



5G's Impact on the DAF

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August XX, 2022



5G



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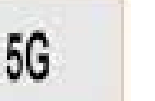
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HISTORY OF CELLULAR TECHNOLOGIES

CELLULAR TECHNOLOGY HISTORY



1G	2G	3G	4G	5G
 speed in kilobit per second 2.4 Kbps	 speed in kilobit per second 64 Kbps	 speed in kilobit per second 2,000 Kbps	 speed in kilobit per second 100,000 Kbps	 speed in kilobit per second 1Gbps
Analog Voice	Digital Voice + Simple Data	Mobile Broadband	Faster and Better	Real World Applications
				

1G – Initial analog cellular technology started in 1970s.

2G – Initial digital cellular technology started ~1990

3G – Initial broadband cellular technology started ~2000

4G – Enhanced broadband cellular technology started ~2009

4G Long Term Evolution (LTE) – Full broadband mobile experience enabling streaming and desktop-like experience, started ~ 2011



5G OVERVIEW



ADVANTAGES OF 5G



- **Massive Machine-Type Communications (mMTC)**

- Supports connectivity of massive quantities of low-complexity, low-power devices for Internet of Things (IoT) applications

- **Ultra Reliable Low Latency Communication**

- Supports systems and applications with time-sensitive data requiring high reliability
- End-to-end latency of 5ms or less with uptime of 99.999%

- **Enhanced Mobile Broadband (eMBB)**

- High download speeds for data-intensive applications on mobile connections
- Maximum achievable data rate: **10-20 Gbps**



Internet of Things



Logistics



Autonomous Vehicles



Smart Grid



UAS



Augmented & Virtual Reality



Home & Enterprise Broadband



Mobile Video Stream



5G SPECTRUM



5G - sub 6GHz

5G - mmWave

1 GHz

6 GHz / 24 GHz

Low band < 1 GHz

Mid band 1 - 6 GHz

High band > 24 GHz



- Strong propagation over larger geographic area
- Non StandAlone (NSA) Architecture



- StandAlone (SA) Architecture

- Congested: less bandwidth and throughput

- Most common development with LTE
- NSA
- SA

- Spectrum licenses nearly full

- Enhanced bandwidth which enables high-throughput and high-capacity uses
- SA only

- Shorter range
- Non-penetrative signal
- Requires increased infrastructure



HIGH-LEVEL 5G INDUSTRY TIMELINE



City-level 5G in selected markets

2019



- First 5G-capable smartphones released

Commercial at scale

2020



- 5G standards published 3GPP Release 16 June 2020

Densification and National Coverage

2021



- 5G standard 3GPP Release 17
- Published Summer 2022

2028



- 5G standard 3GPP Release 18 (5G Advanced)
- Begin Late Summer 2022

Expected Provider 5G Coverage Milestones

- 2021: 10 – 25%
- 2023 – 2025: 25 – 50%
- 2028 – Beyond: 100%



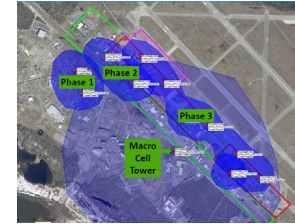
DEPARTMENT OF AIR FORCE 5G EFFORTS



DAF 5G EFFORTS



- Tyndall AFB “Installation of the Future” - An Installation of the Future founded on a robust, secure, seamless fusion between wired and wireless technologies to support the complete base mission. Being accomplished via two paths:
 - AT&T (Capital Investment): New 5G commercial & FirstNet service
 - AFCEC OTL: Verizon 4G LTE and 5G
- FirstNet - the nationwide, wireless communications platform dedicated to America's first responders and public safety community. Result of a public/private partnership between the First Responder Network Authority and AT&T. Authorized and overseen by the Department of Commerce
- Enterprise Information Technology as a Service (EITaaS)
 - Moving Enterprise IT to a service model
 - DAF will not own or operate infrastructure
 - Vendor will be expected to meet requirements/service levels as specified in the contract
- AFCEC Opportunities to Lease (aka “4G LTE on the Path to 5G”)
- DoD 5G Experiments





AFCEC DAF Base Network Infrastructure

“4G LTE on the Path to 5G”



