



## 5G Telemedicine & Medical Training

*The purpose of this article is to inform about exciting activities and future visionary events taking place to enhance Department of Defense (DOD) medical support capabilities within the developing 5G core environment.*

In June 2020, Office of the Undersecretary of Defense (Research & Engineering) named Joint Base San Antonio (JBSA) as an experimentation site for 5G augmented reality support for telemedicine and medical training. Although telemedicine is already happening today, it is often inhibited by a lack of adequate digital connectivity supporting the data speeds and volumes needed to provide real-time virtual healthcare. Since 5G is a critical strategic technology, the DOD must master 5G networks, which will eventually touch every mission and operation of DOD medicine.

The joint DOD telemedicine community has identified seven key goals that 5G solutions must address:

Goal 1: Save lives and maximize preventive medicine.

Goal 2: Provide resilient and fault-tolerant medicine and medical services anywhere in the world to support U.S. national interests and maintain military mission assurance.

Goal 3: Collapse time and space to achieve real-time virtual and digital medical support.

Goal 4: Extend medical expertise forward to the operational edge to enhance support for mobile forces in operational or austere environments.

Goal 5: Ensure mission and data security in all medical applications.

Goal 6: Maintain an environment which allows DOD medicine and medical services to practice virtual medicine to the maximum state possible.

Goal 7: Provide an environment that facilitates the injection of new technologies in support of telemedicine applications.

With these goals as support priorities for the DOD medical services, the JBSA 5G Program Management Office has worked to develop several technical areas to help augment future telemedicine and medical training applications within the 5G environment. The 5G features, functions, and advanced communications technologies, including flexible bandwidth allocation (ultra-narrow to extremely broad), in-network core applications, ultra-low-latency, and ubiquitous connectivity for DOD military medical service components. This will enable the joint medical community to sustain its long-term economic and military advantage.

The JBSA 5G PMO is addressing the medical community's aforementioned goals by utilizing 5G Core functions as an integrated extension of the internet within mobile spaces, including air platforms, ground units, and aquatic/space environments. In detail, JBSA experimental activities will be positioned as individual projects that will address, prototype, and demonstrate the different technical aspects of 5G required to support most medical applications, including those using augmented reality (AR) and virtual reality (VR), artificial intelligence (AI), machine learning (ML), and massive sensor and Internet of Medical Things (IoMT) monitoring and control.

Because of the complexity in 5G capabilities and the operational diversities needed for telemedicine, use of applications under five technical areas for prototype and experimentation with critical 5G capabilities were initially selected as projects partnered with experienced service component leaders. Those include:

- **AR-Guided enhanced medical training.**
- **Advanced telehealth information access.**
- **Advanced telerobotic surgery.**
- **Augmented reality technology enabled remote integrated surgery (ARTEMIS).**
- **Mobile medic environments.**

These five 5G telemedicine and medical training experiments will be shaped to bring medical providers' access to near real-time data and the ability to make the split-second decisions which are critical in healthcare environments. By utilizing 5G core capabilities, transfers of massive files, images, and other content will benefit from low latency. Compute power with 5G will also help accelerate benefits exponentially. Future engagements will also lead toward allowing AI and ML to interact with both providers and patients in real-time. The use of 5G will also expedite the exchange of visual, sensory, auditory, haptic, and robotic control to decrease workload. Since 5G technology offers massive connection and fast speeds, it will transform how healthcare is delivered, including Ultra Reliable Low Latency Communications (URLLC), Enhanced Mobile Broadband (eMBB), and massive Machine Type Communications (mMTC).



Future demonstration details of planned technical area projects are depicted below:

### **TA 1 - 5G AR-Guided Enhanced Medical Training:**



*The prototype and demonstration of this application with 5G is to enhance in-garrison (on the actual post or station) or just-in-time (right before departing for deployment) medical readiness training. It will improve and/or augment capabilities and accessibility for reliable and realistic scenarios which meet or exceed national providers' standards. By integrating service extensions, such as AR, ML, AI, and 3D*

interactive displays, the 5G core network will directly enabled 5G medical IoMT devices. Capabilities for real-time medical tele-mentoring can occur anywhere in the world (also includes training platforms, Military Treatment Facilities, and Partner Nations). Management of initial scenarios with applications in an active AR/VR training environment is to be established initially with several modules which are listed in U.S. Army Training Circular (TC) 8-800. Use of realistic engagements or scenarios for Paramedic-Emergency Medical Technician-Combat Medic certification will also include tracking of activities, progress, and skills verification, which will improve the efficiency and proficiency of medics to meet or exceed national providers' standards.



