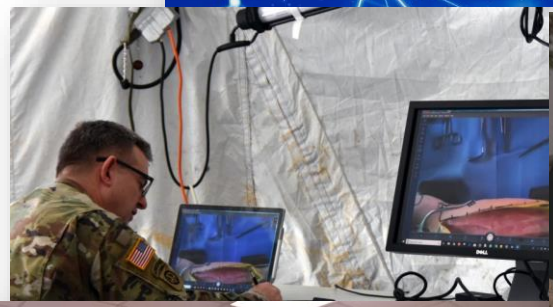
JBSA 5G
Telemedicine & Medical Training
Industry Day

28 January 2021

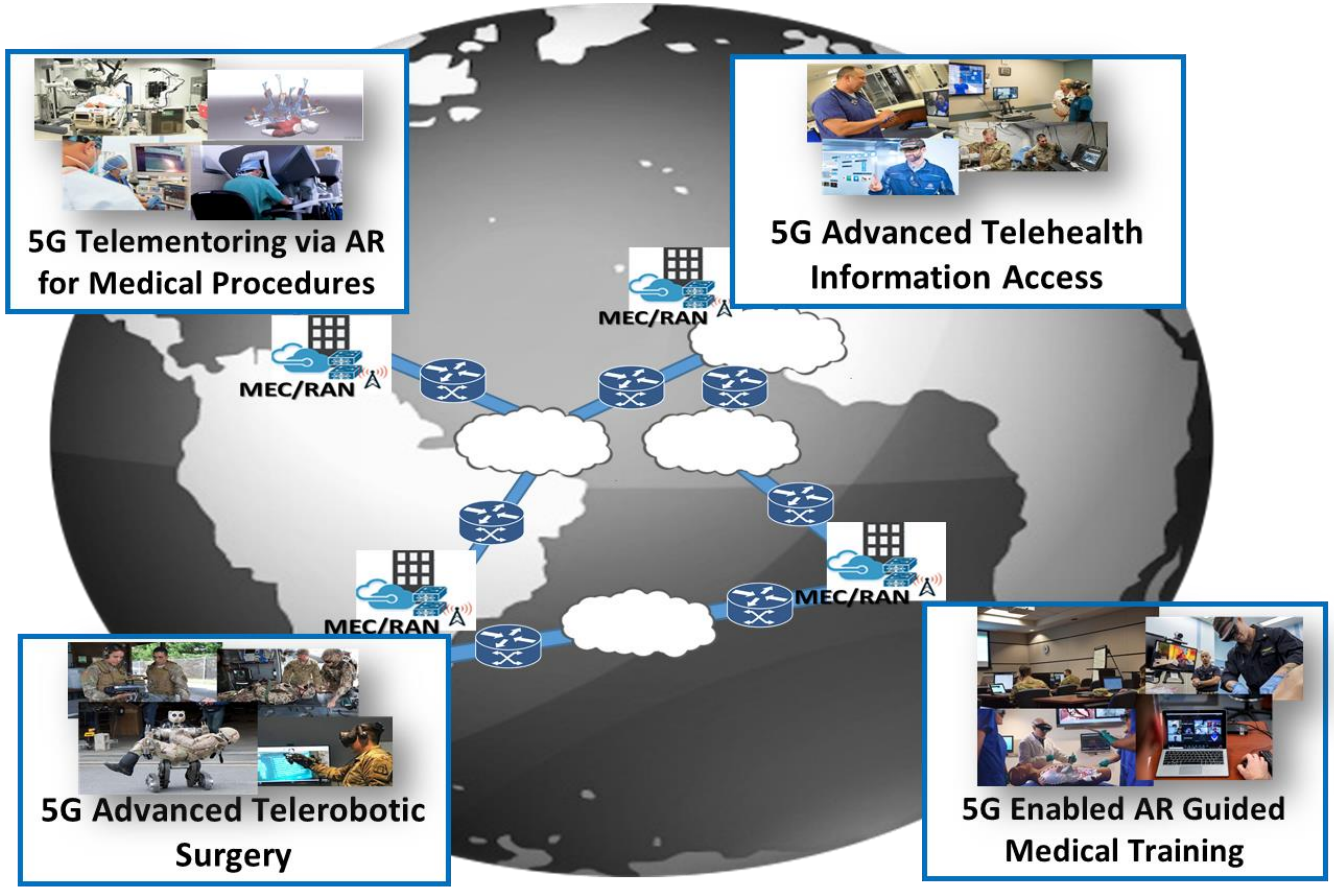
Why 5G For Telemedicine

The Near 5G Future



Experiment Objective

Extend the reach of DoD life saving medical procedures and critical health care expertise by connecting remote sites to 5G Telemedicine services



Project medical expertise virtually using 5G Telemedicine Technology

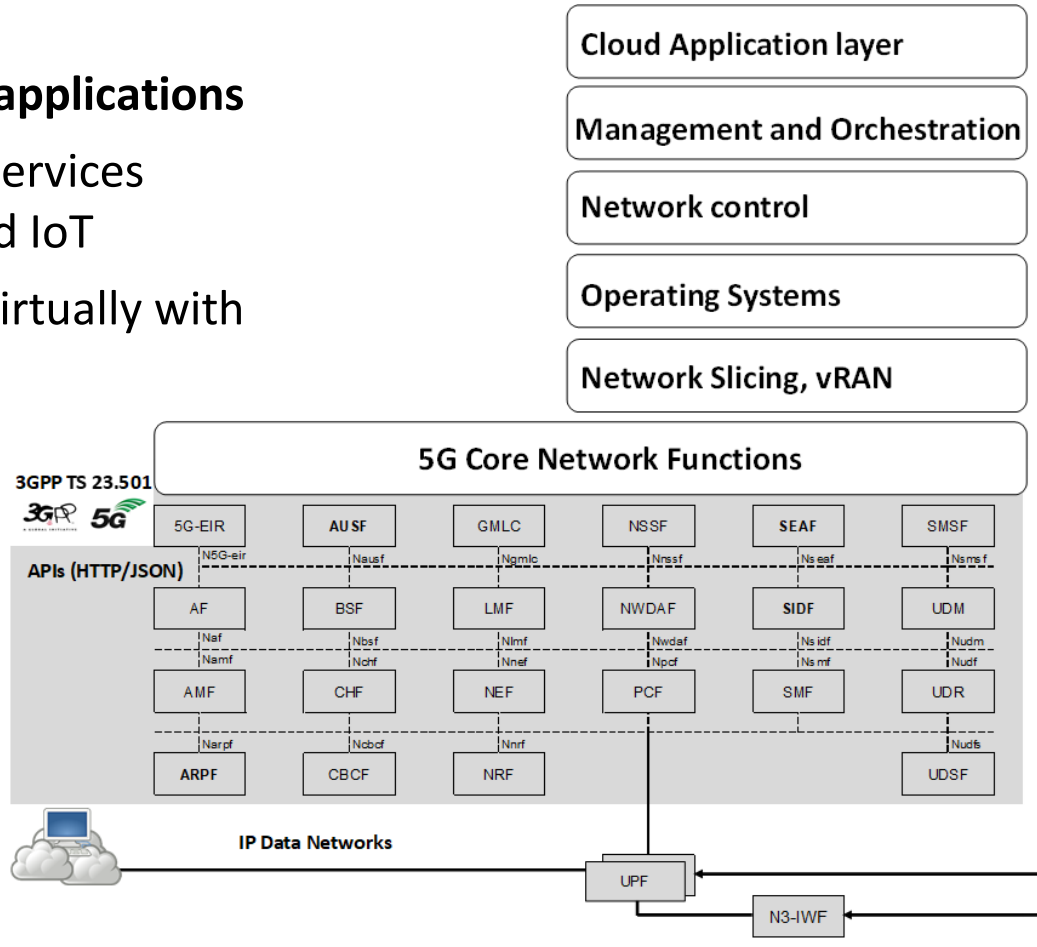
- Providing medical care capability at the point of need
- To remote locations
- Collaboratively and on-demand

Why 5G?

