HORUS: A Testbed for Wireless UAV Networks

Ahmed Abdel-Hadi, Andreas Gerstlauer and Sriram Vishwanath

Wireless Networking and Communications Group (WNCG)

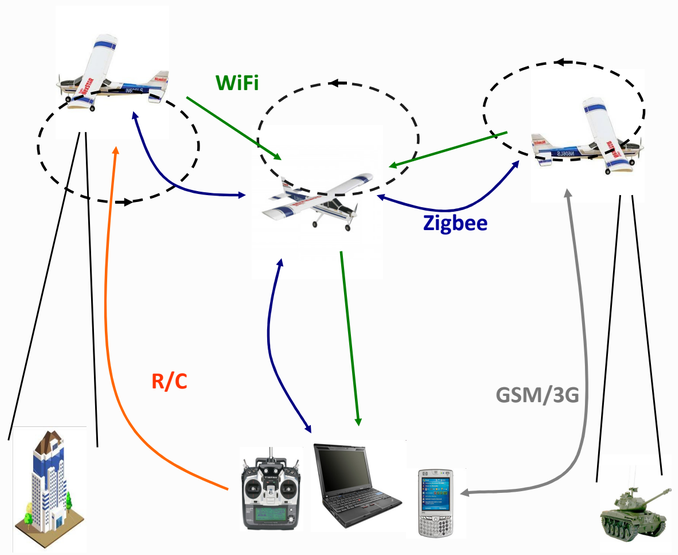
Project Horus

- **General Overview:** Horus is a testbed for studying cooperation, autonomy, tracking and surveillance in a mobile ad-hoc networking context. This project is a cooperation between ECE and ASE departments with the collaboration of other faculty members.
- **ECE Overview:** The primary goal is to transmit real-time video efficiently through the network.
- **Real-Time Video Transmission:** video is captured by one or more UAV and transmitted to the rest of the network in real-time.
- **Ultimate Applications:** 1) Aerial stereo photogrammetry 2) Visual target detection 3) Recording 3D live video signal
- **Testing & Validation Methodology:**

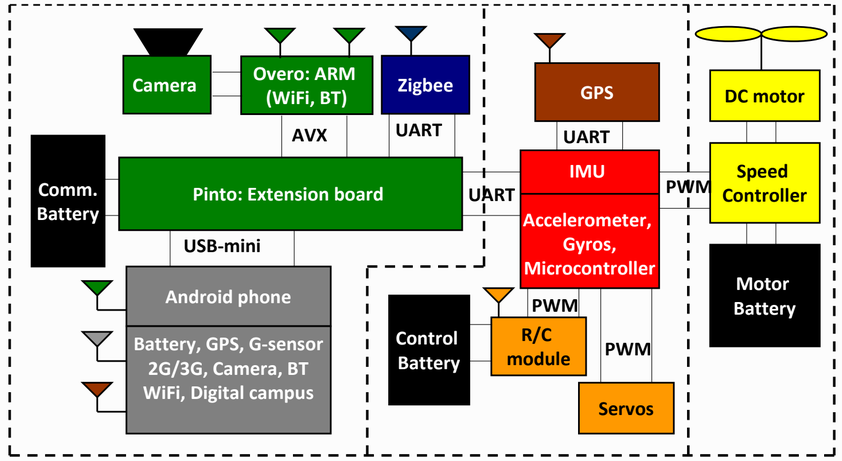
1. **Simulation:** we use OMNeT++ network simulator for modeling our network and testing the network protocol before implementation.
2. **Implementation:** we use off the shelf component that provides reliability, redundancy, modularity, design flexibility and availability. These components are used to provide solid experimental validation of the network protocol.

- **Network Topology:** the figure shows the current network topology used which has a prespecified routing path.

Project Diagram



Horus Node Block Diagram



On board wireless transceivers:

- **WiFi (2.4GHz):** video transmission between UAVs.
- **Zigbee (900MHz):** inter-UAV autonomous position and path co-ordination.
- **GSM/3G (1900MHz):** backhaul to ground station and secondary control.
- **Radio(72MHz):** flight takeoff, landing, and manual ground emergency control.

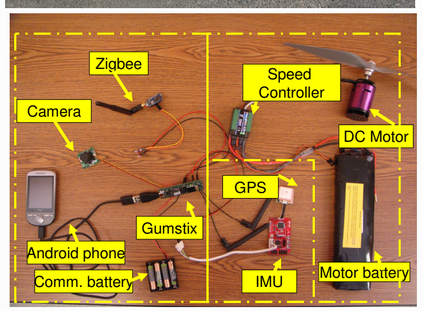
Horus Node Hardware

Node Subsections:

- **Propulsion:** maintains enough force to move UAV in the air.
- **Control:** ensures flight stability and flight path management.
- **Communication:** is concerned with streaming packetized media between UAVs.

Architecture Goal:

- The chosen node architecture achieves the desired modularity and design flexibility for testing distributed communication and control.

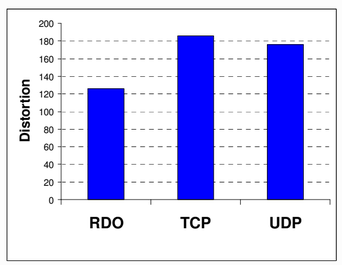


Video Transmission Results

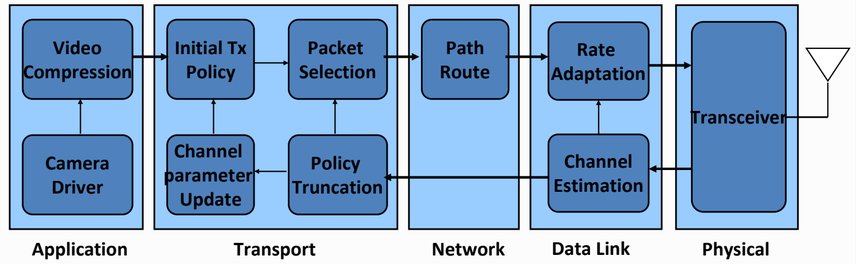
- **UDP Transmission**: no guarantee for packet delivery at the receiver.
- **TCP Transmission:** guarantee that each packet is received by the receiver.
- **RDO Transmission:** guarantee the delivery of high priority packets. No guarantee of packet delivery for low priority packets. The goal is to optimize the video quality received at the destination in real time transmission.

Distortion:

- It is a measure of the effect of lost packets on the quality of the received video at the destination.
- Quality of video decreases with distortion increase .



RDO Transmitter OSI Model



Rate Distortion Optimization (RDO) Algorithm:

- Select the packet with the earliest deadline for transmission.
- Retransmit the packet with high priority until an ACK is received at the receiver.
- Transmit the packets with low priority once and do not wait for an ACK.
- Switch to new group of frames when the deadline of the group of frames is reached.

THE UNIVERSITY OF TEXAS AT AUSTIN
UT ECE
ELECTRICAL & COMPUTER ENGINEERING

THE UNIVERSITY OF TEXAS AT AUSTIN