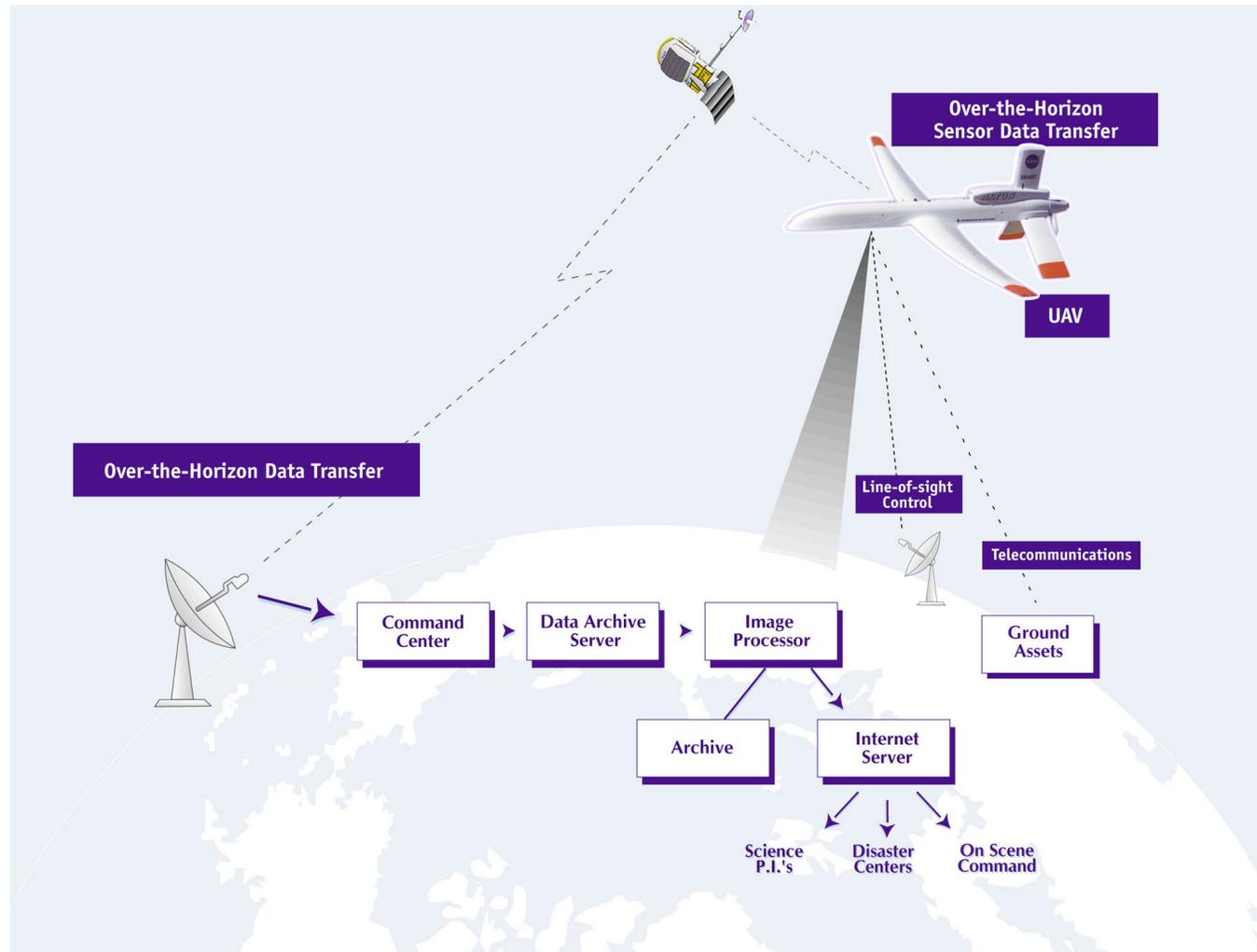


UAV Over-the-Horizon Disaster Management Demonstration Projects



Steve Wegener, NASA Ames Research Center

Project Vision

We are developing real-time data acquisition and information delivery systems employing uninhabited aerial vehicle (UAV) technology for disaster mitigation and assessment. The UAV, collecting data over a “disaster” (wildfire for this experiment) can provide Over-The-Horizon (OTH) data transfer and communication with a remote command center. The data, in this case calibrated thermal infrared digital imagery of a wildfire event, is sent from the attaining UAV via satellite communications to a data archive server, and then to an image processing station. At the image processing station, the data is rapidly geo-rectified for ingestion in a myriad of GIS or image analysis packages. After these corrections are applied, the data is both archived and distributed through standard internet protocols to a disaster mitigation center, an investigator, or to a remote, on-scene command center. Ground assets (such as fire attack equipment and/or personnel) are also monitored in real-time using GPS systems and wireless telecommunications linkages between the asset and the aircraft. In this scenario, the UAV serves as a data relay station in the sky, sending packets of information concerning the asset location to the ground station as well. That information is then distributed to a rectified image or map base to allow the real-time monitoring of asset locations in the affected region.

