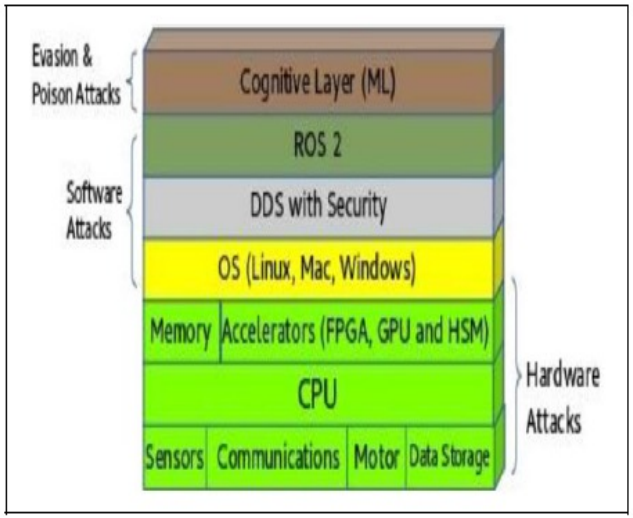
Cybersecurity Evaluation and Testing of the ROS 2 Architecture for Networked UAV Networks

CRUSER
Consortium for Robotics and Unmanned Systems Education and Research



Network stack of a ROS 2 robotic system and its associated vulnerabilities

How

- Step 1: ROS 2 and DDS testing
  - Test with a small UAV network (3-5 UAVs) and ground station. We will use Gazebo on a Ubuntu/Linux workstation along with Matlab
    - 1) Denial of Service (DoS): consider different attack levels (benign, intermediate and severe); quantify time to launch attack and ROS 2 mitigation
    - 2) Man-In-The-Middle (MITM): quantify how an MITM attacker overtakes the communication either between two UAVs or between the UAV and ground station; quantify how ROS 2 provides mitigation against MITM attack
- Step 2: Performance and Security Tradeoff
  - Analyze network performance metrics including any delays, overhead and scalability issues associated with the ROS 2/DDS

What/Deliverables

- Scope of this work is focused on the testing and evaluation ROS 2 and DDS in networked UAV systems, focusing on software attacks
- Provide formal verification and validation of ROS 2 security to enable faster transition to the fleet
- We define several adversarial models for ROS 2/DDS and determine how ROS2/DDS react and mitigate against different threat vectors
- Deliverable 1: Evaluation and results of DDS/ROS 2 performance against the stipulated attacks (Denial of Service and Man in the Middle)
- Deliverable 2: Evaluation of DDS/ROS 2 in terms of network performance compared to ROS 1 in terms of scalability and latency
- At least one MS EE student thesis in FY19 that supports this work. A presentation by the study at a CRUSER monthly meeting and/or TechCon

Why/Objective

- ROS 2 is a critical technology that supports rapid innovation of UxS and can be leveraged for military applications.
- ROS 2 has not been easily accepted into the fleet in part due to a lack of proof of the quality of the system (i.e., formal verification and validation)
- Evaluating ROS 2 from a security perspective will have an immediate impact on its implementation and transition to the fleet
- The proposed research is operationally relevant and will contribute to relevant thesis study for NPS students
- Cybersecurity is an important research and curricular component at NPS and thus furthers the mission of the school, Navy and DoD

NPS PRAESTANTIA PER SCIENTIAM

FY19 Call for Proposals

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