2024

TÜBİTAK BİLGEM

TÜBİTAK INFORMATICS & INFORMATION SECURITY RESEARCH CENTER

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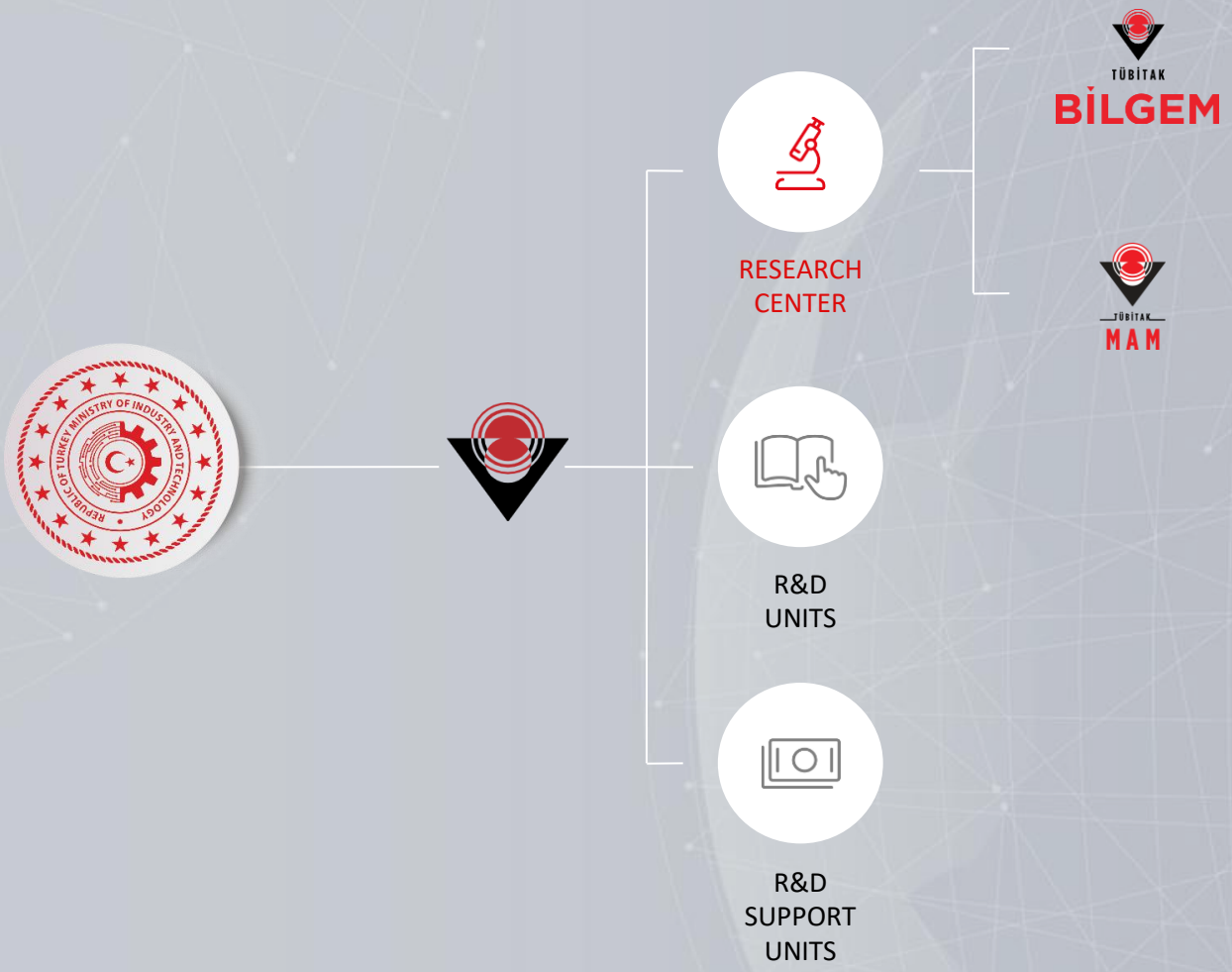
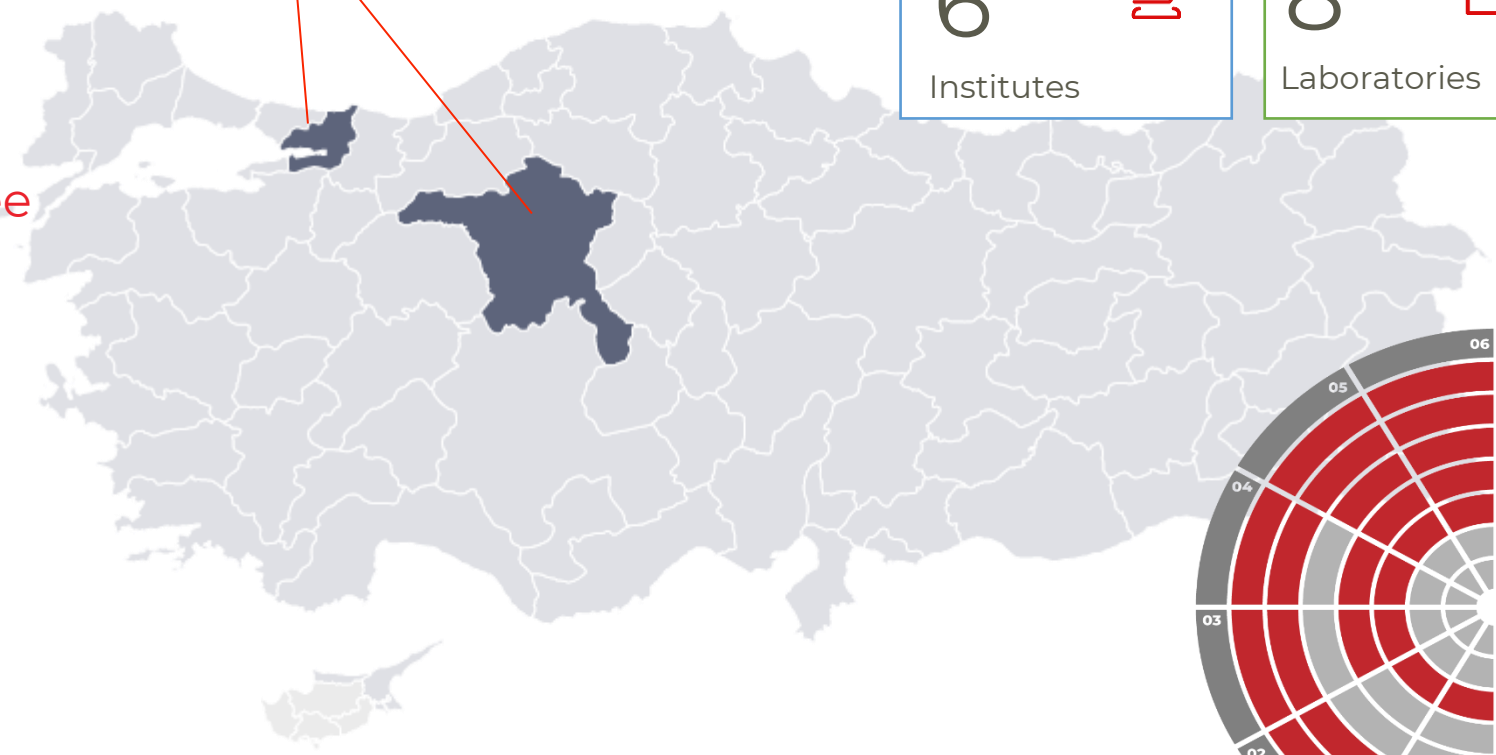


