Technology Candidates for Air-to-Air and Air-to-Ground Data Exchange:
An overview of three NASA NRAs

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NRA Background

- NASA Research Announcement (NRA) "Research opportunities in Aeronautics", NNH11ZEA001N, Released on August 26, 2011

- NNH11ZEA001N Amendment: C-2 Concepts and Technology Development Project (CTD1). Proposals due 4/3/12.

- Research is to support the 2011 NASA Strategic Plan Sub-Goal 4.1: Develop innovative solutions and advanced technologies, through a balanced research portfolio, to improve current and future air transportation.

- ARMD/ASP/CTD Subtopic 3: Technology Candidates for Air-to-Air and Air-to-Ground Data Exchange

- NASA anticipated the total funding of CTD1 Subtopic 3 to be in the range of $250K/year for each award. The anticipated duration is 24 months from the date of the award.

- Three awards were made.

NextGen – Concepts and Technology Development Project Overview

- The NextGen Concepts and Technology Development Project integrates solutions for a safe, efficient and high-capacity airspace system through joint research efforts and partnerships with other government agencies.

- The focus is on developing capabilities in traffic flow management, dynamic airspace configuration, separation assurance, super density operations, and airport surface operations.

- Important to its research is the development of human/automation information requirements and decision-making guidelines for human-human and human-machine airportal decision-making.

- Airborne separation, oceanic in-trail climb/descent and interval management applications depend on location and intent information of surrounding aircraft.   ADS-B is proposed to provide the information exchange, but other candidates (satellite-based receivers, broadband or airborne internet, and cellular communications) are possible candidates.

- http://www.aeronautics.nasa.gov/pdf/ctd_project_plan_2011_508.pdf

CTD1 Subtopic 3: Technology Candidates for Air-to-Air and Air-to-Ground Data Exchange

<u>Objective:</u> Identify several long-term technology candidates that will allow air-to-air and air-to-ground data exchange. The specific goals are as follows:

1. Identify existing or emerging technology candidates (and their integration), including but not limited to ADS-B, suitable for air-to-air and air-to-ground communications over a NAS modernization horizon of 50 years.

2. Quantify the functional attributes and characteristics of each candidate, including communications range, bandwidth, latency, integrity, reliability, and security.

3. Map the technology candidates to specific air traffic management applications where they will be most beneficial and cost effective.

4. Identify the infrastructure and architecture needs of the potential technologies for air-to air and air-to-ground exchange.

5. Identify rough magnitude cost estimates, or relative cost comparisons, and any technological characteristics such as bandwidth, and reliability.

6. Assessment how these technologies could be used for air traffic management applications including airborne separation and interval management.

7. Identify vulnerabilities and security issues and mitigation of any proposed concepts.

NRA Awardees

- A Study of NAS Data Exchange Environment through 2060
  - Honeywell (Columbia, MD)
  - Aloke Roy, PI
- NASA Com50
  - Rockwell Collins (Cedar Rapids, IA)
  - Joel Wichgers, PI
- Technology Candidates for Air-to-Air and Air-to-Ground Data Exchange
  - Agile Defense LLC (Hopkins MN)
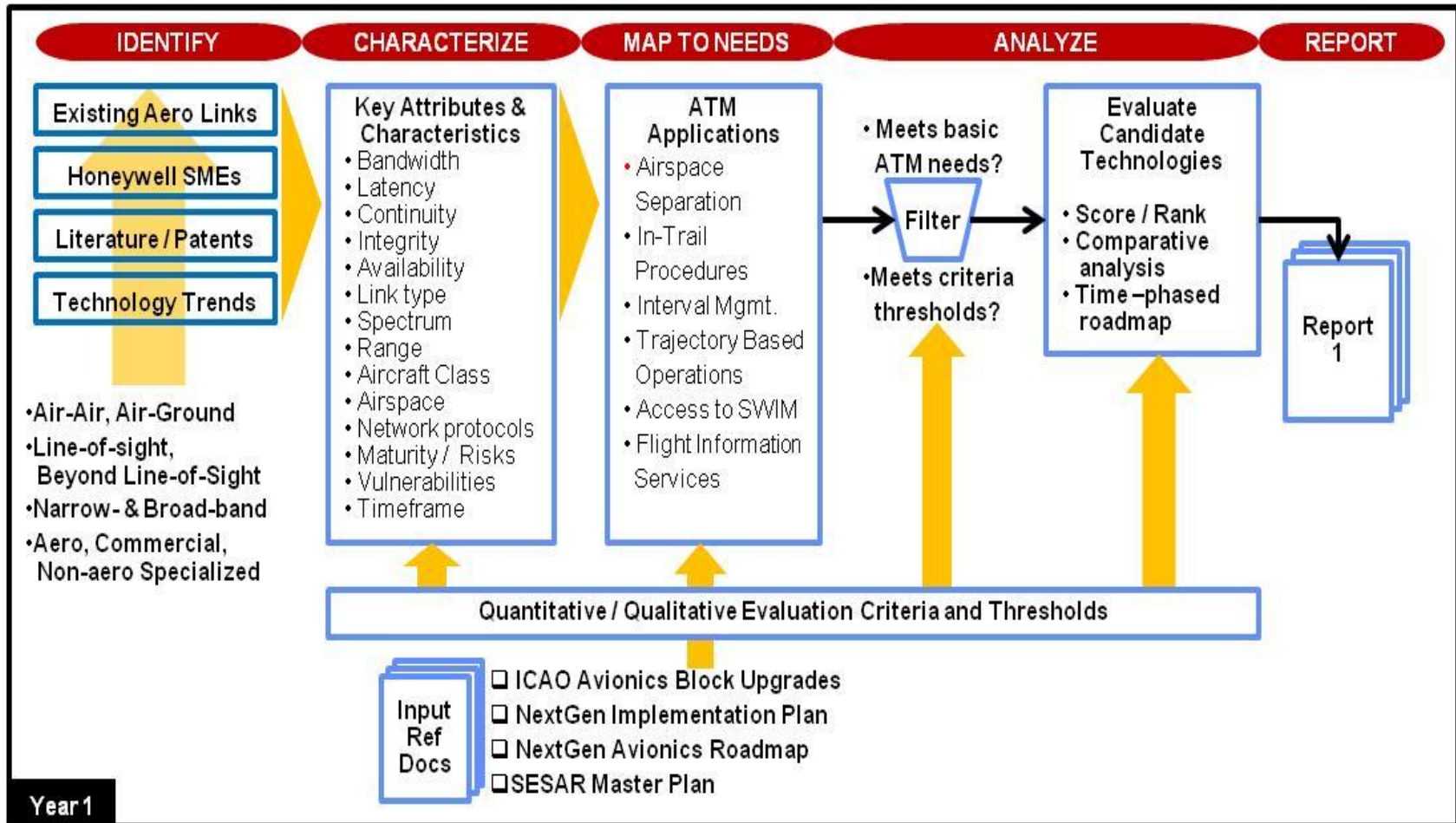 - Daniel Johnson, PM
  - Brian Hayes, PI