5G offers broad array of advanced Telemedicine services, once unimaginable

Untethered 5G Telemedicine applications

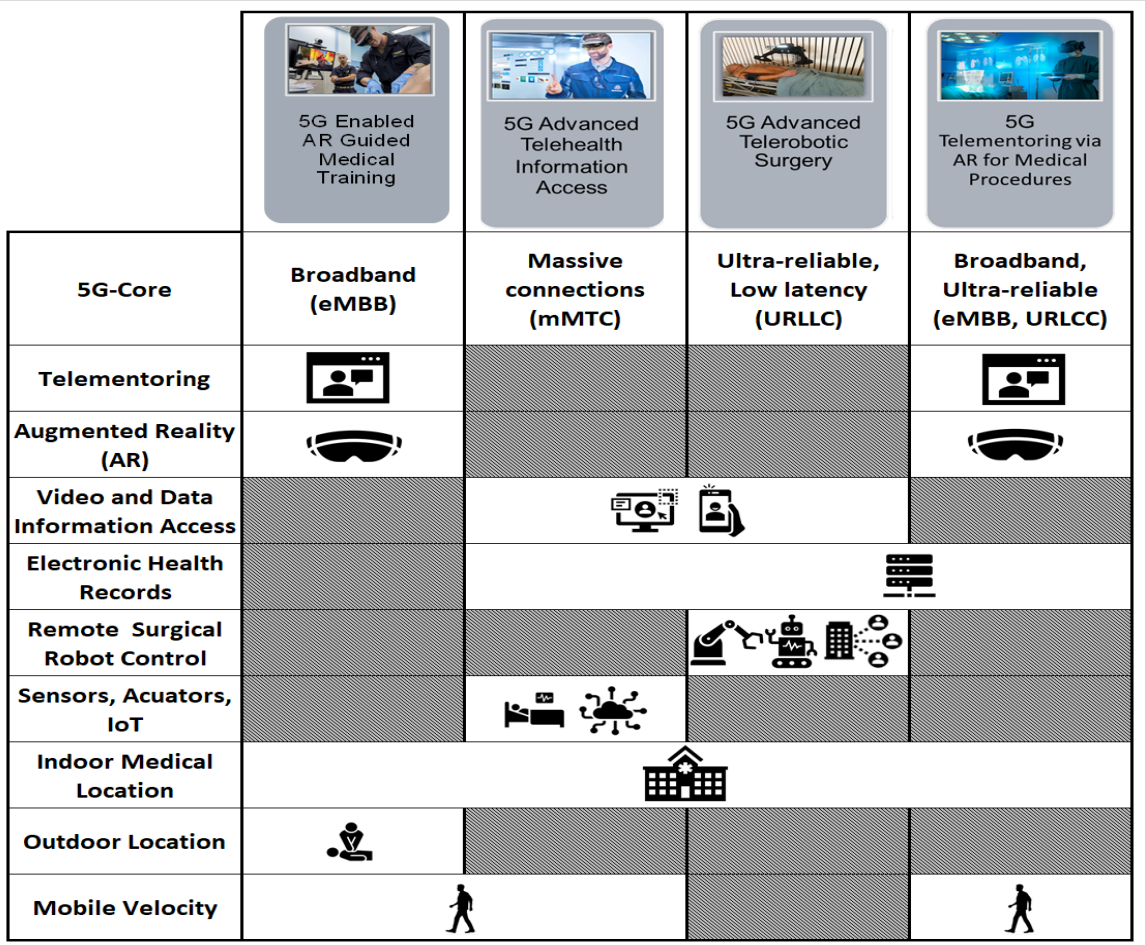
- Wide integration of cloud services information technology and IoT
- Project medical expertise virtually with broadly integrated array of telemedicine applications
- Gigabit data rates
- Low latency control
- 5G Edge Computing