Our requirements, established in conjunction with the user community, are to deliver geo-rectified image information to an investigator in less than one hour. The accomplishment of these goals will have a profound effect on assisting the disaster management community in managing and mitigating the event.

Disaster Management Demonstrations

Overall Goals:

- To demonstrate the ability to provide safe, timely, critical information to disaster managers using UAV systems.
- To enhance the value of disaster data.
- To refine the process for planning such demonstration missions, enabling expanded operations.

Overall Plans:

- To perform a minimum of three disaster management demonstrations over three years.
- To expand the performance and operational envelope with each mission (platform, payload and data management).

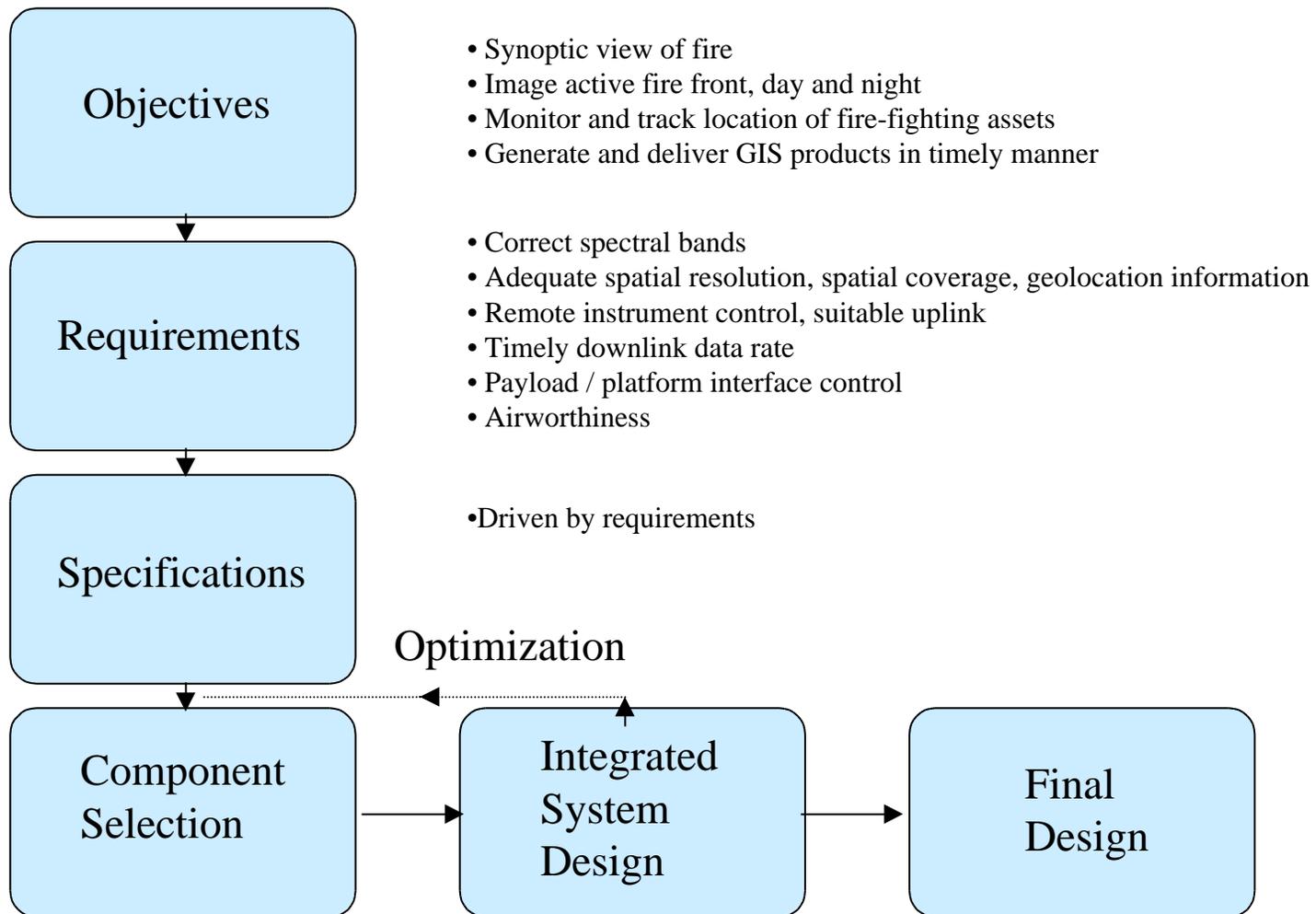
Elements of 2001 UAV Fire Mission

- Demo mission(s) to be flown in Spring 2001 (target March - April)
- Location: Los Angeles National Forest
- UAV Platform: General Atomics Altus[®]