- BİLGEM (Informatics and Information Security Research Centre), has a distinguished track record in conducting cutting-edge research, developing novel technologies, and fostering innovation in various areas.
- The largest research center in Türkiye, focusing on informatics and information security.

2500+

14%
Ph.D Degree

25%
Master's Degree

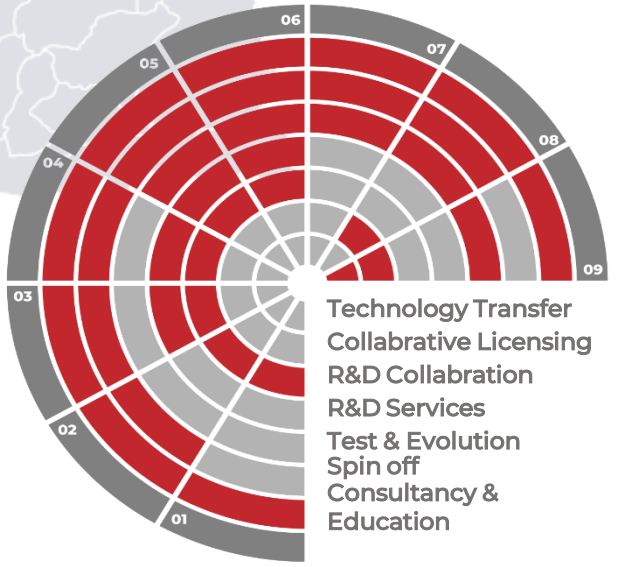


15
Main Research Areas

6
Institutes

8
Laboratories

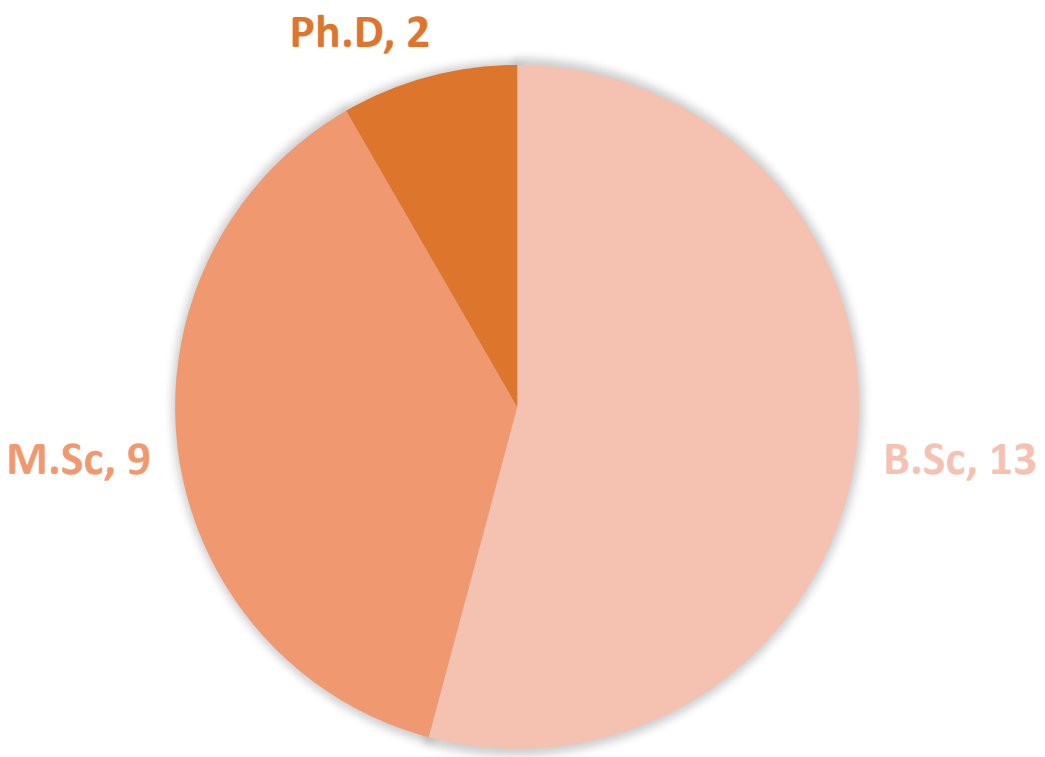
140
Externally Supported Projects

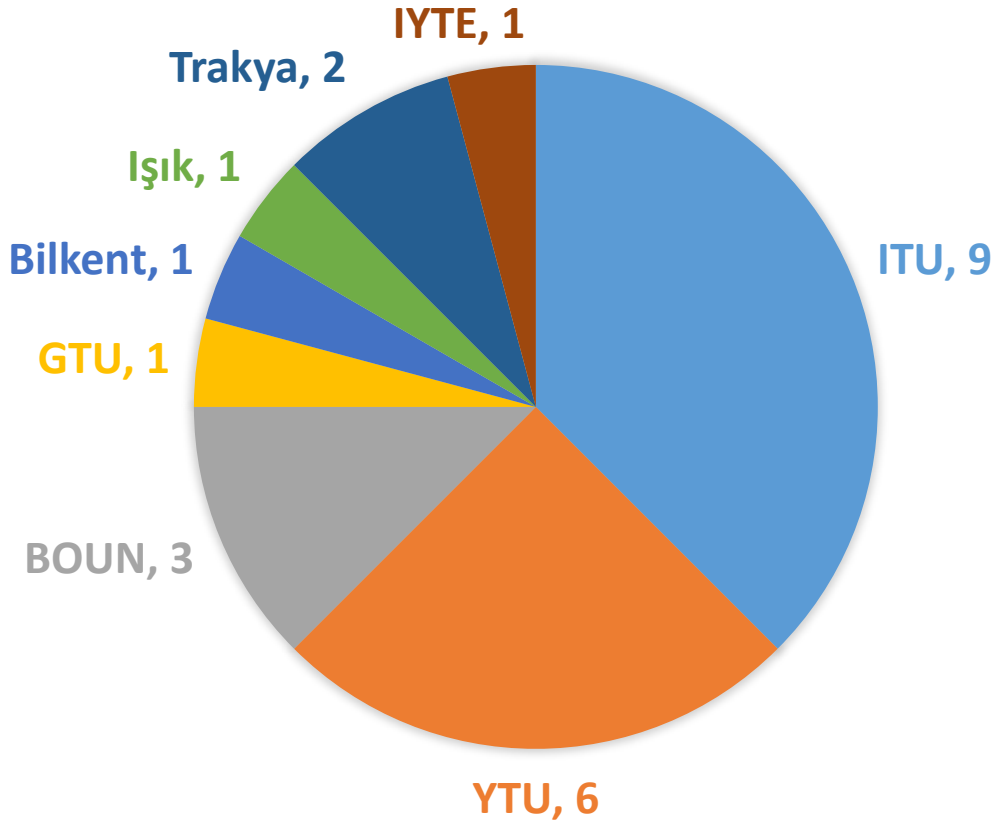


Areas of Research

- Avionics
