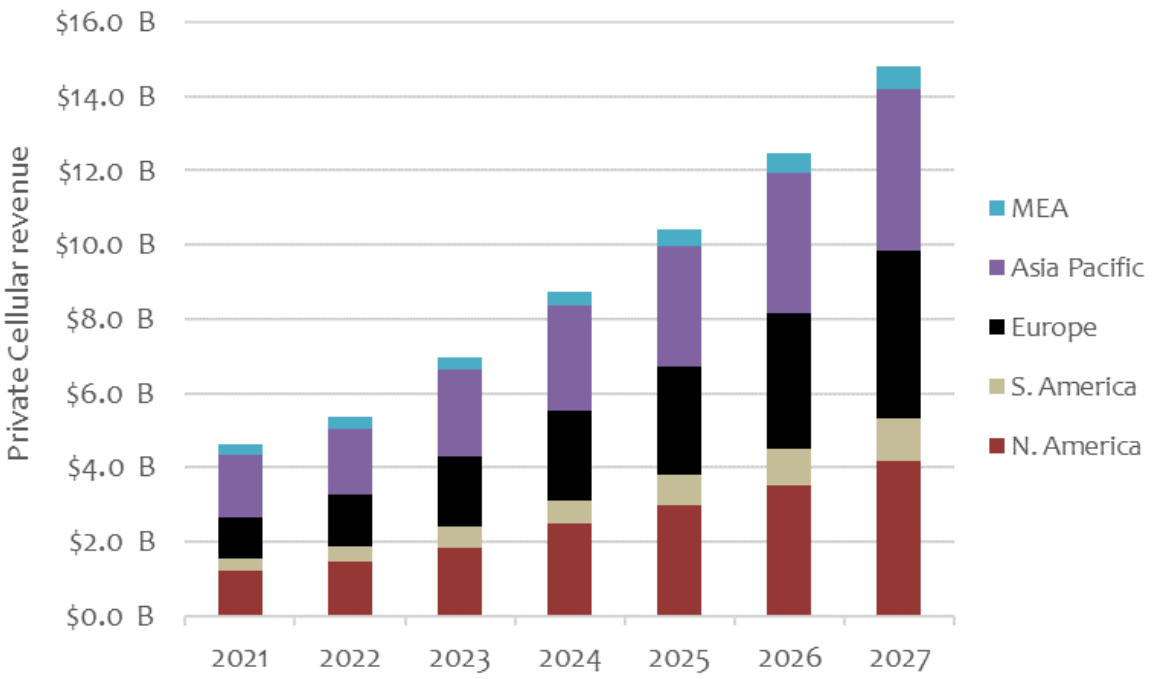
Private Cellular Market by Region



* Private cellular equipment & services market

- APAC is the largest market for private cellular. Though the number of private networks are small, project deals tend to be large in scope and value (e.g., Korea's $1.5B Public Safety LTE, private LTE network deployments in mining fields in Australia, etc.)
- Europe is the fastest-growing and possibly the largest market for private 5G over a long term. Active regulatory actions on dedicated private 5G spectrum and strong interests from large manufacturers are driving the growth in private 5G
- N. America growths are coming from defense (e.g., DoD $600M 5G program), utility, education, and transportation and logistics