- Payload: NASA's AIRDAS instrument (IR, fire); Inmarsat M4 antennas for real-time, over-the-horizon operation
- Co-sponsors: ERAST, California Dept. of Forestry, U.S. Forest Service (Region 5), Los Angeles County Fire Dept., Riverside Incident Command Center, City of Los Angeles, National Interagency Fire Center

Selecting the Demonstration Mission

- Many possible missions considered: fire, flood, hurricane, tornado, earthquake, volcano, etc.
- Mission selected to meet objectives: demonstrate O-T-H data downlink from UAV in real-time to aid disaster management effort
- Budget and schedule limited to existing systems, near-by location and probable or simulated event
- Selected event (fire) in convenient location (Calif.) with well-understood parameters (Project Wildfire) and known user community, leveraging on-going research applications
- Selected existing instrument (AIRDAS)

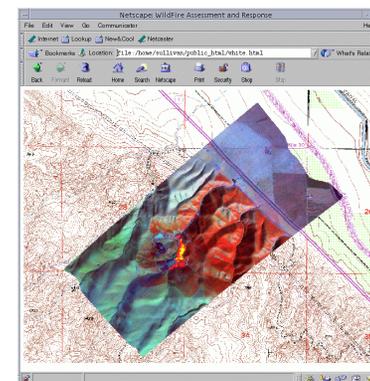
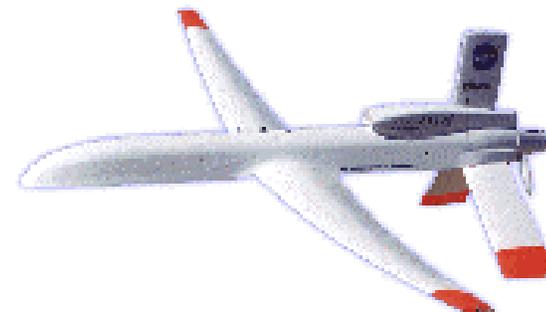
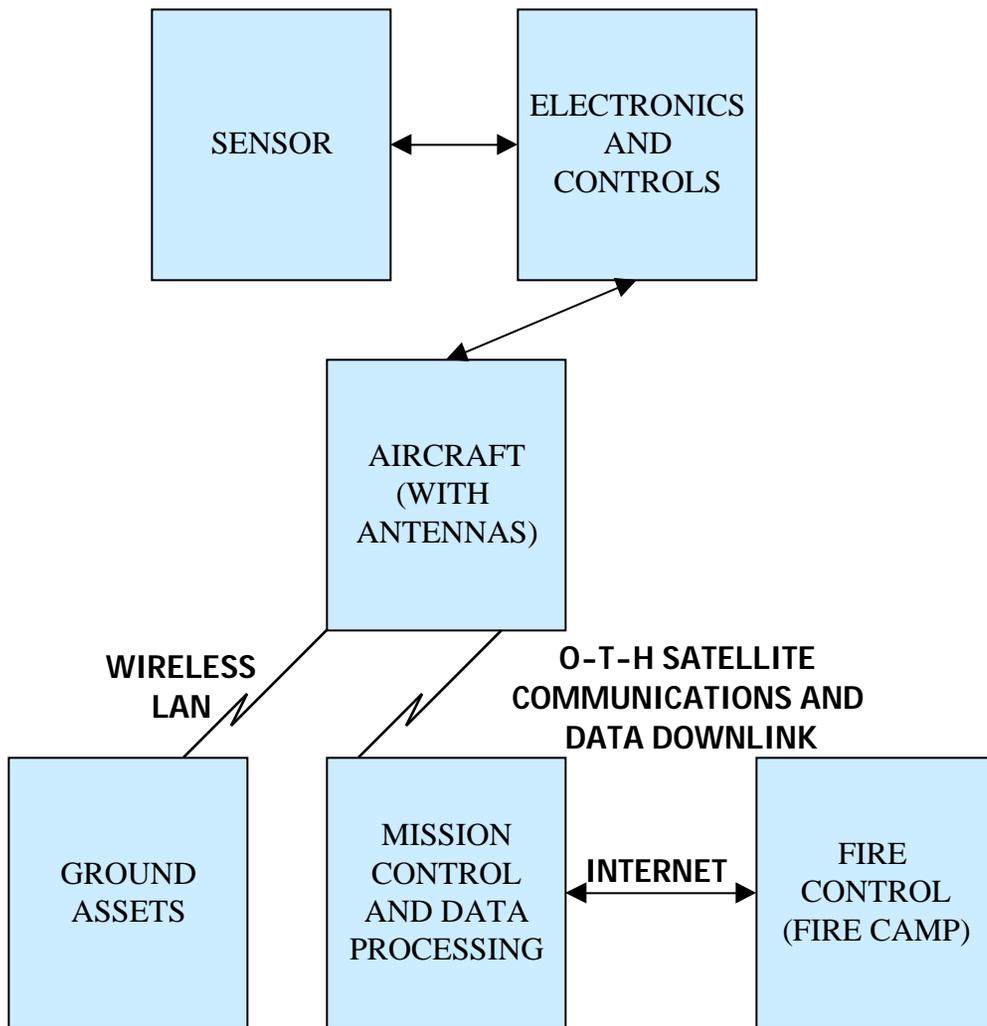
System Engineering / Design Process