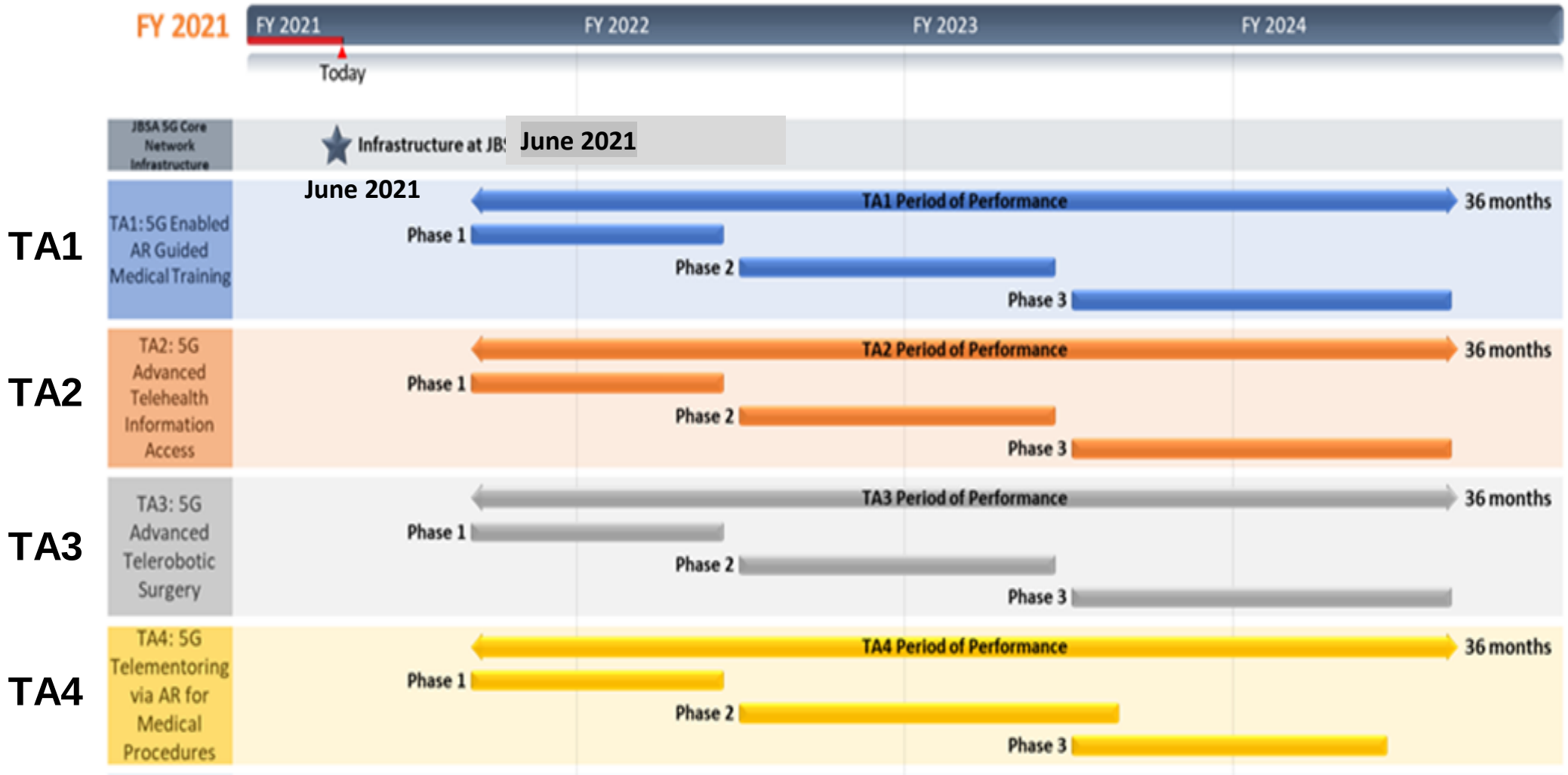
Technical Area and Prototype Overview

New Telemedicine capabilities, stuck in indoor labs, advanced by applying 5G technology to Telemedicine

- Move AR Telementoring and Training out of Lab (untether)
- Surgical experts to remotely operate on patients with surgical robotics
- Infuse 5G Telehealth into both future and legacy medical facilities, rapidly
- Telementoring reach-back access to medical expertise and health records, on-demand, saving lives
- Four (4) 5G Telemedicine technical areas



Phases Goals & Activities Timeline



4 Concurrent Technical Areas (TA)

Each TA Timeline has three 12-Month Phases

Overview of Experimental Program Phases

PHASE 1

Infrastructure & Application Framework

- 12 Months
- SW Delivery at end of Phase
- Key Milestones:
  - Award / Start Work
  - Kickoff Meeting
  - Software Requirements Review
  - Architecture Design Review
  - Framework Integrated and Operational
  - Exit Criteria / Delivery
    - 5G Core (framework) Working
    - Application SW Framework

PHASE 2

Application and Testing

- 12 Months
- SW Delivery at end of Phase
- Key Milestones:
  - Requirements Update
  - Design Update
  - Experiment / Test Plan
  - Regular Technical Exchange Meetings
  - Interim Software Deliveries
  - Testing / Experimentation / Data Collection
  - Exit Criteria / Delivery
    - Fully Functional 5G Core and Application Software Delivery at End of Phase
    - Application Demonstration

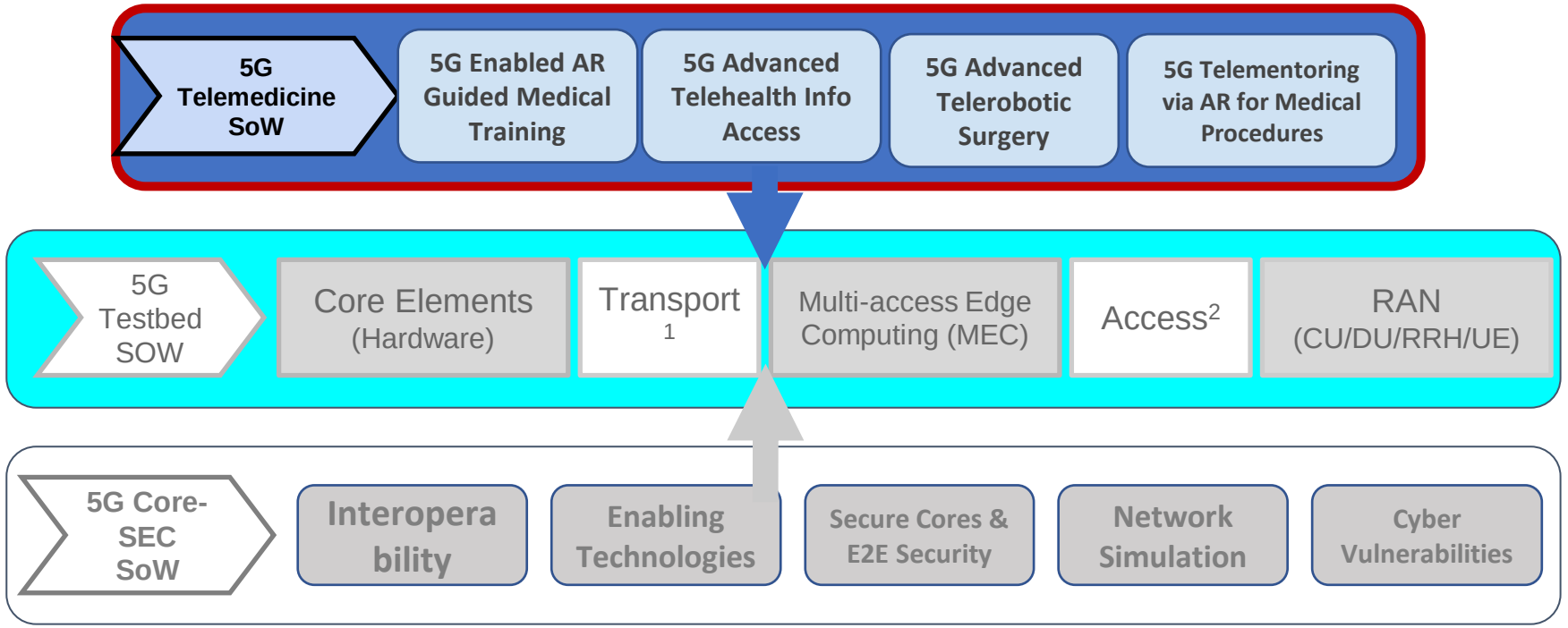
PHASE 3

Experimenting, Exercising, and Evaluating

- 12 Months
- SW Delivery at end of Phase
- Key Milestones:
  - Updated Experiment Test Plan
  - Testing / Experimentation / Data Collection
  - Live Exercise Plan and Scenario
  - Live Exercises and Data Collection
  - Interim Software Deliveries
  - Exit Criteria:
    - Fully Functional Opt. 5G Core Application
    - Full 5G Application Demonstration
    - Final Technical Report

JBSA 5G Telemedicine Experimentation Site and Programs

The experiment projects share infrastructure which is being procured in a separate OTA, and provide full 5G Telemedicine capability