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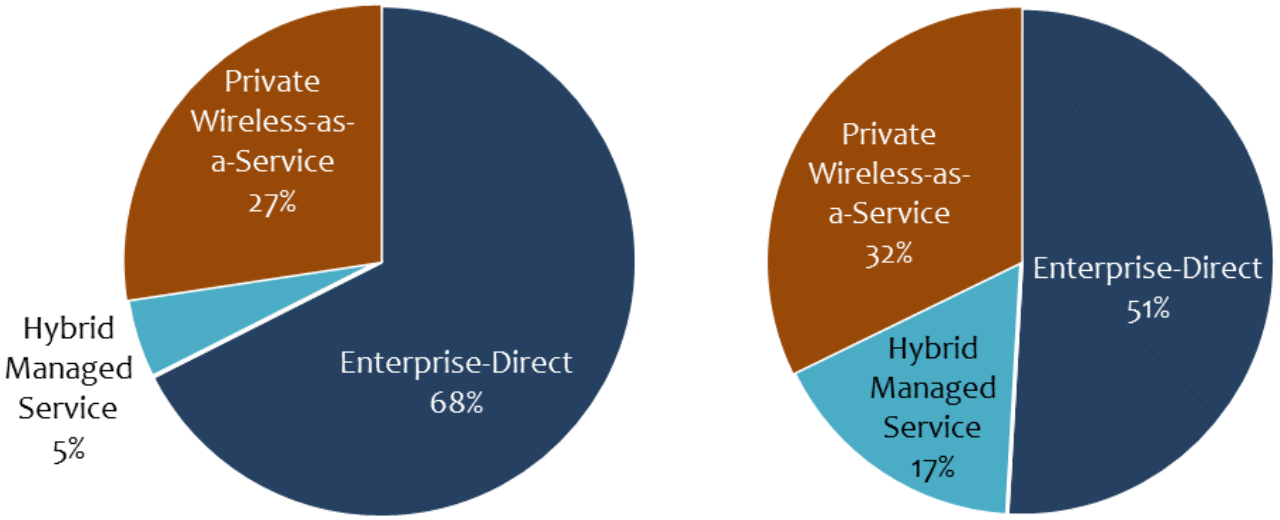
Private Cellular Market by Business Model

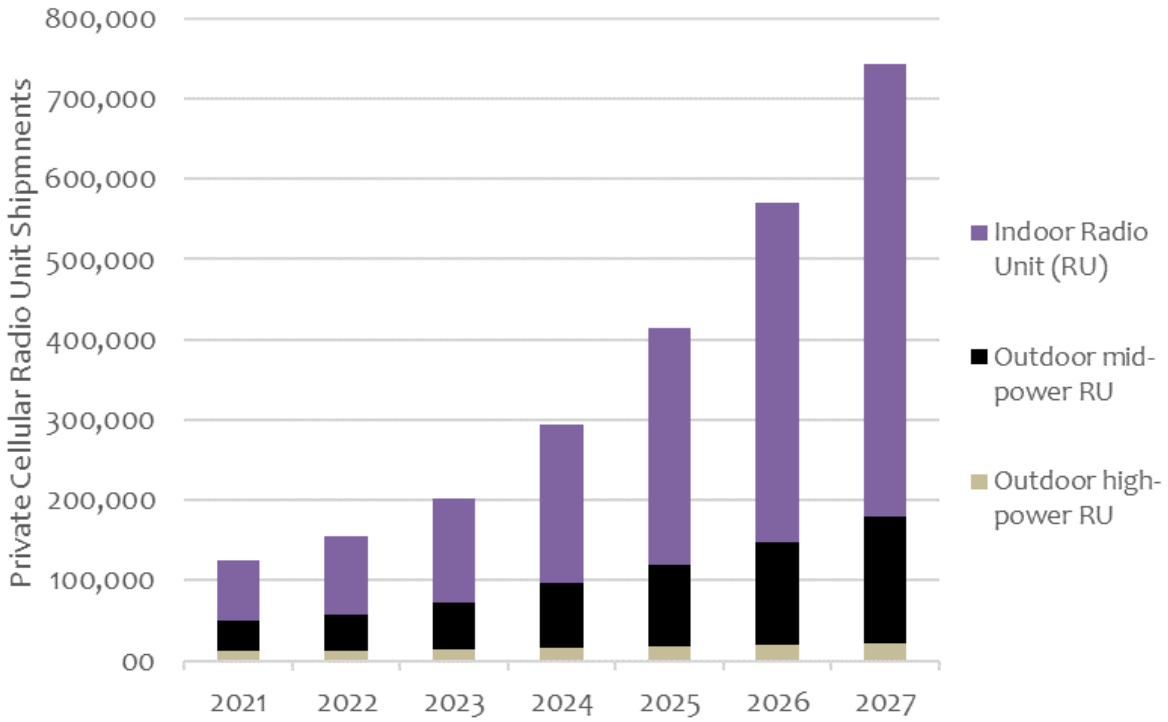
- Outside of major public sector deployments, most private LTE and 5G network deployments are driven by enterprises today to trial and experiment
- While major enterprises such as utilities who prefer a "fully owned" CAPEX model, we believe enterprises especially smaller SMBs will prefer "as-a-service" models
- In China, operators offer 'virtual' private networks (e.g., via network slicing or extended local RAN deployments), and they are the primary channel as private wireless-as-a-service (PWaaS) providers
- Cloud players (e.g., AWS, Google, Microsoft) are emerging as hybrid managed service providers
- Traditional MSPs and neutral-host infrastructure providers (e.g., tower companies) are well positioned to act as full PWaaS or hybrid managed service providers