- Artificial Intelligence
- Electronic Warfare
- Digital Assets and Cloud
- Sensors & Radar
- Cryptographic Systems
- Semiconductor Technologies
- Blockchain & Metaverse
- Quantum Technologies
- High Energy Laser Systems
- Cyber Security
- Naval Defense
- Digital Transformation and Software
- Electro and Optical Communication
- Mobility

HİSAR (Communications and Signal Processing Research) Lab.



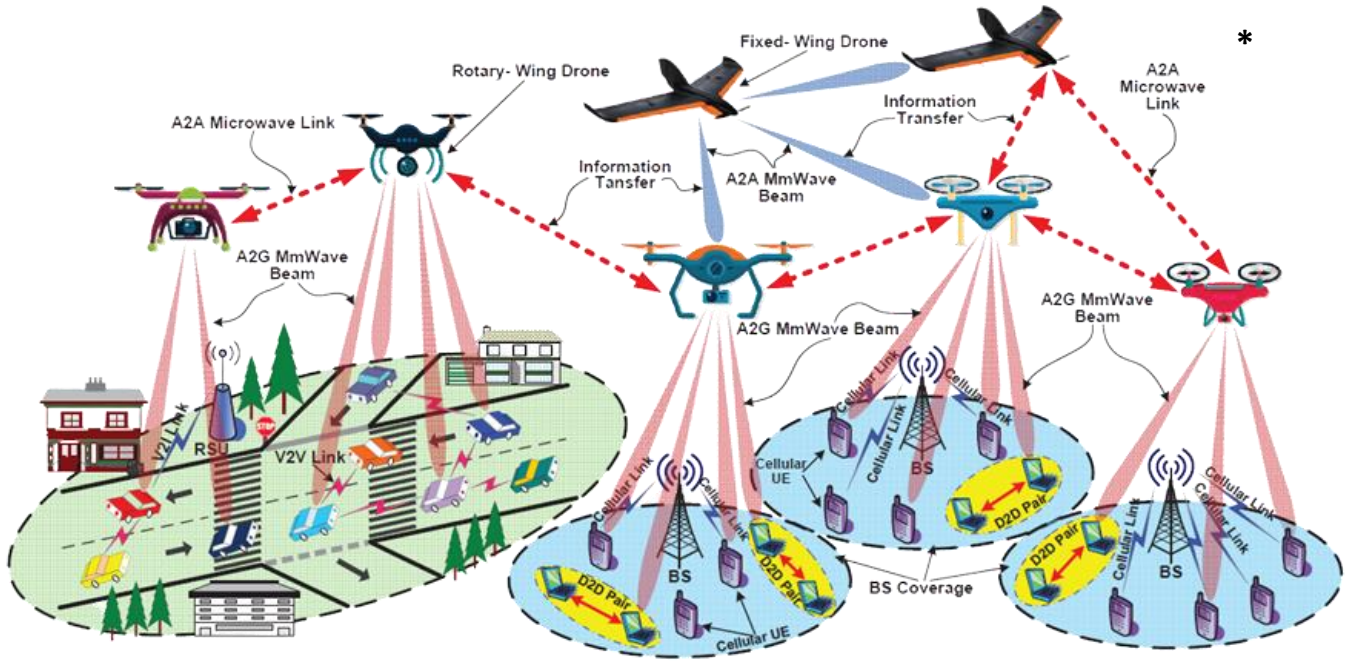


- Academic consultants:
  - Prof. Ali Emre Pusane (Boğaziçi University)
  - Prof. Mehmet Kemal Özdemir (Medipol University)
  - Dr. Mohaned Chraiti (Sabancı University)