Medical Experiments

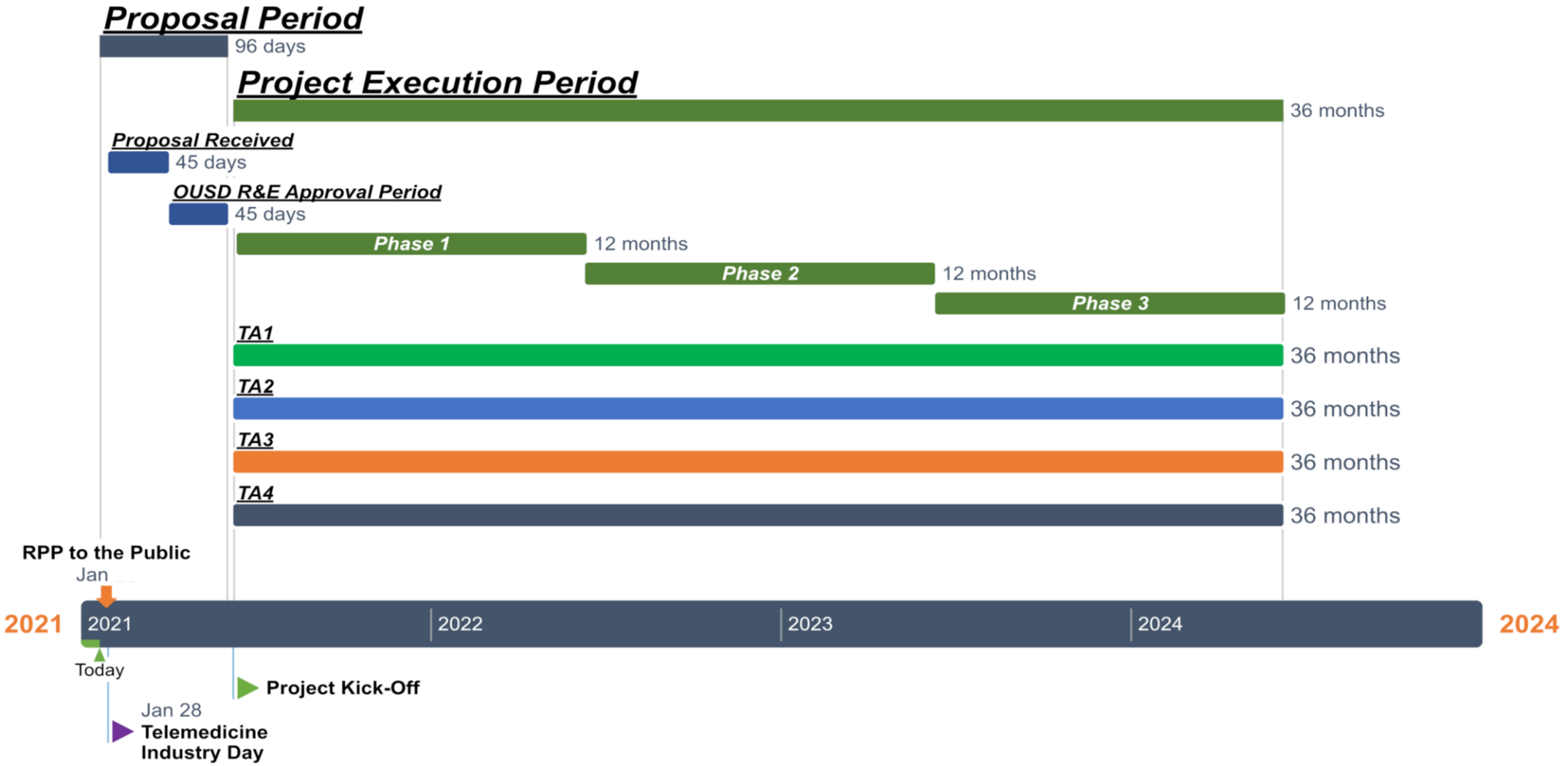
- Augmented Reality (AR)
- Video Services
- Remote Surgical Robotics
- Electronic Health Records
- Medical IoT (IoMT)

5G 3GPP Use Cases

- Reliable Low Latency (URLLC)
- Broadband (eMBB)
- Massive Density (mMTC)

1 - Limited experimentation in Transport Area
2 – Experimentation focus on ubiquitous connectivity

Experiment Timeframe (Notional Schedule)



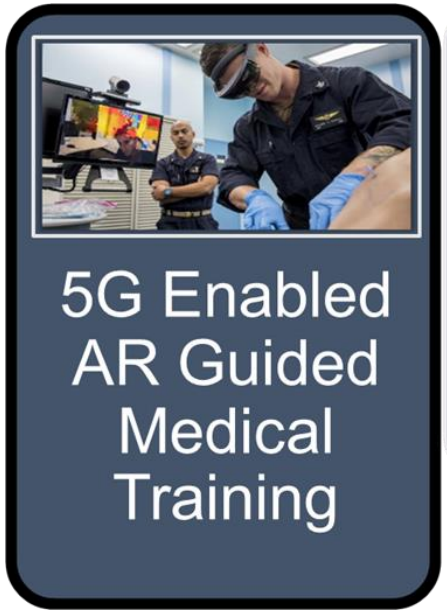
TA 1: 5G Enabled AR Guided Medical Training

Objective: To optimize in-garrison medical training and operational support

5G Enabled Tech → Augmented Reality

5G Use Case → eMBB

Outcome → Medical Training




5G Advanced Telehealth Information Access


5G Advanced Telerobotic Surgery


5G Telementoring via AR for Medical Procedures

Partnered with US ARMY Virtual Medical Center, BAMC, Ft. Sam Houston, TX

TA 1: Objective & Overview

Objective

To provide access to high-quality virtual training which utilizes 5G to:

- Expand medic training capacity
- Extend expert capability to remote sites, virtually
- Augment proficiencies and improve courseware for provider and technician medical standards

Overview

Use Case: 5G Enabled AR-Guided Medical Training

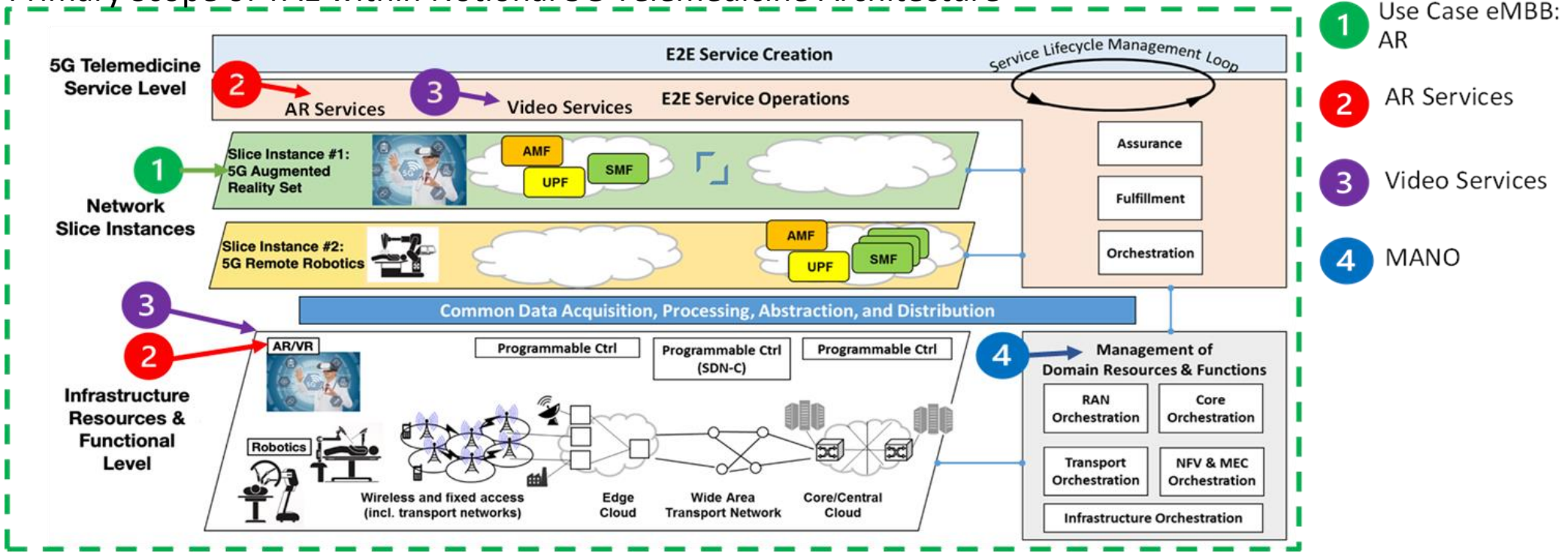
- Application of lifesaving steps for individuals with a traumatic lung injury or under respiratory distress

