GIRD Systems, Inc.
Engineering Research and Development

L3 communications Nova Engineering

NETWORKED OFDM RANGING SYSTEM (NORS) FOR GPS DENIED NAVIGATION

SPAWAR Systems Center San Diego

Technology in Development:

- SPAWAR Phase I SBIR awarded to Nova Eng. July 2005
- SPAWAR Phase II SBIR proposal pending
- Hardware real-time flight demonstration – 2 years into Phase II

General Description:

GIRD Systems, in collaboration with L-3 Communications Nova Engineering, is developing a novel GPS-denied navigation system called networked OFDM ranging system (NORS).

The weak GPS signals are easily denied, due to shadowing, foliage, or intentional jamming. The NORS allows a ground user to compute its locations when GSP is denied in such situations.

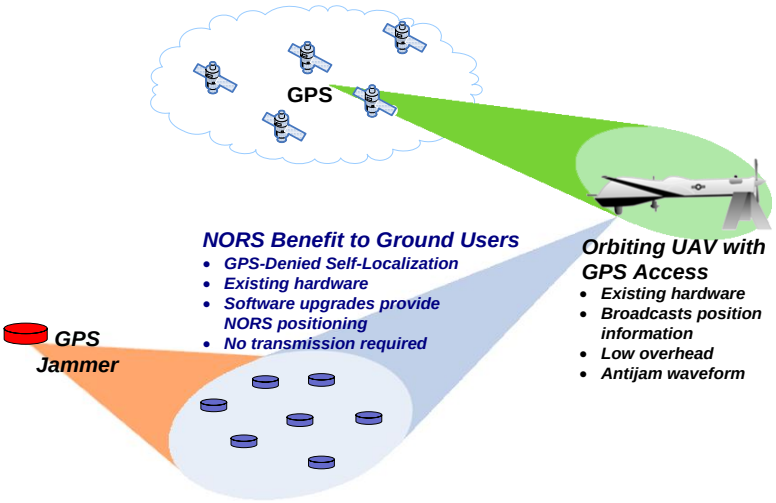

Figure 1 – The NORS concept: While the ground users are denied GPS, a flying UAV still has access to GPS. With an anti-jam communications link from the UAV to the ground users, ground user locations can be computed.

The basic concept of NORS is illustrated in Figure 1, where the aid of a position server (PS) such as a UAV is required. The position server can fly-by or loiter overhead, with access to GPS. It communicates with the ground user through a radio link using an anti-jam OFDM waveform. The ground user derives its own location based on the received signal from the position server. The ground user is completely passive in this process, thus it is LPD/LPI.

Figure 2 illustrates computer simulations of tracking a single moving ground user. A UAV PS loiters

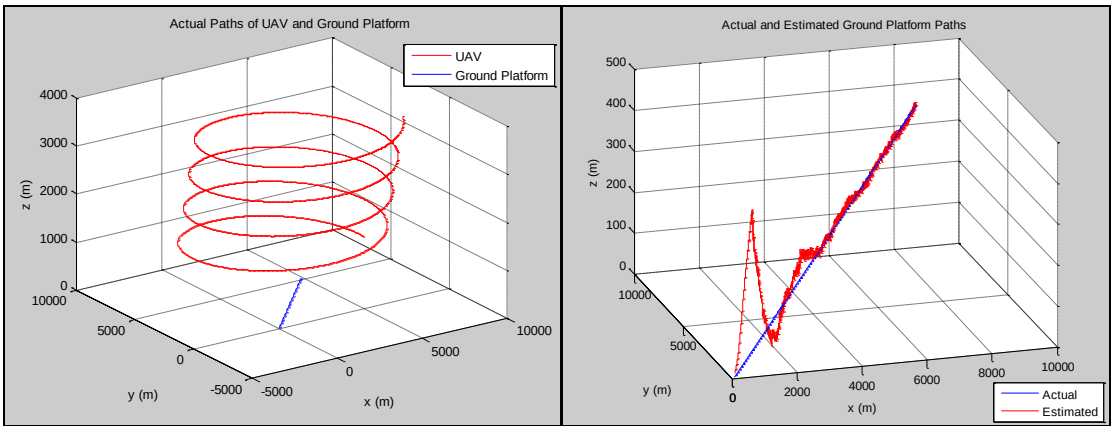

Figure 2 – Simulation results: Actual trajectories of loitering UAV (left, red) and ground user (left, blue). Tracking results on the right: Actual ground user trajectory (right, blue) and tracked trajectory (right, red).