- Cellular coverage is needed on all DAF bases where military missions are supported as well as for centers of the community such as retail locations, the library, the gym, and housing neighborhoods.
- Cellular coverage on DAF bases varies widely from location to location; some have partial coverage throughout the base while others have none.
- In order to address these gaps in coverage, the DAF has streamlined the process to grant leases for commercial broadband/cellular deployment to improve comprehensive coverage and increased capacity across its enterprise.
- To ensure all bases receive enhanced cellular coverage and capacity, the DAF is grouping bases into regions and evaluating commercial lease opportunities to identify the best solution for all bases in the region.
- As preparation for the leasing opportunity, worked with each base commander to determine the operational and quality of life areas that are required for coverage – not fence to fence in most locations.
- Evaluation criteria in order of importance are:
 - Coverage of areas required on each base
 - Capacity associated with each required area
 - Locations covered (pass/fail)
 - Timeline
 - Technology infusion – moving to 5G
 - Compensation (which can be in-kind capabilities)



PHASE 1



- Leasing opportunity is for all bases within the region; site visits (which include drive through) were arranged as part of the leasing opportunity request
- Worked with Defense Spectrum Management Office to streamline the spectrum approval process to treat all bases as a single approval provided that same spectrum/devices are used. One offs are handled at the base level.
- Leasing opportunity will be up to 25 years (normally limited to 5 years)
- Southeast region was designated as Phase 1 and Opportunity to Lease (OTL) was completed 2QFY21
- Phase 1 consists of 10 Bases:
 - Dobbins Air Reserve Base (ARB), Georgia - Complete
 - Moody Air Force Base (AFB), Georgia – ECD 4QFY22
 - Robins AFB, Georgia – ECD 1QFY23
 - Grissom ARB, Indiana – Complete
 - Seymour Johnson AFB, North Carolina – ECD 1QFY23
 - Joint Base Charleston , South Carolina – ECD 1QFY23
 - McEntire Joint Guard Base, South Carolina – ECD 4QFY22
 - Shaw AFB, South Carolina – ECD 4QFY22
 - Arnold AB, Tennessee – ECD 4QFY22
 - Tyndall AFB, Florida - Complete



PHASE 2



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- Based on the first leasing opportunity, determined that additional clarifications needed to be provided and add extra time for final sightings into the expected implementation timeline.
- Second phase consists of 20 bases in Central West CONUS
 - OTL completed 3QFY21
 - Site Visits underway
 - **Buckley Space Force Base (SFB), CO**
 - Cannon AFB, NM
 - Cavalier Space Force Station (SFS), ND
 - Cheyenne Mountain SFS, CO
 - Creech AFB, NV
 - Davis-Monthan AFB, AZ
 - Ellsworth AFB, SD
 - FE Warren AFB, WY
 - Grand Forks AFB, ND
 - **Hill AFB, UT**
 - Holloman AFB, NM
 - Kirtland AFB, NM
 - Luke AFB, AZ
 - Minneapolis-St. Paul Air Reserve Station (ARS), MN
 - Minot AFB, ND
 - **Nellis AFB, NV**
 - Offut AFB, NE
 - Peterson SFB, CO
 - Schriever SFB, CO
 - USAF Academy, CO