THULAB (Telsiz Haberleşme Uygulama ve Ölçüm Laboratuvarı)

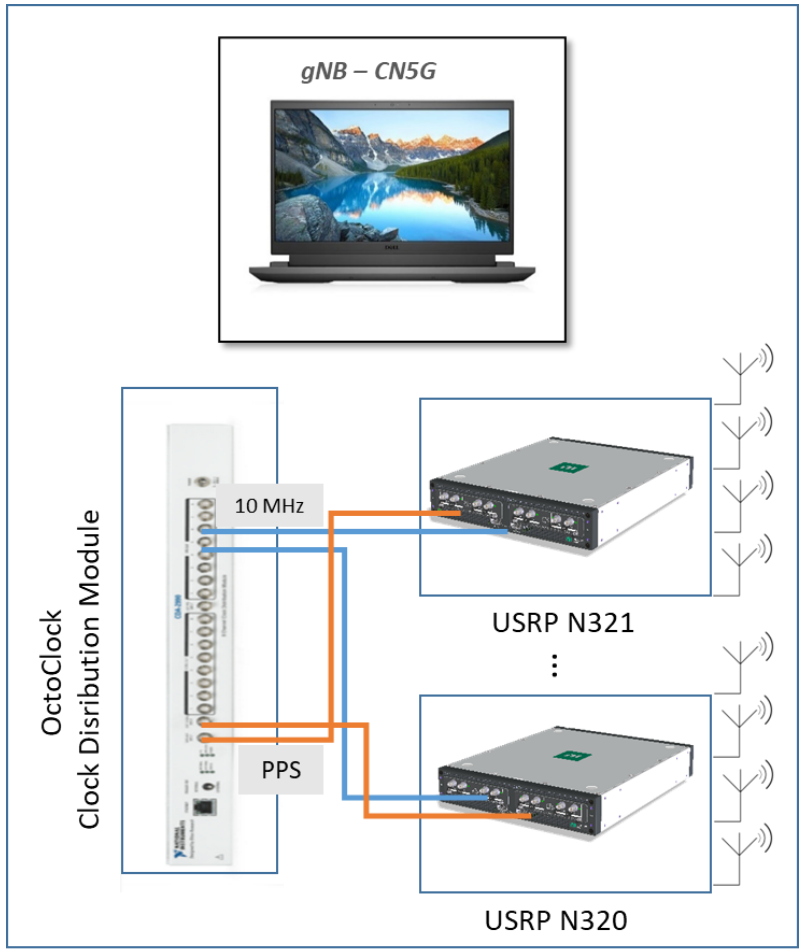
Wireless Communication Application and Measurement Laboratory

- Heterogeneous wireless access technologies
- Distributed and scalable testbeds
- Multi-disciplinary research and prototype development activities
- Bridge between academia and industry
- Patent, know how, applications for 5G/6G networks



*L. Zhang et al., "A Survey on 5G Millimeter Wave Communications for UAV-Assisted Wireless Networks," in IEEE Access, vol. 7, pp. 117460-117504, 2019, doi: 10.1109/ACCESS.2019.2929241.