Design Overview / Basic Elements

- Platform: Altus, with suitable payload interfaces
- Ground control: GA at El Mirage
- Payload / Instrument: AIRDAS, modified to fit and be operated remotely
- O-T-H Data link: Inmarsat Mobil Video Teleconference System (NERA); ISDN - fixed antenna
- Data enablers: GPS info, clock, DEM, other GIS parameters
- Data processing: NASA Ames (quality assurance, geo location, GIS layers, real-time web interface)
- Mission control: NASA Ames (mission planning, mission assurance)
- Fire control center: field Incident Command Center

FiRE System Diagram

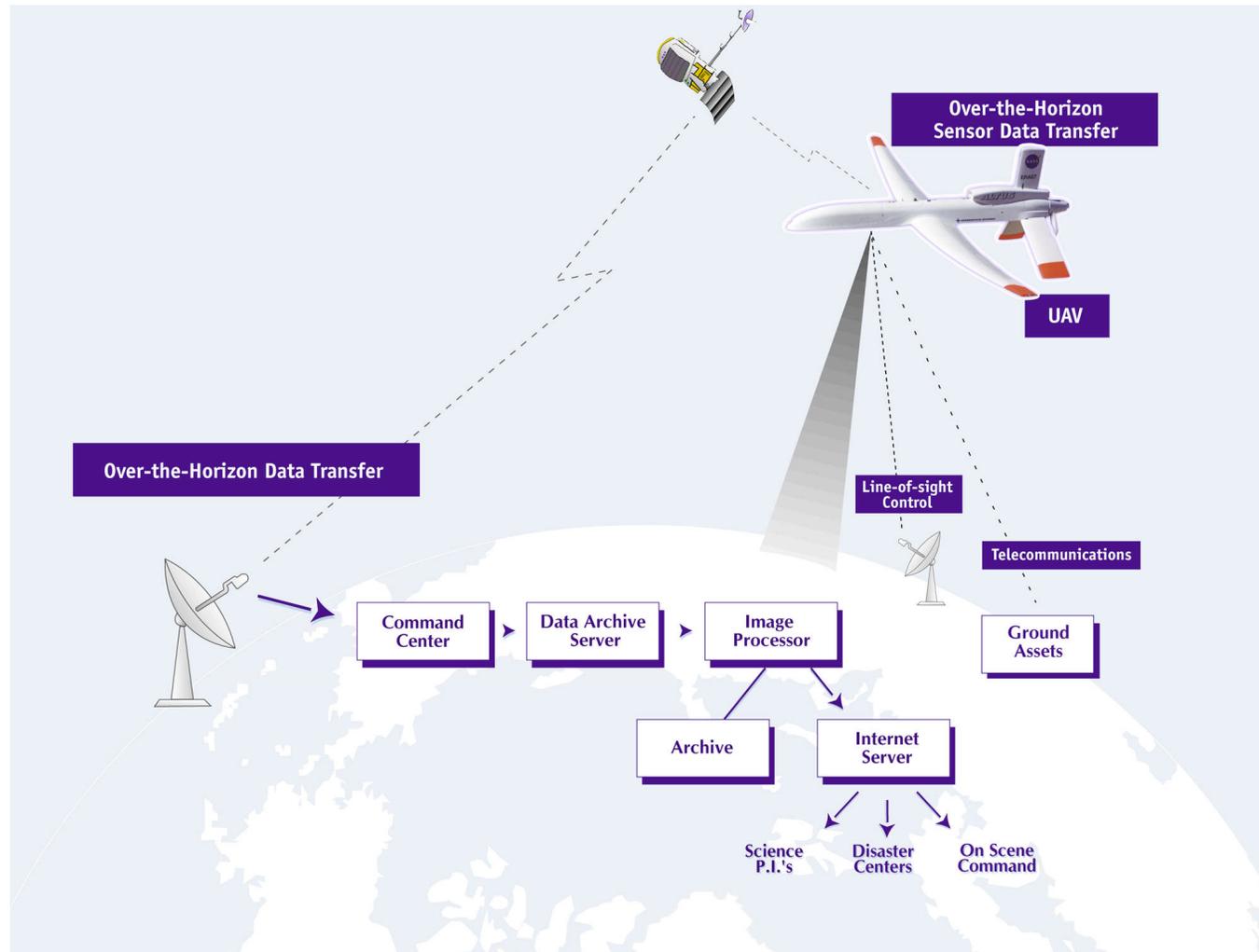


UAV FiRE - Project Schedule

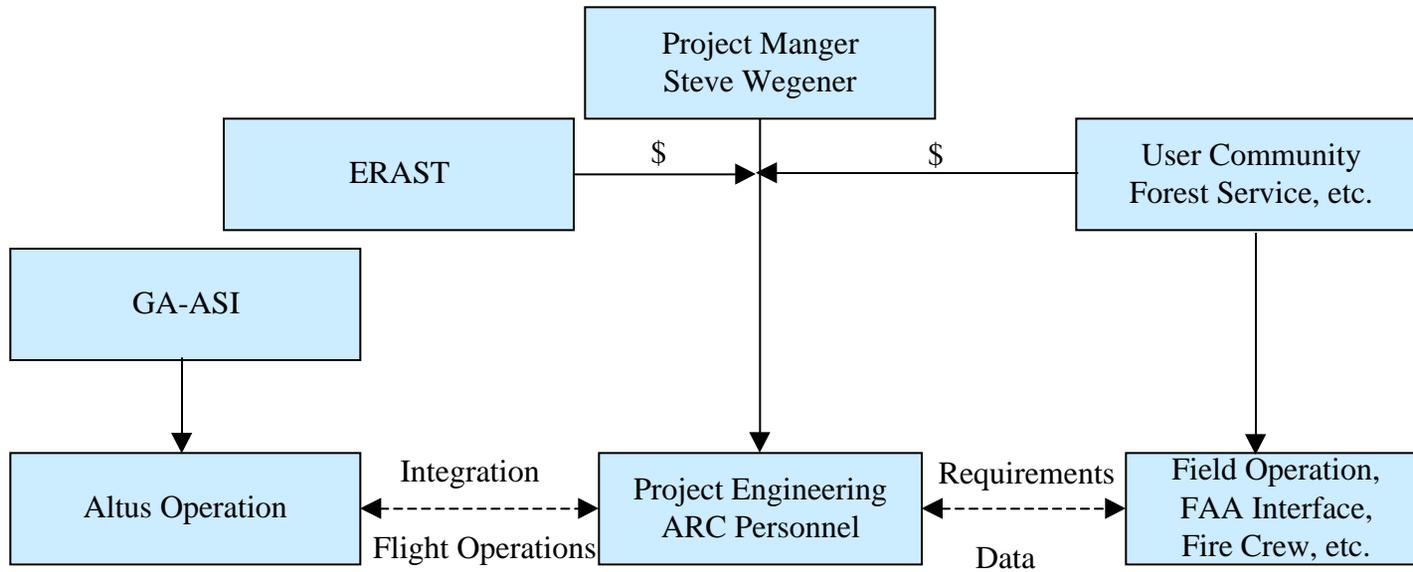
Activity Name	2001												2002		
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Payload Completion and checkout	█														
Navajo test flights		◇													
Payload Integration on Altus		█													
Flight tests / flight readiness review			◇												
Flight Demonstration			◆												
Additional target of opportunity flights									△						
Prepare for Altair flights in 2002			█												