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overhead the ground user, and broadcasts pertinent information. The ground user receives such information, then uses it to track its own locations as shown.

Figure 3 shows a fast moving airplane that flies-by, instead of a loitering UAV. A number of stationary ground users use the broadcast information from the airplane to compute their own locations. It is seen that the location accuracy are mostly within 10 meters.

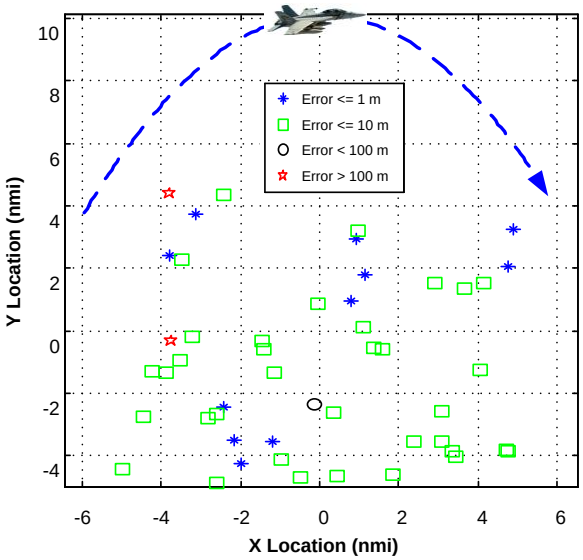

Figure 3 – Even when fast moving positioning servers are only available for a few seconds, most users in this scenario experience localization accuracy to within 10 m.

Hardware Implementation:

The NORS will be implemented in Nova Engineering's multi-band radio. Figure 4 shows the digital board for the radio, a compact board providing the digital processing of the waveform and networking processing. The radio was developed for the UAV environment, its SWAP (size, weight, and power) characteristics meet the requirements and the resources available on a UAV. Of course, the location capability can also be implemented as software upgrade to any existing radio that has extra computational capabilities.

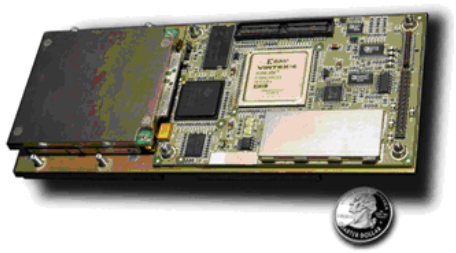

Figure 4 – During Phase II real-time flight demonstration, Nova Engineering's multi-band radio will be used as a radio platform.

Accommodating Other Functions of Position Server:

Since to fly a UAV just for the positioning purpose alone could be expensive, the NORS is designed to fit into an existing airborne PS that is carrying out other missions. The positioning capability becomes an addition to existing airborne platform's multiple missions, and is an enhancement for the ground users. Figure 5 illustrates how the positioning functionality and capability can be tied into the airborne server's other missions.

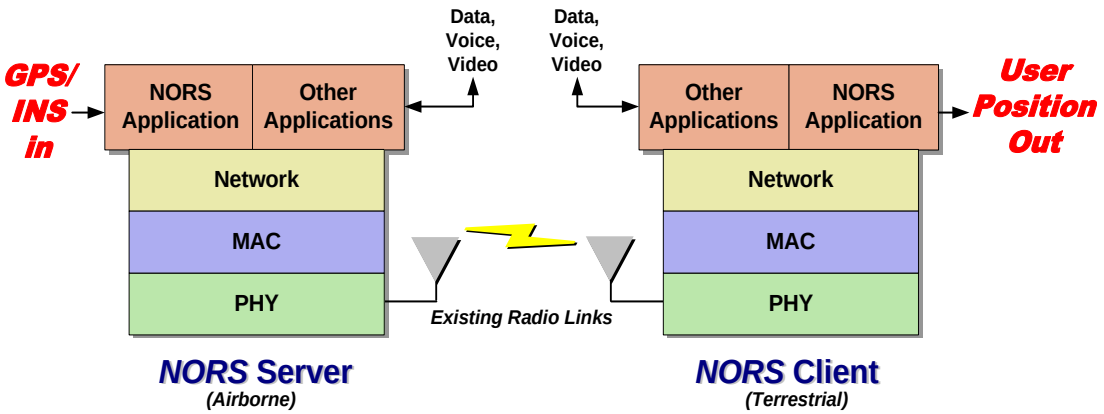

Figure 5 – Positioning as an additional functionality/capability of an existing Server's multiple missions