Massive MIMO Testbed



5G IP Camera

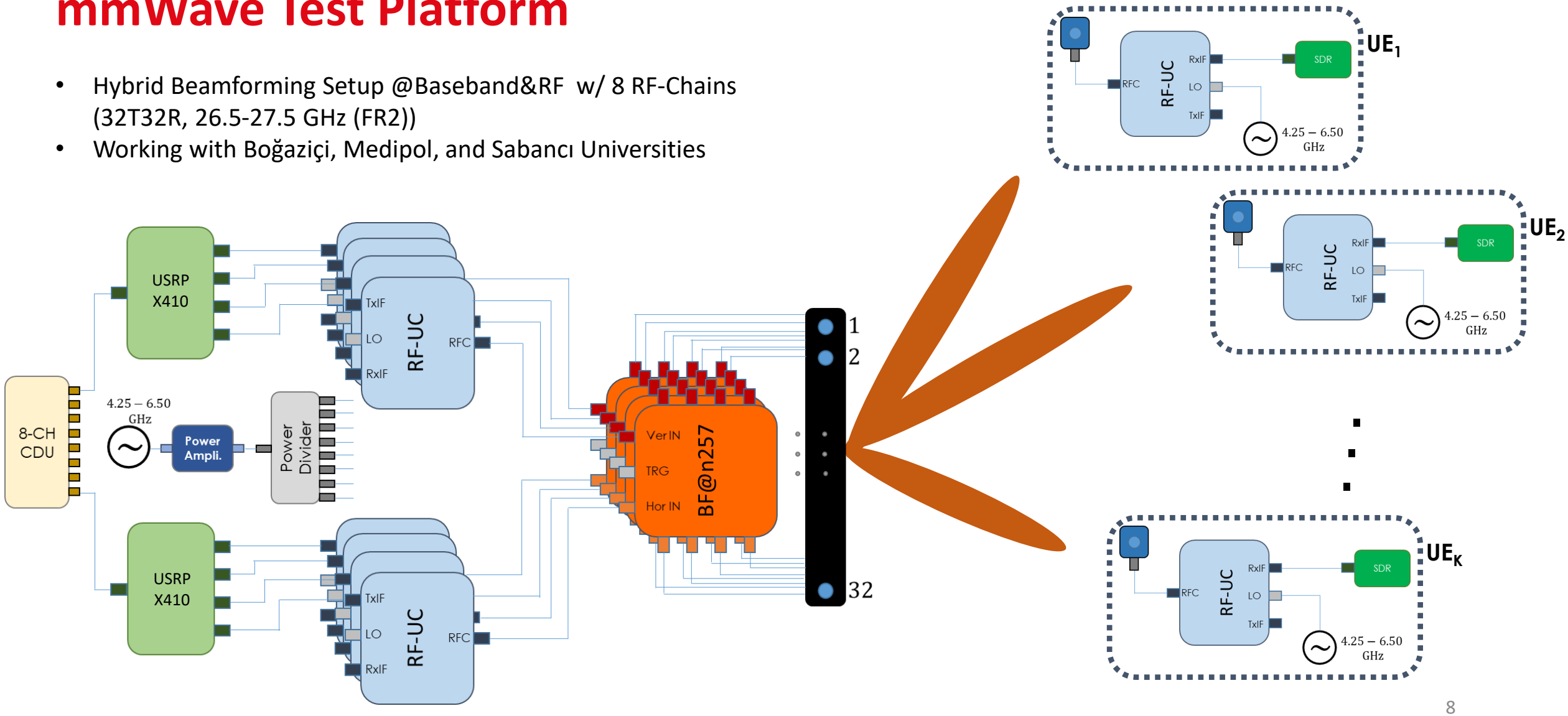
Quectel RM500Q

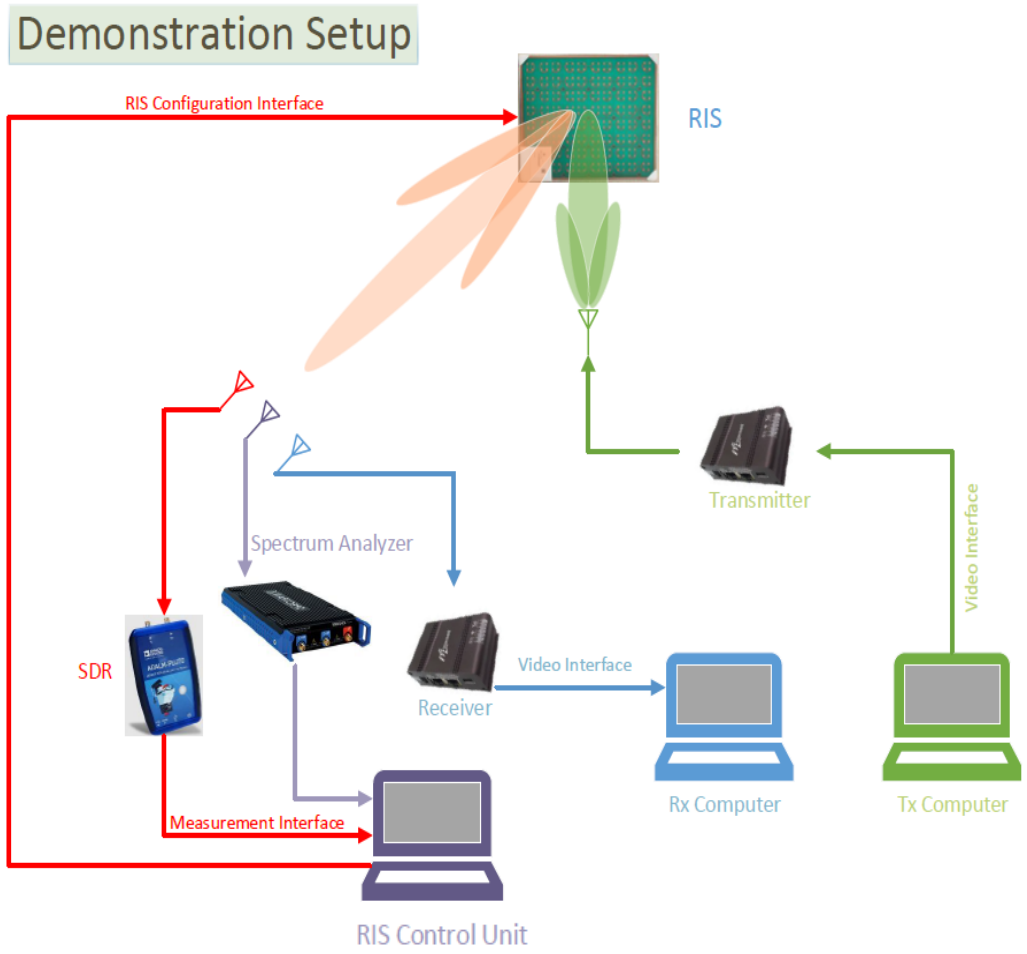
5G Mobile Phone

COTS UEs

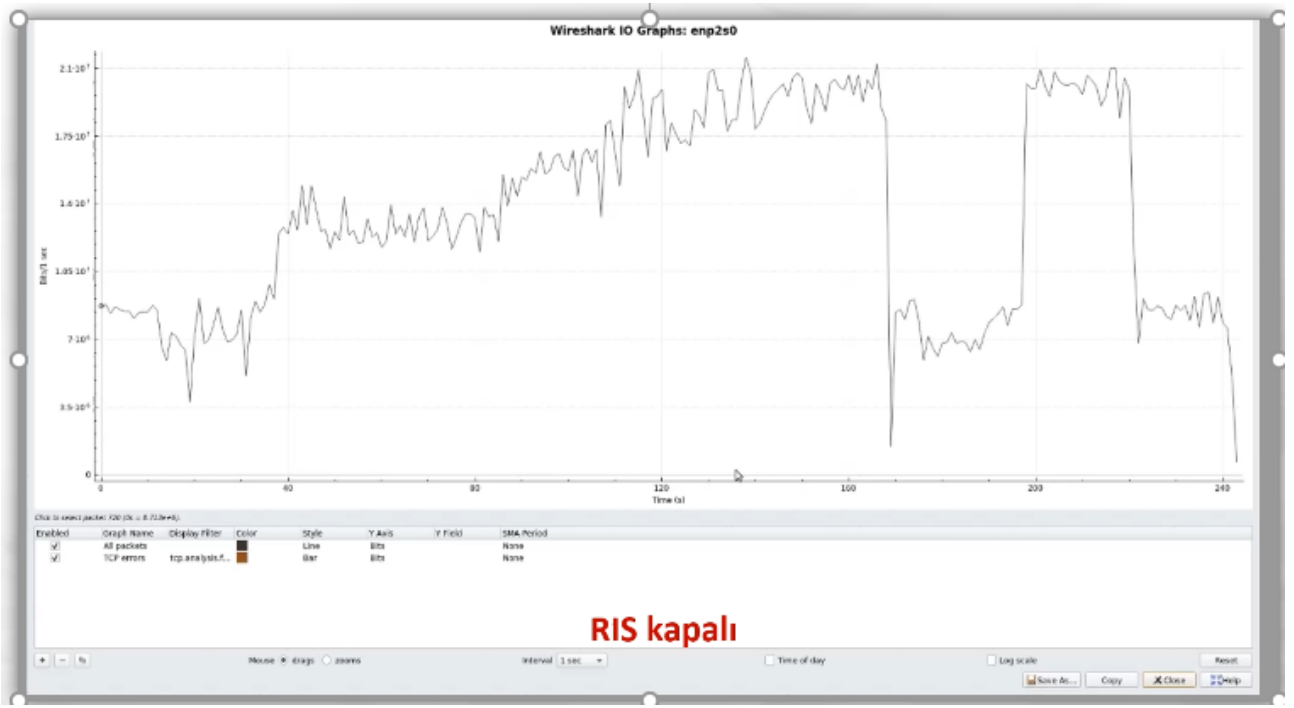
mmWave Test Platform

- Hybrid Beamforming Setup @Baseband&RF w/ 8 RF-Chains (32T32R, 26.5-27.5 GHz (FR2))
- Working with Boğaziçi, Medipol, and Sabancı Universities



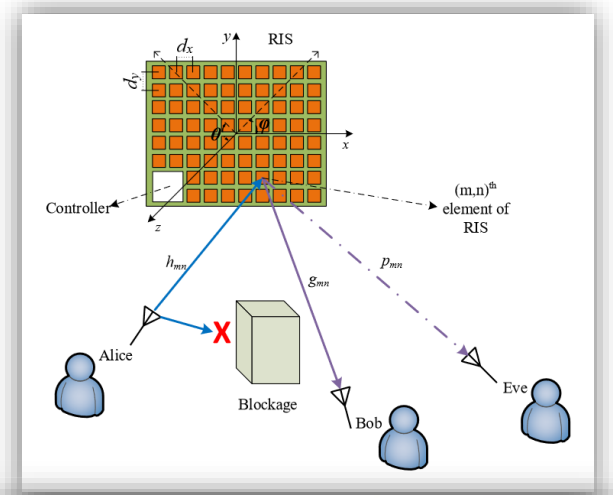