Illustration of providers and technicians training with AR/VR display

TA 1: 5G Prototype Architecture

5G Prototype provides access to high-quality virtual training courseware capable of accessing required 5G AR bandwidth and reduced latency

Primary Scope of TA1 within Notional 5G Telemedicine Architecture



5G AR Experiments occur at 5G JBSA System Integration Lab (SIL)

TA 1: 5G Requirements

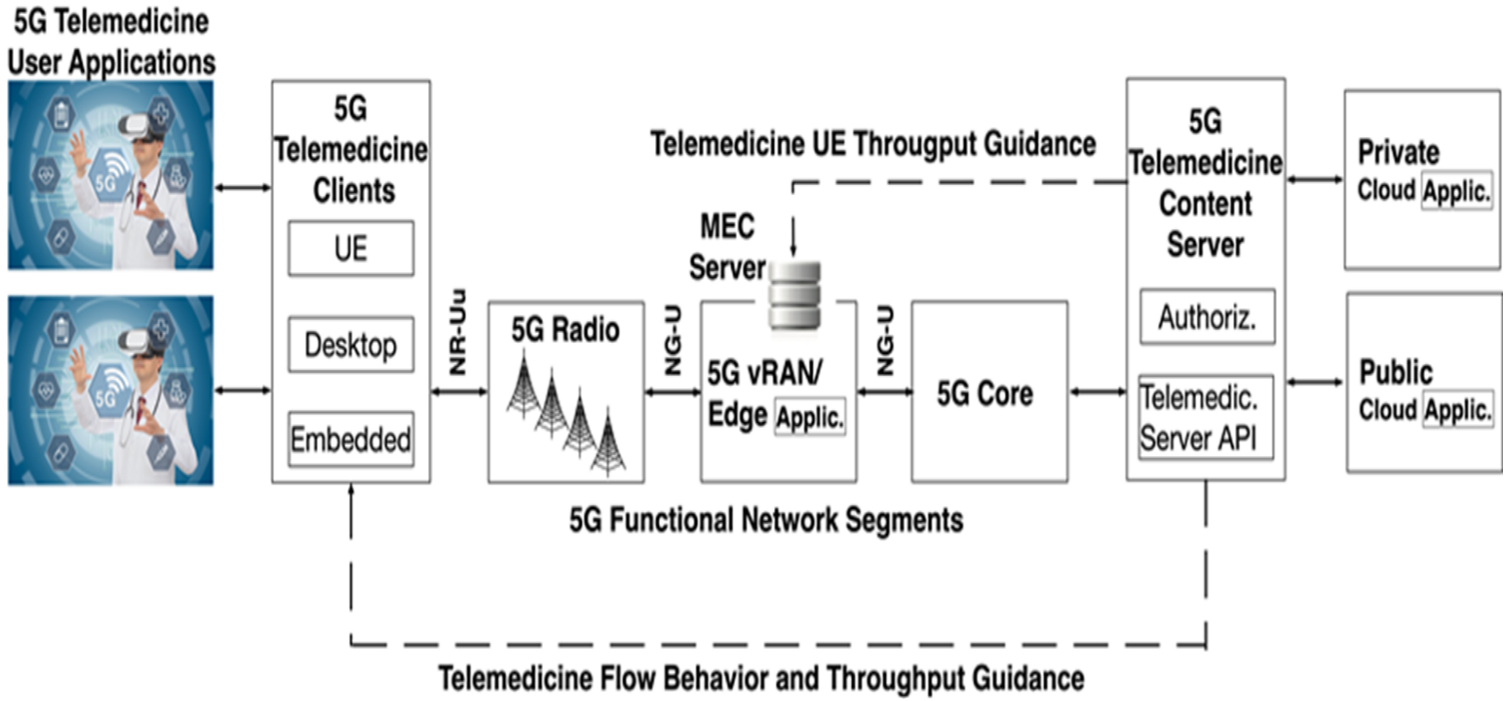
AR requires Enhanced Mobile Broad Band (eMBB) for Gigabit data rates

- AR enabled medical training not feasible with 4G as it lags bandwidth and latency requirements
- 4G 50 millisecond latencies are do not support AR
  - 5G responsive with 1 millisecond latency (50X times reduction) and 10X times data rate of 4G
- 20X times number of 4G users
- 5G allows AR to reach regions of space connected to the 5G network
- 5G latency meets the requirement of 5 millisecond, ideal for AR

TA 1: Potential 5G Prototype

Improve capability for rapid, effective, and remote collaborative training

- Real-time AR training & telementoring
- Increase opportunities for larger classes, remote training and distance learning
- Untethered AR/VR Heads-up-Display (1Gbit/s)
- AR Medical Training widely accessible from any 5G Network connection
- Low delay 5 millisecond latency



TA 2: 5G Advanced Telehealth Information Access

Objective: To prototype and design high performance self-configurable 5G-IoT health networks

5G Enabled Tech → Telehealth Data, IoT

5G Use Case → mMTC

Outcome → Information Access

5G Enabled AR Guided Medical Training

5G Advanced Telehealth Information Access

5G Advanced Telerobotic Surgery

5G Telementoring via AR for Medical Procedures

Partnered with US ARMY MEDCOM TATRC, Ft Detrick, MD

TA 2: Objective & Overview

Objective

- Prototype and demonstrate the application of self-configurable 5G-IoT health networks capable of supporting high IoT device densities

Overview

- To rapidly build, utilize, and deploy sophisticated health networks, referred to as the IoMT networks, for medical clinics, health facilities, and health teams at in-garrison and forward operating locations
- To improve and provide flexible mobile medical capabilities with secured connectivity