PHASE 2B Air Force Reserve Command

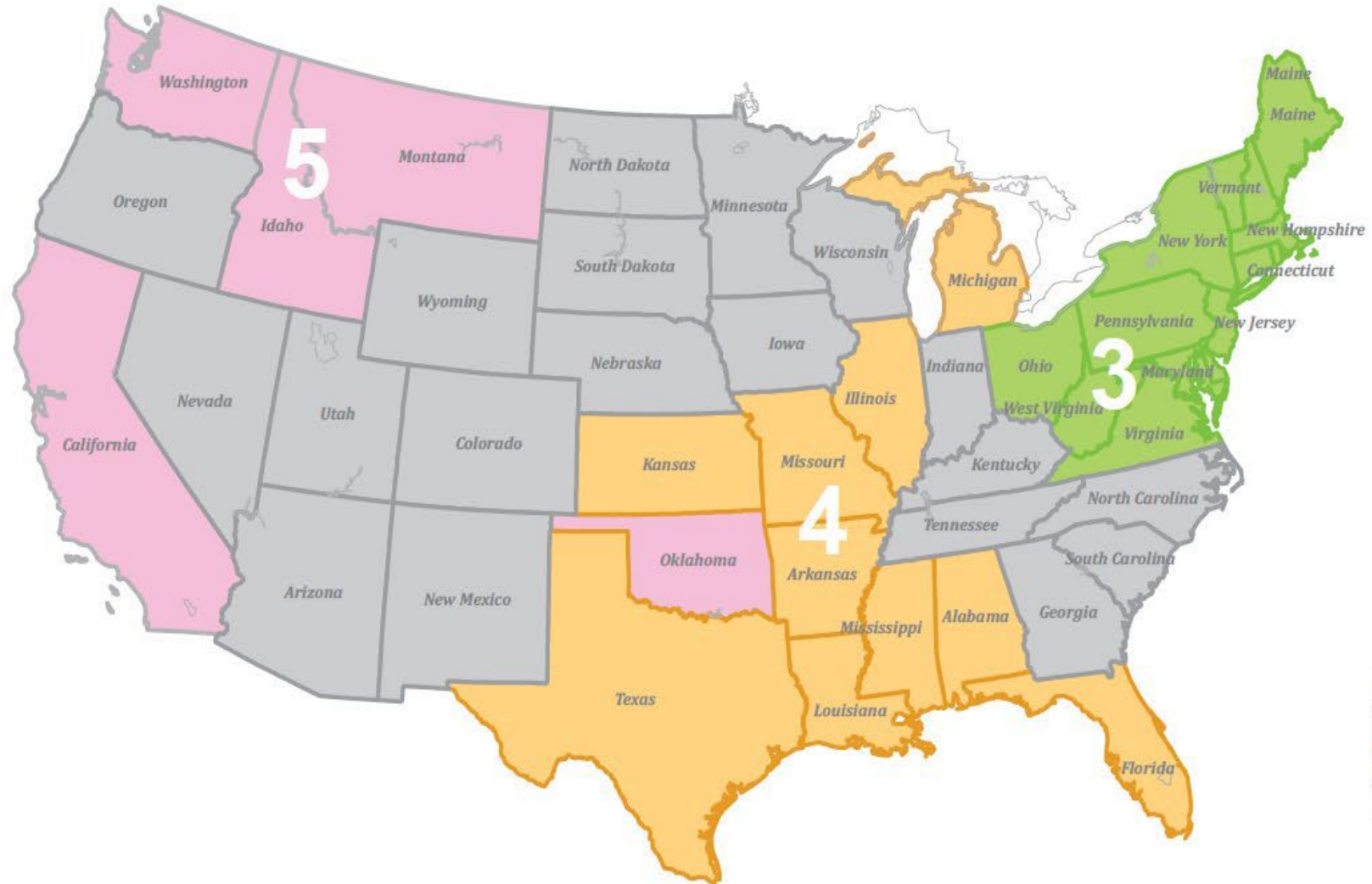


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- 3 year acceleration for Air Force Reserve Command (AFRC) mobile workforce to improve wireless access and coverage gaps
- AFRC bases have a more dynamic personnel fluctuation than the regular Air Force. During Unit Training Assemblies (UTA) at AFRC host bases with a population of approximately 10,000 weekday personnel can increase to as much as 32,000 on a UTA weekend
- Current Schedule
 - OTL complete 4QFY21
 - Site visits started 2QFY22
 - Carswell ARB, TX
 - Homestead ARB, FL
 - March ARB, CA
 - Niagara Falls ARB, NY
 - Pittsburgh ARB, PA
 - Westover ARB, MA
 - Youngstown ARB, OH



AFCEC REMAINING PHASES



Legend

- Phase 3
- Phase 4
- Phase 5



PHASE 3 & BEYOND



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Phase 3 is

- OTL Solicitation closed in Spring 22 with OTL award anticipated 4QFY22

Beyond Phase 3

- Based upon lessons learned readdressing future phases to try to expedite and complete in one or at most two additional phases



DOD 5G EXPERIMENTS (DAF BASES)