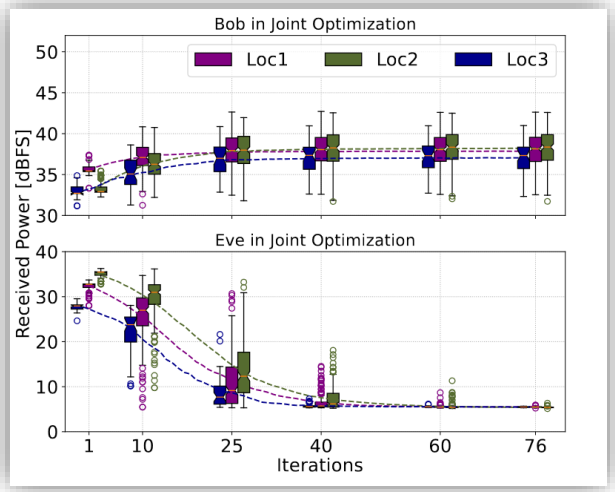
- Received data rate is increased from ~8 Mbps to ~20 Mbps

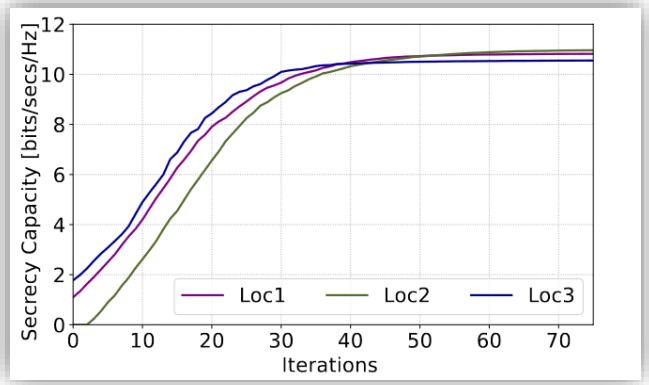


RIS Studies

- Best Paper Award in IEEE VTC2023 Spring *







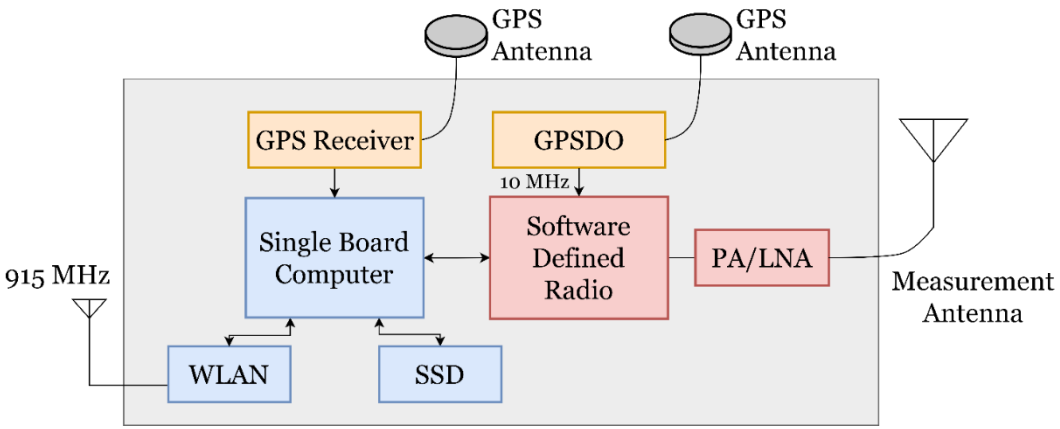
✓ TÜBİTAK BİLGEM has been collaborating with TÜBİTAK MAM, mobile operators, and Koç University for developing RIS prototypes.