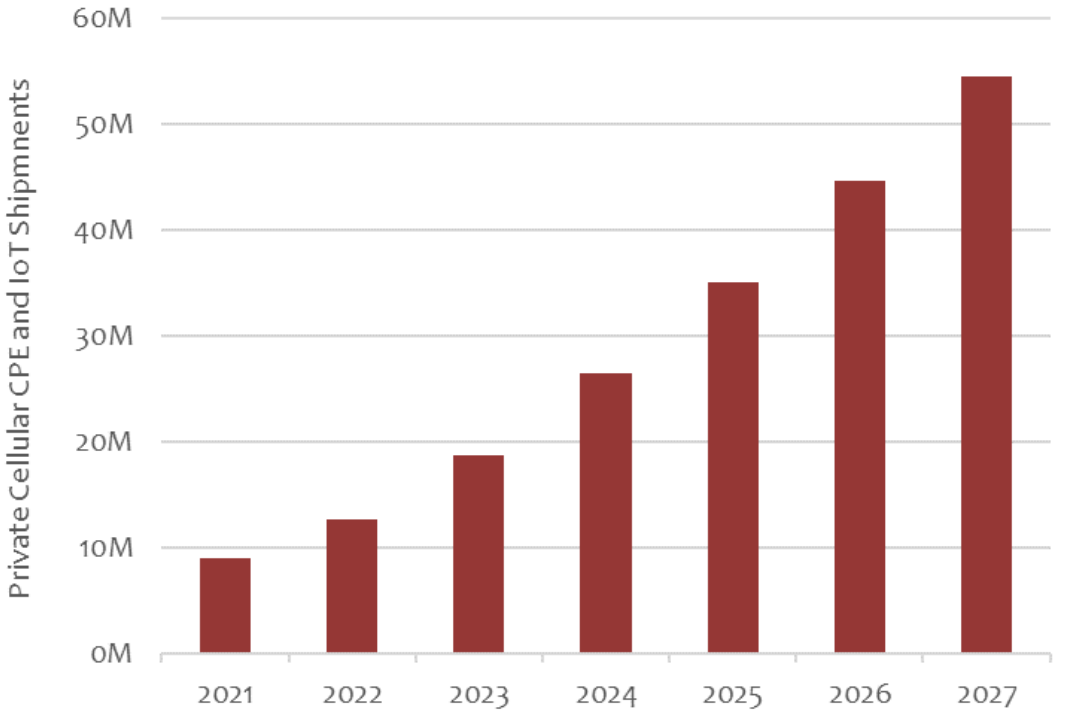


$4.6 B (2021) ——+20% CAGR——→ **$14.8 B** (2027)

* Private Cellular Equipment and Services market view

Private Cellular Shipments





- Annual private RAN shipment will increasingly lean indoors – growing from ~95k units in 2022 to over 550k units in five years
- Annual private RAN outdoor shipments will grow from ~60k units in 2022 to ~180k units in five years

- Annual private cellular device shipments (CPEs and IoT devices) is projected to grow at over 30% CAGR to over 50M units in 2027
- End device shipments include fixed wireless CPEs, cellular IoT gateways, mobile routers, and industrial user devices (e.g., tablets, etc.)