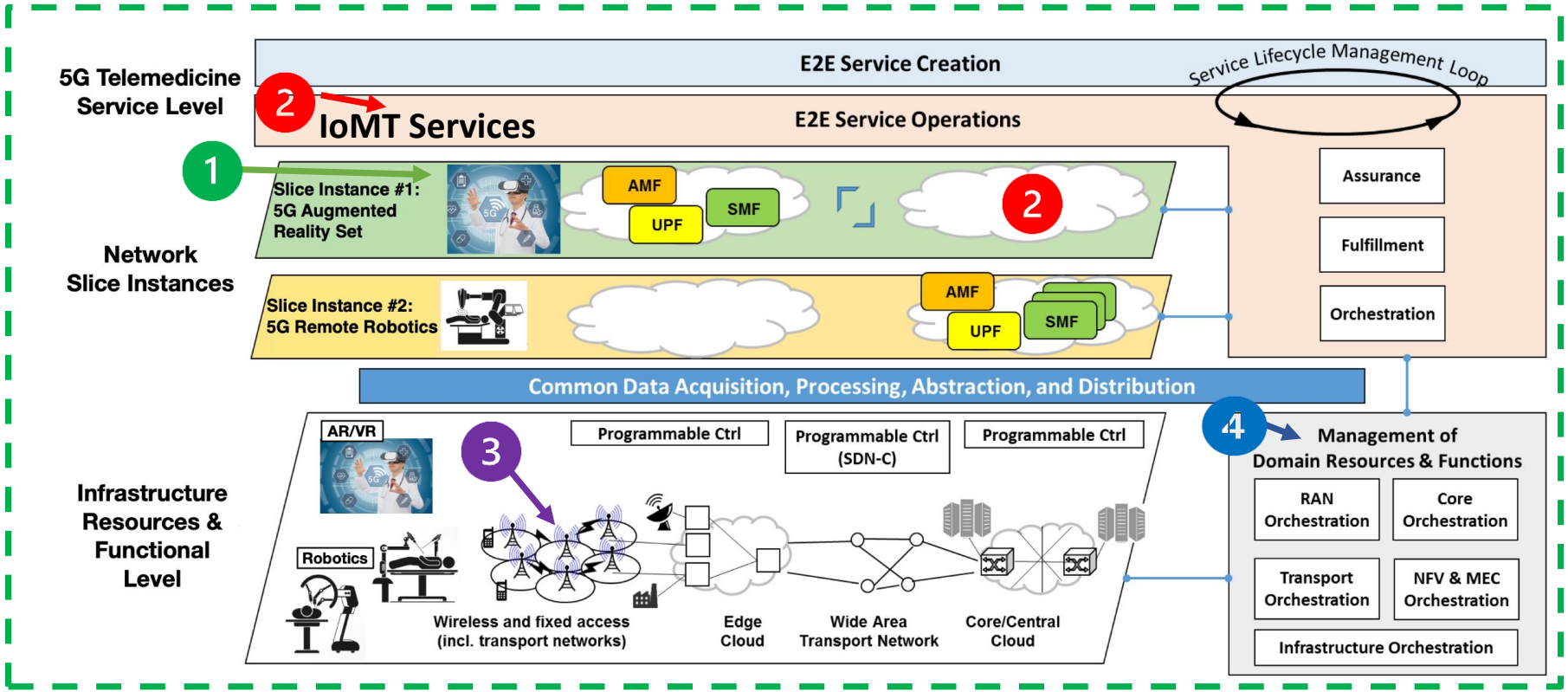
Use Cases:

- Near Real-Time pervasive access of medical records
- Real-Time Secure Messaging with High Resolution Imaging and Ultra High Definition (UHD) Streaming Video
- Automatically collecting and ingesting patient medical data from IoT devices
- Big Data analysis of patient data

TA 2: 5G Prototype Architecture

TA2 enables entirely wireless 5G medical care facilities supporting massive numbers of Internet of Things (IoMT) devices

Primary Scope of TA-2 within Notional 5G Telemedicine Architecture



1. 5G Use Cases mMTC
2. IoMT Services
3. Massive No. of IoT Device
4. MANO for Info. Access

5G AR Experiments occur at 5G JBSA System Integration Lab (SIL)

TA 2: 5G Requirements

5G will provide mobile enhancements capable of on-demand, near real-time, low latency access to patient Electronic Health Records (EHR)

- 5G Core Network capable of infusing 5G high-rate capable networks into new and existing facilities and hosts an entire medical facility
- 5G IoT network, enables rapid health facility stand-up with 50K-100K devices per cell
- Informs the capability of 5G 3GPP use case mMTC (massive Machine Type Communications) on the Prototype
- Supports Electronic Health Record (EHR) access

TA 2: Potential 5G Prototype

Improved remote data rate flow with near real-time capabilities which is now achievable only through tethered Ethernet

- IoT enabled medical network hosted on a 5G Core Network with massive numbers of devices (20X times that of 4G)
- Download Large Medical Files in 1/10th the time
- 10X times data rate between 4G and 5G
- 20X times number of users
- 5G enabled self network optimization for easy deployment by non-network experts

TA 3: 5G Advanced Telerobotic Surgery

Objective: To utilize low-latency 5G Network Services for remote 5G Telerobotic surgery

5G Enabled Tech → Robotics

5G Use Case → URLLC

Outcome → Remote Surgery

Partnered with US ARMY MEDCOM TATRC, Ft Detrick, MD

TA 3: Objective & Overview

Objective

- Project surgical experts to forward care settings, virtually on-demand, through 5G surgical robotic technology

Overview

- Fulfill a surgical capability gap, extend and enable remote surgical operations, procedures and interventions to the point of need

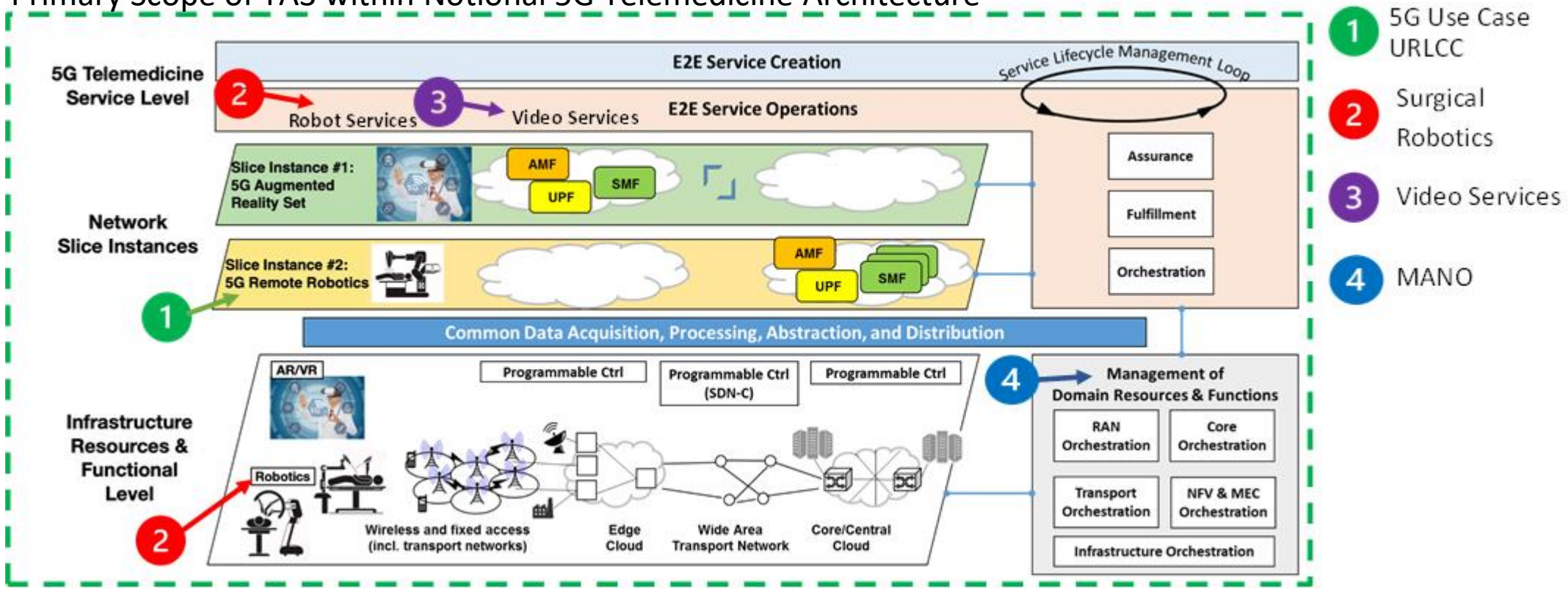
Use Cases:

- Remote Surgical 5G Telerobotics
- 5G Resilient and Secure Connectivity for telerobotics (aligned with 3GPP URLLC use case)
- Forward operationally deployed telerobotic to point of need

TA-3: 5G Prototype Architecture

TA3 5G enabled remote telerobotic surgical prototype supporting Ultra Reliable Low Latency Communications (URLLC)

Primary Scope of TA3 within Notional 5G Telemedicine Architecture



5G Telerobotic Experiments occur at 5G JBSA System Integration Lab (SIL)

TA 3: 5G Requirements

5G Prototype expands surgical interventions and remote capabilities that optimizes life-saving opportunities

- Projects surgical interventions to the point of need, on-demand
- Remote surgical experts accurately control the surgical robot
- Balances Ultra-reliable low-latency communications (URLLC) and broadband (eMBB)
  - Weighted combination of URLLC and eMBB Quality of Service (QoS)
- eMBB broadband enables:
  - Ultra high-definition video and high-resolution imagery
  - Stereoscopic video
- Superimpose digital and text artefacts onto physical systems

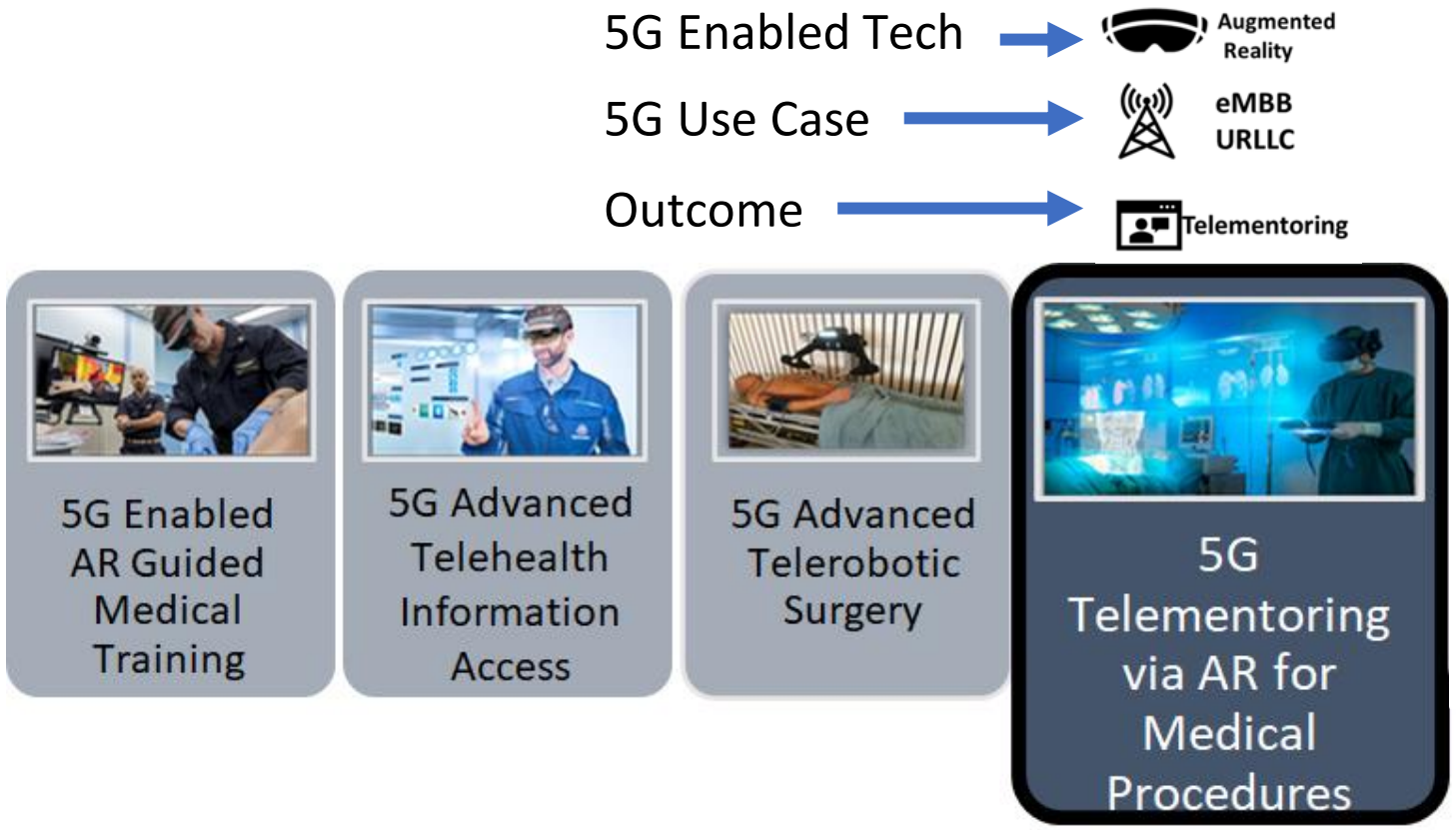
TA 3: Potential 5G Prototype

Ultra-reliable low-latency communications (URLLC) and eMBB-broadband with video sensors capture high resolution imagery for stereoscopic video and remote control of surgical robots

- A 5G enabled Remote Telerobotic Surgical Prototype with ultra low latency feedback control
- The Prototype projects surgical expertise to the point of need in forward care settings, on-demand, using 5G Network Technology

TA 4: 5G Telementoring via AR for Medical Procedures

Objective: To optimize reach-back 5G Telemedicine and Telementoring for in-garrison and forward operating locations using real-time 3D imagery and AR/VR



Partnered with Virtual Medical Center INDOPACOM, San Diego, CA

TA 4: Objective & Overview

Objective

- To provide high quality 5G Telemedicine and Telementoring for in-garrison and forward operating locations to:
  - Deliver real-time 3D imagery and AR/VR to remote sites
  - Expand the capabilities of **A**ugmented **R**eality **T**echnology **E**nabled re**M**ote **I**ntegrated **S**urgery (ARTEMIS)
    - See https://www.artemis.surgery/

Overview

- This core telemedicine application directly supports instrumentation, usually based in a central location, to become mobile, thereby maximizing combat power forward.