- OUSD (R&E) has outlined a plan to conduct experiments focused on 5G technologies. These experiments are based upon three lines of effort:
 - Accelerate – Hasten DoD's adoption of 5G
 - At-scale test facilities that enable rapid experimentation & dual-use application prototyping
 - Leveraging commercial technology and processes to address DoD Use Cases
 - Operate Through – Ensure that US forces can operate through wherever and whenever we deploy
 - Dynamic spectrum utilization
 - "Zero Trust" architectures
 - Innovate – Enhance 5G technology and invest in future "Next G" technologies
 - There is no finish line.
- Efforts broken into tranches of activity, DAF specific efforts are:
 - TRANCHE 1:
 - Hill AFB – Spectrum Sharing
 - Nellis AFB – Dispersed C2 for Agile Combat Employment
 - TRANCHE 2:
 - Joint Base Pearl Harbor-Hickam – Enhance Aircraft Mission Readiness
 - Joint Base San Antonio – Augmented Reality Medical Training and Telemedicine/5G Core Security
 - Tinker AFB – Enhanced Aircraft Maintenance

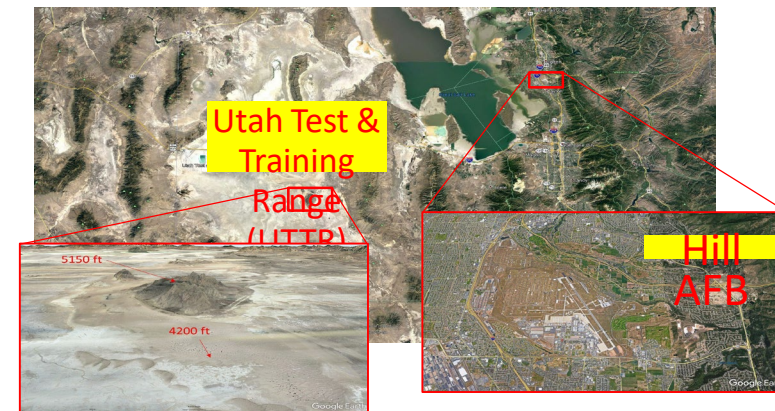


TRANCHE 1 HILL AFB



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- Hill AFB selected for dynamic spectrum sharing between 5G and high-power military radars
 - Develop Spectrum Sharing Coexistence System (SCS) prototype
 - Provide interoperability between airborne radar and 5G cellular system in 3.1-3.45 GHz Band (may expand up to 3.6 GHz)
 - Effort completed in phases. Initial phase has multiple vendors providing their solutions for comparison. After each phase solutions are evaluated and top solutions will move to next phase.
 - Testing focused on evaluating impact on actual airborne systems
- Infrastructure in place. 13 Cells on Light Truck (COLTs) installed across Hill Test Range.
- Initial testing completed first week of March. No interference noted in initial tests



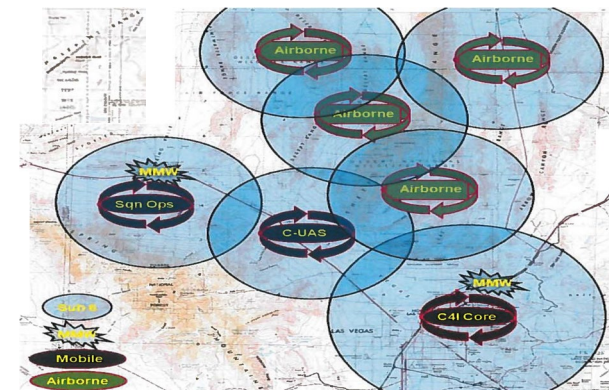


TRANCHE 1.5 NELLIS AFB



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- Experiment is to use 5G capabilities for Disaggregated and Distributed Command and Control (C2) for Agile Combat Employment (ACE)
 - Effort focused on Air Operation Center
 - Experiment researching technology components necessary to deliver a private cellular network to the “last mile” warfighter, completely mobile, agile, resilient, and rapidly configurable to support ACE and tactical reload requirements. Technical components required for success:
 1. Big Data to the EDGE at high speed
 2. Extend network between base and core nodes
 3. Transition C2 to Cloud/Virtual Network with Apps/Services optimized for Next Gen
 4. Integrate Existing Comms/Networks via Gateways to leverage Next Gen
 5. Constant Next Gen Connectivity on the Move
 6. Next Gen capability built on a self-healing network in a Zero Trust Environment
- Infrastructure in place; experimentation to begin by 3QFY22



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TRANCHE 2 JOINT BASE SAN ANTONIO