* Keşir, S., Kayraklık, S., Hökelek, İ., Pusane, A. E., Basar, E., & Görçin, A., “Measurement-based Characterization of Physical Layer Security for RIS-assisted Wireless Systems”, IEEE VTC2023 Spring.

Sub-6GHz Wireless Channel Characterization

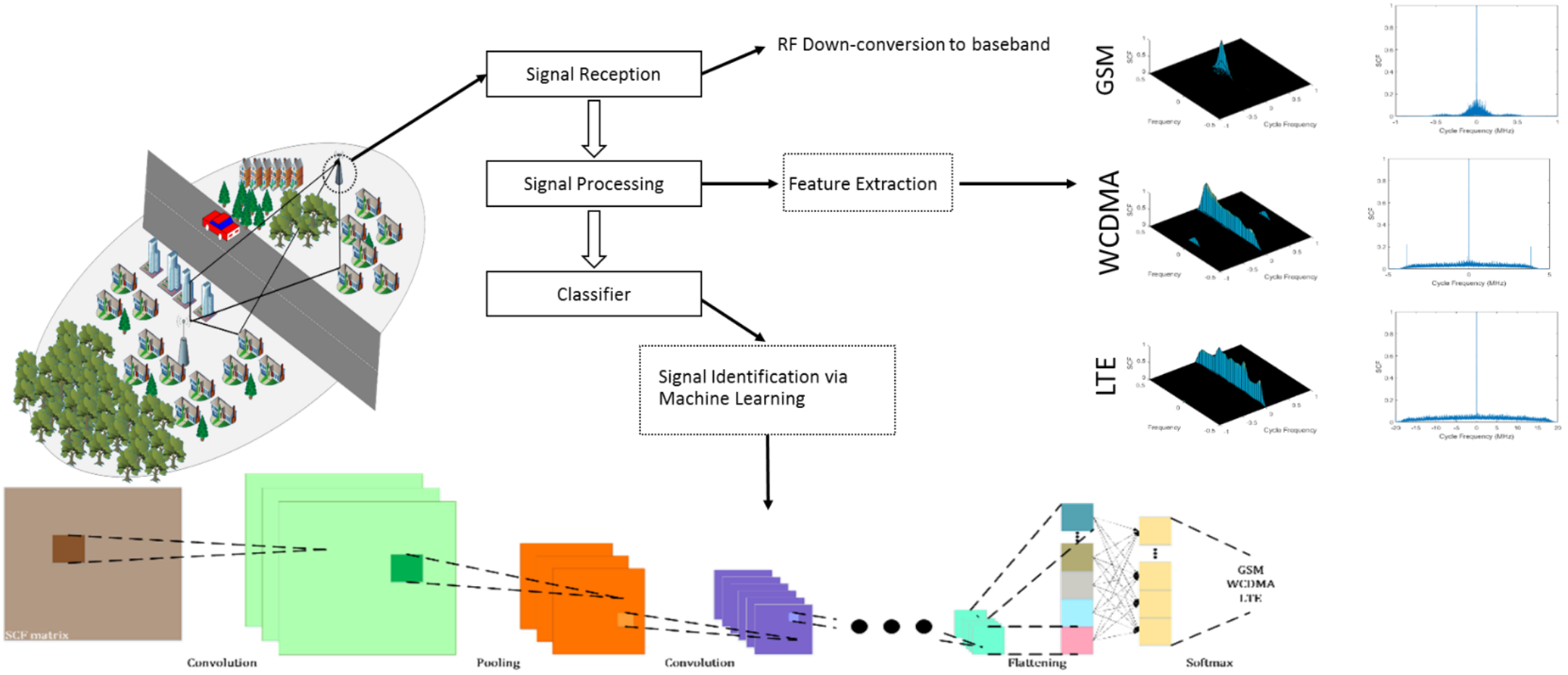
European Union (EU)-Founded R&D Projects

Drone-Based Transceiver Design



- Software-defined waveform design
  - DSSS, CW, Chirp, etc.
- Up to +30 dBm output power
- Up to 56 MHz bandwidth
- GPS-Disciplined oscillator(GPSDO)
  - Frequency synchronization

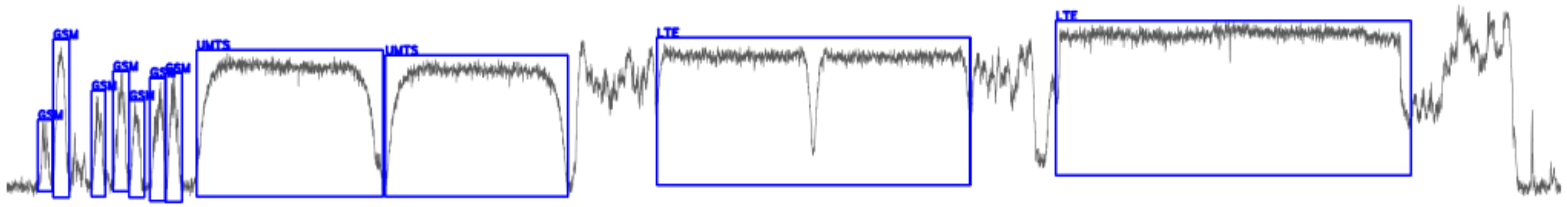
AI/ML Approaches on Signal Identification – CNN Approach