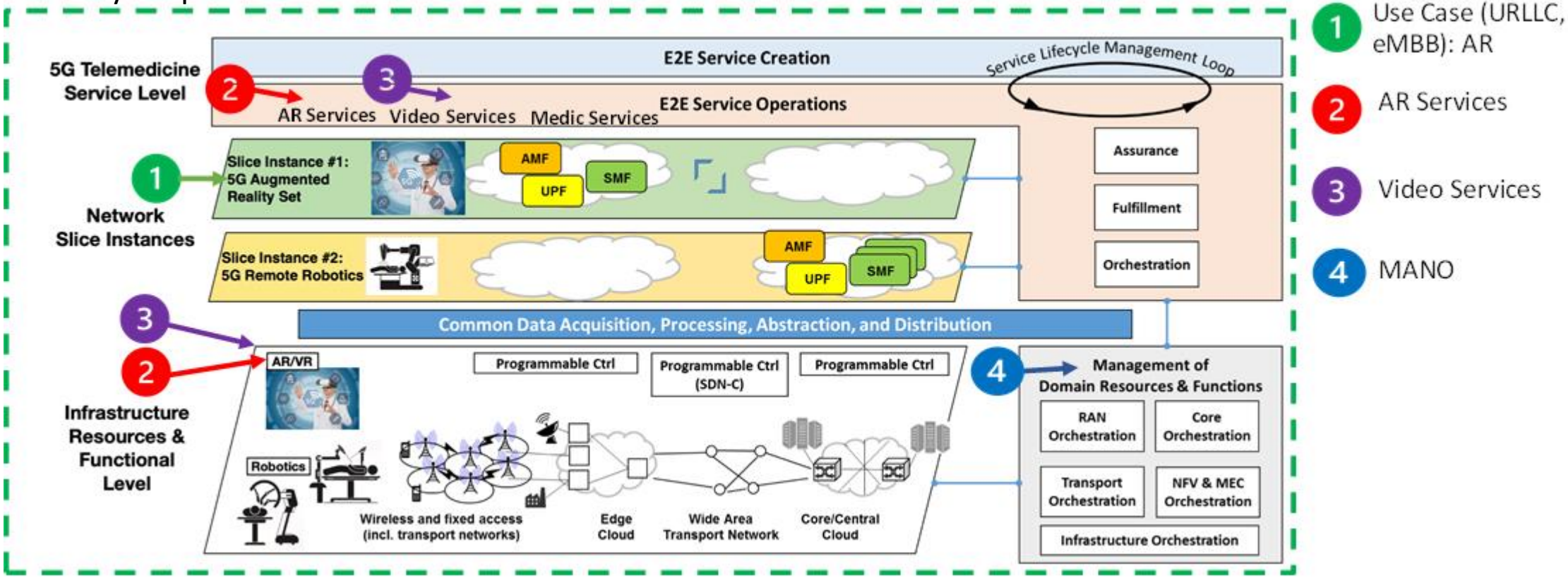
Use Case: 5G Enabled ARTEMIS

- Re-architect ARTEMIS (or analogous systems) communication interfaces with Service Based Architecture APIs capable of establishing 5G radio sessions

TA 4: 5G Prototype Architecture

5G Prototype provides medical expertise to in garrison and forward operating locations using 5G-AR-Telementoring

Primary Scope of TA4 within Notional 5G Telemedicine Architecture



5G AR Experiments occur at 5G JBSA System Integration Lab (SIL)

TA 4: 5G Requirements

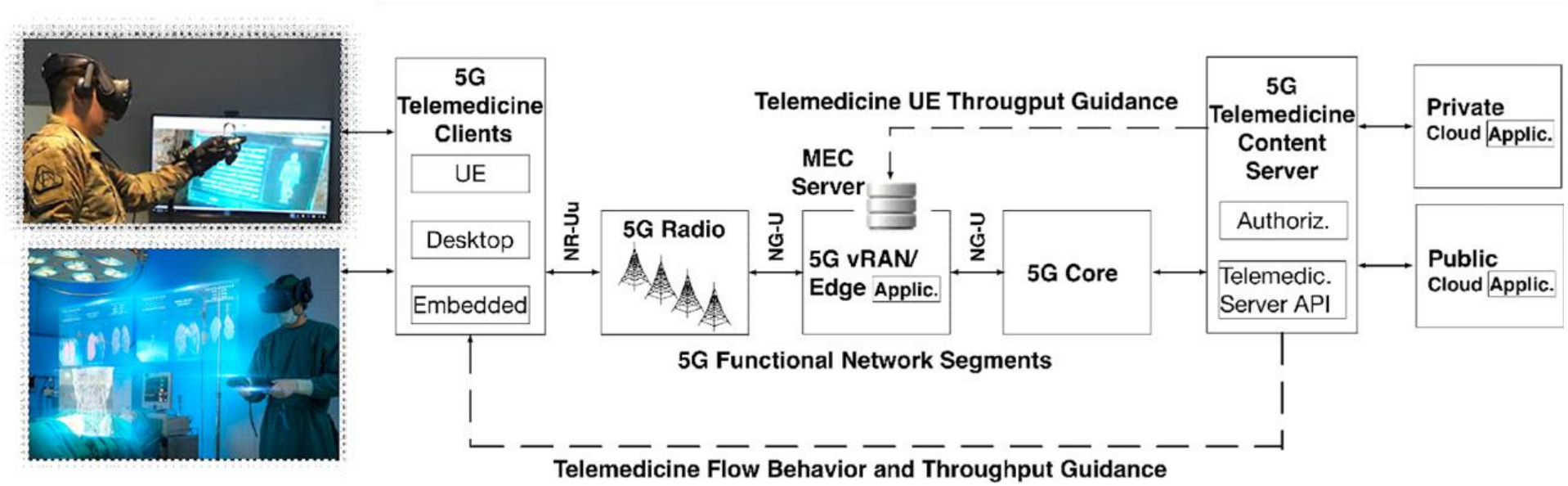
Enable 5G AR Telementoring supporting onsite surgery services and clinical interventions for use in-garrison and at forward operating locations

- Ultra-reliable low-latency communications (URLLC) and eMBB necessary
- Network Slicing enabling QoS for Multi-access Edge Computing (MEC) and vRAN
- AR enables medical training not feasible with 4G as it lags bandwidth and latency requirements
- 5G latencies (1-5 mSec) are 10-50x that of 4G (50 mSec)
- 10X-20x times data rate of 5G over 4G
- 5G will support one 10 -20 AR user as opposed to 1 AR user for 4G

TA 4: Potential 5G Prototype

Support multiple remote users with 5G AR/VR

- Onsite AR surgery services with 5G-Telementoring enabling clinical interventions
- E2E 5G Telementoring AR connecting AR channels between remote and central sites
- Prototype supports multiple remote 5G Telementoring experts and mentees (10 to 20 AR), 400 to 800 4K video streams



Project Location(s)

- **Prototype development at vendor site**

- **JBSA 5G Program Management Office**
  4178 Petroleum Drive, Building 3528
  JBSA-Fort Sam Houston, Texas 78234

In summary...

- 5G offers substantial potential for revolutionizing DoD virtual and telemedicine
- We are looking for innovative ideas and approaches that lead to highly successful prototypes
- Telemedicine and 5G researchers and provider should consider teaming
- This is an exciting field and can have a major impact
  - Driving virtual medicine in DoD and commercial into the future
  - Bringing medical expertise and care to the patients where and where it is needed
  - Save lives!

Questions & Answers

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