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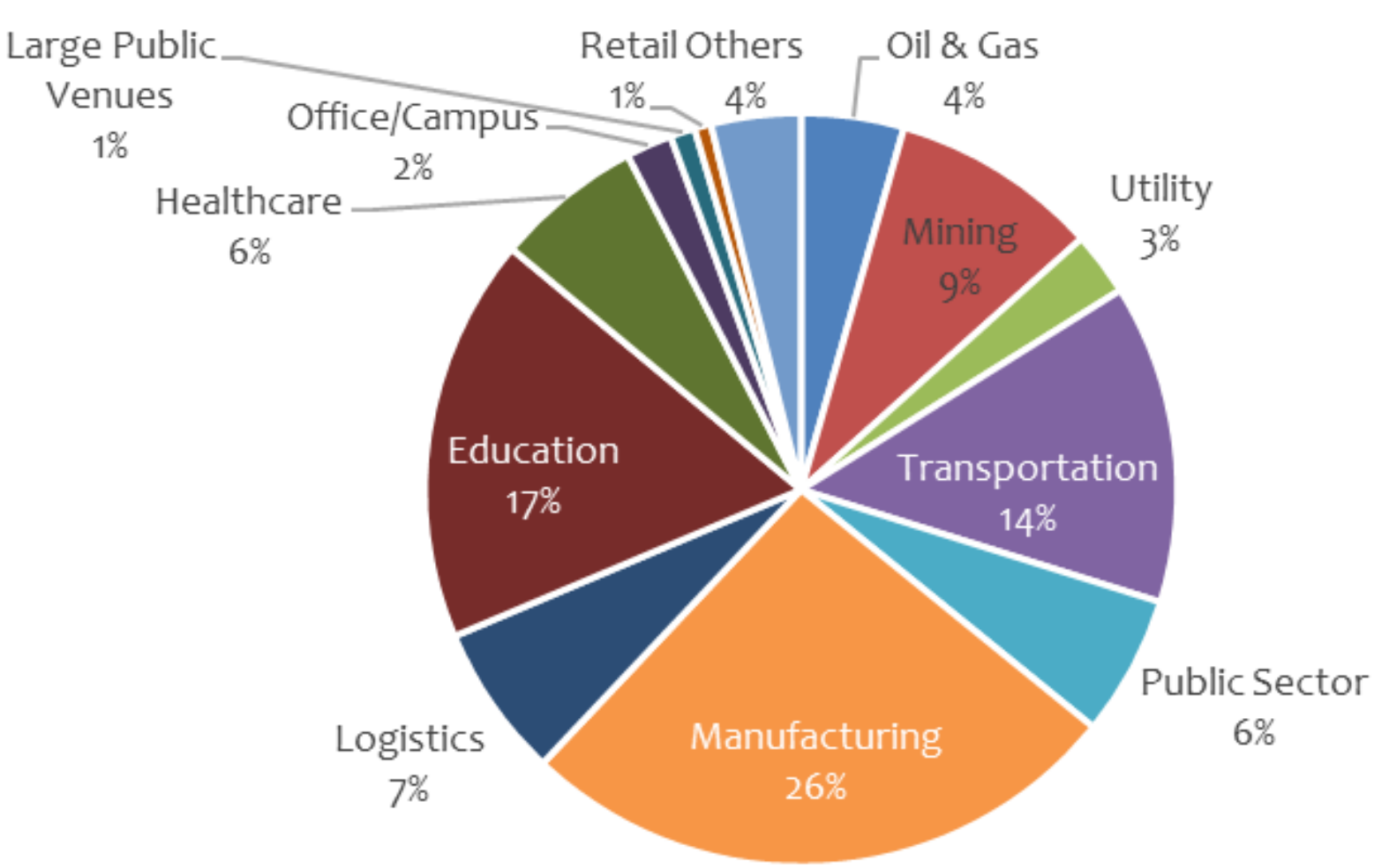
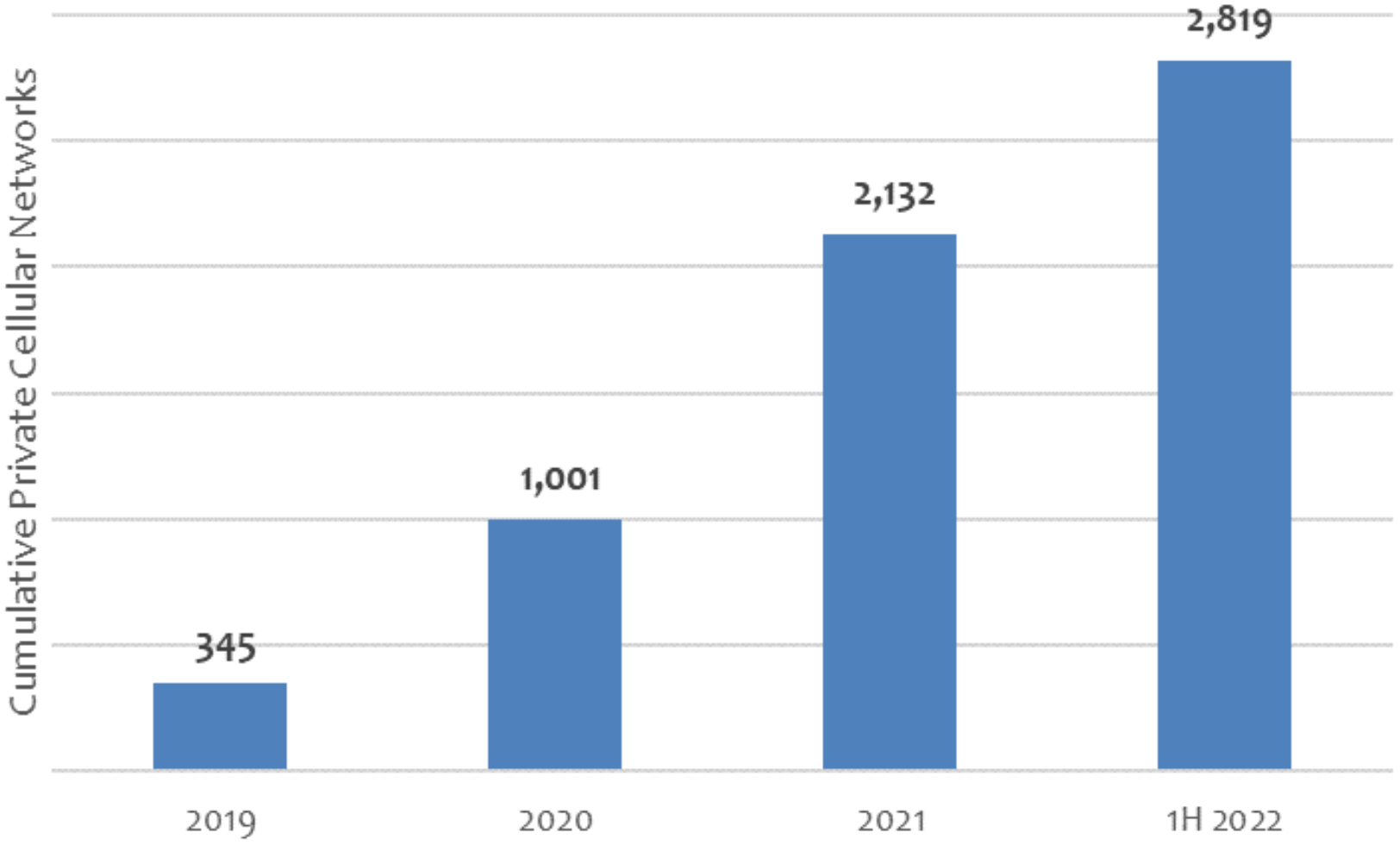
Number of Private Cellular Networks by Industry



* Cumulative, as of the end of June 2022

Cumulative Private Cellular Networks Deployed



Definitions

- Private Cellular Network is defined as:
  - Private wireless network intended for enterprise and government use (other than mobile operators' public network use)
  - Using 3GPP technologies (2G/3G, LTE, 5G) including GSM-R, FRMCS
  - Using licensed and unlicensed spectrum band, as identified by 3GPP
- Disparate campus networks leveraging a common core, but separated with MEC for local processing, are counted as individual Private Cellular Networks
- Cumulative figure does not exclude those that have been de-commissioned. Hence, actual installed base may be lower.
- Private Cellular Network does not include "virtual" private networks leveraging public network (e.g., network slicing) – e.g., China has thousands of 'virtual' private 5G networks directly deployed by the mobile operators for business applications*

* China's Ministry of Industry reporting 5,300+ virtual private 5G networks (May 2022)

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