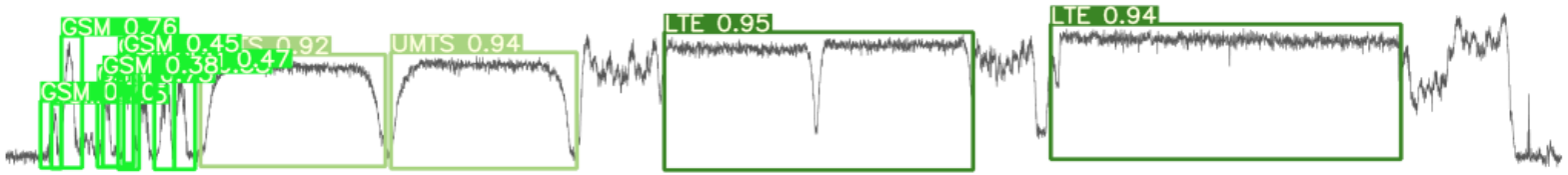
AI/ML Approaches on Signal Identification – Object Detection Approach

YOLO-R and Detectron2

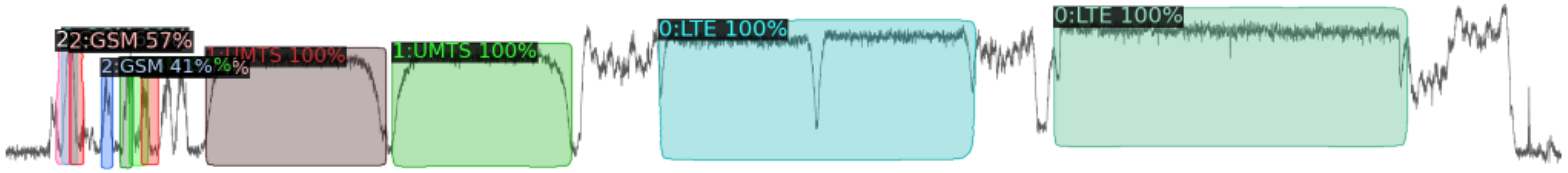
Labelled Data:



YOLO-R estimates:



Detectron2 estimates:



Recent Publications

- H. Nayir, E. Karakoca, G. K. Kurt, A. Görçin, **Experimental Assessment of Misalignment Effects in Terahertz Communications**. arXiv preprint arXiv:2305.13910. (Accepted in IEEE ICC2024).
- M. Y. YAĞAN, S. KEŞİR, İ. HÖKELEK et al. **Multi-User Directional Modulation with Reconfigurable Holographic Surfaces**, 2023, PREPRINT available at Research Square [https://doi.org/10.21203/rs.3.rs-3637206/v1]
- Erhan Karakoca, Hasan Nayir, Güneş Karabulut Kurt, Ali Görçin, "**Measurement-Based Modeling of Short Range Terahertz Channels and Their Capacity Analysis**", IEEE Globecom 2023.
- Umut Yıldız, Ahmet Faruk Coşkun, "**Application of Kalman Filtering Approach on Signal Angle-of-Arrival Estimates**", IEEE SIU 2023.
- Tayfun Yılmaz, Ahmet Faruk Coşkun, Hacı İlhan, "**Performance Analysis of Massive MIMO Network with Space-Time Line Coded OFDM Under Practical Impairments**", IEEE BlackSea 2023.
- Ömer Faruk Akyol, Semiha Tedik Başaran, İbrahim Hökelek, Ali Görçin, "**User Pairing and Beamforming Design in mmWave CR-NOMA Networks**", IEEE BalkanCom 2023.
- Eda Kurt Karakuş, Ömer Faruk Gemici, İbrahim Hökelek, Hakan Ali Çırpan, "**AI Based Resource and Power Allocation for NOMA Systems**", IEEE BlackSea 2023.
- Kesir, S., Yagan, M. Y., Hokelek, I., Pusane, A. E., Gorcin, A., "**Rapid CNN-assisted iterative RIS element configuration**", 10th International Symposium on Networks, Computers and Communications (ISNCC'23).
- Kayraklık, S., Yildirim, I., Gevez, Y., Basar, E., & Görçin, A. , "**Indoor Coverage Enhancement for RIS-Assisted Communication Systems: Practical Measurements and Efficient Grouping**", IEEE ICC 2023.
- Y. Yüksekdağ, İ. Altunbaş,İ. Hökelek and A. F. Coşkun, "**Outage Probability Analysis of RIS-aided FSO Under Exponentiated Weibull Distributed Turbulence**," 2023 31st Signal Processing and Communications Applications Conference (SIU).
- B. Bilgiç, S. T. Basaran, İ. Hökelek and A. Görçin, "**Performance Analysis of Dual-Hop THz Communication Under Foggy Weather**," 2023 IEEE International Black Sea Conference on Communications and Networking (BlackSeaCom).
- Keşir, S., Kayraklık, S., Hökelek, İ., Pusane, A. E., Basar, E., & Görçin, A., **"Measurement-based Characterization of Physical Layer Security for RIS-assisted Wireless Systems**", IEEE VTC2023 Spring (**Best Paper Award**), 2023.
- U. Erdemir, B. Kaplan, I. Hökelek, A. Görçin, H. A. Çırpan, "**Measurement-based Channel Characterization for A2A and A2G Wireless Drone Communication Systems**", IEEE VTC2023-Spring, 2023.
- Gizem Sümen, Ali Görçin, Khalid Qaraqe, "**Measurement-based Modulation Classification in Unlicensed Millimeter-Wave Bands**", IEEE WCNC, 2023.
- H. Nayir, E. Karakoca, A. Görçin and K. Qaraqe, "**Channel Estimation Using RIDNet Assisted OMP for Hybrid-Field THz Massive MIMO Systems**," ICC 2023 - IEEE International Conference on Communications.
- E. Karakoca, H. Nayir, A. Görçin and K. Qaraqe, "**RIDNet Assisted cGAN Based Channel Estimation for One-Bit ADC mmWave MIMO Systems**," 2023 IEEE 97th Vehicular Technology Conference (VTC2023-Spring).

THANK YOU

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