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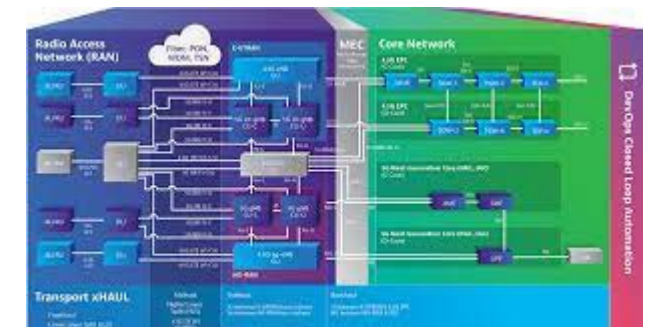
- **Augmented Reality (AR) Medical Training and Telemedicine**

- Deploy a 5G network covering the medical training/ health care facilities on a base with high throughput and low latency for Augmented AR
- Develop applications to support following use cases
 - Extend virtualized instructions & diagrams to the AR devices
 - Allow immediate conference with a remote Subject Matter Expert (SME) with access to AR info
- Integrate network and applications and test / verify capabilities



- **DOD 5G Core Security Experimentation Network**

- Create a testbed ecosystem with platforms for deployment and experimentation of a DoD 5G Core
- Hybrid cloud / local implementation
- 5G Interoperability experimentation with Management and Orchestration Software (MANO) security
- Pilot Training Transition (PTT) Application prototype with transition path
- 5G Standalone (SA) architecture secure slicing implementation and experimentation
- Collateral classified over 5G in support of ARNORTH
- 5G Vulnerabilities Assessment (16 AF/67 CW)
- Intelligence Automated 5G Core Assessment (AFRL/RIG)
- Open Radio Access Network Assessment



- Source selection for both efforts to begin 3QFY22



TRANCHE 2 JOINT BASE PEARL HARBOR-HICKAM



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- Experiment focused on **Enhanced Aircraft Mission Readiness**
 - Deploy a 5G network covering the flight line, maintenance and warehouse areas on a base and develop a connectivity approach to selected aircraft
 - Develop applications to support following overarching use cases:
 - GB transfer rates from aircraft to 5G node
 - Rapid/automated capture and analytics of aircraft data
 - Identify repair/maintenance needs (and/or mission data)
 - Tie into maintenance/warehouse data bases which can support AR enabled repair/maintenance
 - Six specific DAF Use Cases:
 - C-17 Connected Maintainers
 - Autonomous Vehicle Foreign Object Debris (FOD) Detection
 - Use of drones for exterior C-17 inspection
 - C-17 AR/VR training w/HoloLens SME reach back
 - F-22 rapid data download and analytics
 - F-22 Low Observable scan inspection
 - Infrastructure contract awarded 1QFY22; Fully implemented 3QFY22 with experimentation beginning shortly after





TRANCHE 2 TINKER AFB



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- Improve Workforce Development technical learning with 5G enabled AR/Virtual Reality (VR) by working with local educators and AFMC team
 - Build and validate Aircraft maintenance digital learning and reference tools using commercial off the shelf (COTS) software extended reality capabilities
 - Demonstrate feasibility of COTS in Tinker AFB 5G Testbed
- Utilize 5G capabilities to support tracking of Aircraft Ground Equipment (AGE) across Tinker AFB
 - Seamlessly track and monitor 5000+ of AGE to reduce dependency on hard-wired data connections





6G/NEXTG



6G/NEXTG MYTHS



- 6G will be available in the next couple of years
- 6G will just be slightly faster 5G and not bring significant new capabilities
- We don't need to start thinking about 6G today during the era of 5G



6G/NEXTG REALITIES



- 6G will come to the market at the end of the decade (normal 10-year cycle)
- NextG Alliance has stated 6 audacious goals for 6G:
 1. Trust, Security, and Resilience
 2. Digital World Experience
 3. Cost Efficient Solutions
 4. Distributed Cloud and Communications Systems
 5. AI-Native Network
 6. Sustainability (focused on the Environment)
- Need to think through requirements for 6G and begin R&D efforts now; based upon lessons learned from 5G
 - USD R&E leading DOD NextG efforts
 - NextG Alliance leading North American efforts



Thank you!
Q & A



BACKUP