### **TA 2 - 5G Advanced Telehealth Information Access:**



*The prototype and demonstration of this application within 5G will explore rapidly self-configurable 5G IoT Electronic Health Networks. It will build, utilize, optimize, and deploy sophisticated health network applications and health records (access) into the IoMT for medical clinics, health facilities, and health teams in-garrison and at forward operating locations. Improved medical capabilities along secured*

connectivity in-garrison, in stable facilities, tactical or Partner Nation environments, and austere forward operations will allow efficient provider productivity and interoperability options. Continuous avenues for ubiquitous or on-demand tele-mentoring and training will include the capacity to:



- 1- Build robust database and access existing applications, to include Electronic Health Records (EHRs) and digital imaging.
- 2- Immediately project multi-specialty access for credentialed caretakers.
- 3- Build global medical capabilities with assistance also to mobile medical capabilities (see TA 5).
- 4- Optimize medical desktop applications/programs.

### **TA 3 - 5G Advanced Telerobotic Surgery:**

*The prototype and demonstration of this 5G experiment is to utilize 5G applications for remote telerobotic surgery. This fulfills a potential capability gap to extend the reach of remote surgical capability interventions (physical interactions or procedures) to the point of need in forward care settings. The emergence of compact tele-surgical robot platforms offers potential solutions to technical limitations by developing portable hardware or prototypes which can be staged further forward. Additionally, 5G offers the potential to mitigate some network-imposed*



limitations of telerobotic surgery such as signal delay (latency), bandwidth restrictions, and signal disruption, which could lead to deleterious surgical performance. The vision of implementing telerobotic surgery in a forward-care setting will look to improve the

functionality of current telerobotic surgery platforms and will expand training and mentoring opportunities.

#### **TA 4 - 5G Augmented Reality Technology Enabled Remote Integrated Surgery (ARTEMIS):**



*The prototype and demonstration of this experiment is to test and evaluate 5G capabilities to support telemedicine/tele-mentoring technology and build robust remote medical capabilities. In this instance, 5G will utilize 3D, AR, and VR to optimize reach-back capability for tactical or airborne medical care when transportation is constrained by geographic or facility limitations. Equipment and invasive procedures,*

which are usually based in a centralized location, will be capable of becoming mobile, thereby maximizing combat power forward. And, 5G will adapt and validate a wearable AR-based system which can enable high-fidelity, bi-directional specialized medical and surgical consultation by a remote expert. Advances in AR technology will allow for virtual information to be holographically inserted into the field of view of the user. Overall, this program will improve the capability and capacity of diagnostics by monitoring through sensors which also clarify and focus feedback.

#### **TA 5 - 5G Mobile Medic Environments:**

*The prototype and demonstration of this application with 5G is to provide critical life-saving treatments to wounded soldiers in the field. Under field and combat conditions, immediate triage, diagnosis, and treatment could save lives. Although military mobile medics are highly trained in treating physical trauma and life threatening wounds received in the field under adverse and often hostile conditions, having real-time access to knowledge and expertise to assess, diagnose, and complete complex procedures and protocols to treat critical wounds could save lives and reduce warfighter attrition due to*



debilitating injuries. Under this experiment/project, 5G systems and networks will optimize the effectiveness and efficiencies for mobile medical personnel when constrained in any environment that limits access to the resources of a definitive/specialized medical care facility; create resilient, real-time reach-back capability for tactical or airborne-platform medics; incorporate real-time primary care support from extenders and specialists; improve point-of-need care, which could mitigate the need to transport patients to higher levels of care, thereby maximizing combat power forward; and allow utilization of telemedicine or tele-mentoring technology for training which could increase the clinical skills and abilities of field medics.

Although there are some cross-functional and cross-coverage enhancements seen in these TAs, JBSA 5G PMO has established a 5G Medical Steering Committee with medical service partners to oversee and influence the prototypes into individual project developments and meet both 5G architecture needs as well as DOD telemedicine needs.



This steering committee will provide advice and technical expertise from both the base project teams and military community subject matter experts. By enhancing and advancing medical enterprise capabilities at any point of need, these projects will synergistically advance medical technology, medical and telemedicine applications, medical training, and surgical capacities to extend operational medical expertise globally for integrated, efficient, and effective employment of DOD medical service support.

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10 December 2020