Steve Wegener
2/7/01

Demonstration Scenario - Project Fire



UAV FiRE - Project Organization



- Mission Planning
- Payload Development
- Data Processing

Demonstration Scenario

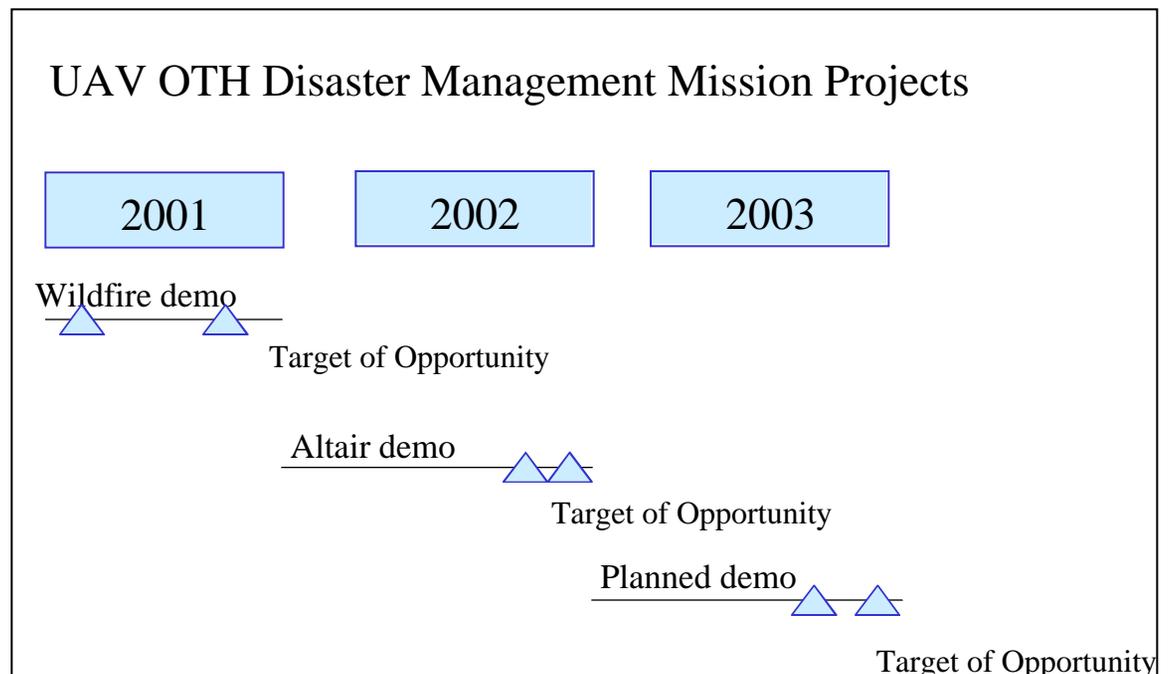
- Real fire or prescribed burn in forest area
- Altus on station overhead
- Altus on station ~ 4 hours at a time; demonstrate day and night operation, if possible
- Rough coordinates of fire front provided by customer and verified by video link
- AIRDAS data collected over active fire front
- Altus flies suitable path for link to satellite telemetry
- Data downlink over ~ 30 minutes
- Data processing; products delivered via internet to fire camp within ~ 1 hour
- Asset tracking demonstrated via wireless LAN

Near-term Follow-on

- Mission target March - April, 2001
- GA available for additional, target-of-opportunity flights
- Report on lessons learned to be prepared by participants
 - Flight performance
 - FAA experience
 - Payload performance
 - Data link performance
 - Data processing and product delivery success
 - Field camp experience
 - Asset tracking results
 - Overall customer reaction
- Outreach to disaster community; appropriate meetings or conferences
- Plans for 2002 include transition to Predator B / Altair

Long-term Program Plan

- Plan 2 additional demos: 2002, 2003
- Push envelope (with Altair):
 - O-T-H data link performance; data rate
 - Platform O-T-H
 - Expanded user community
 - Platform performance (endurance, altitude)
 - Payload type
 - Geographic location
 - Regulatory acceptance



NASA Project Management Compliance

- Project Plan drafted
- Mission Planning document drafted
- Management / Organization responsibilities established
- System engineering approach being used to reach final design
- Work Breakdown Structure used for tasking
- Procurement procedures adopted
- Schedules established and updated
- Resources identified and secured
- Management reviews scheduled (PDR, AFSRB, FRR)
- Approval controls identified