Study of NAS Data Exchange Environment through 2060
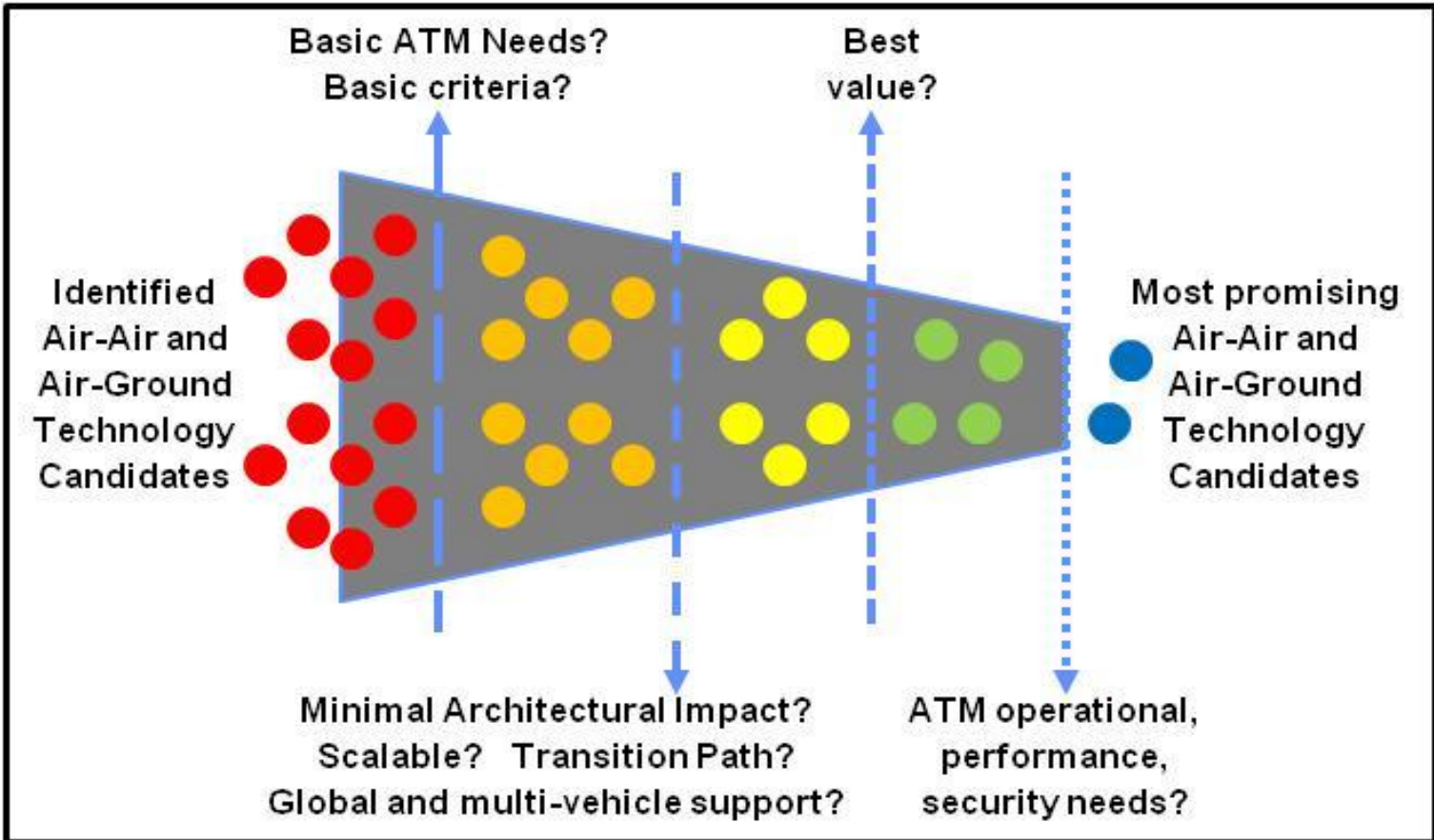
Overview of Honeywell Task Order

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Honeywell

Technical Approach

Technical Approach (Cont.)

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Development of NextGen Concepts for Air-to-Air & Air-to-Ground Data Exchange:
A forward looking study to identify candidates for meeting the communication needs of the NAS during a 50 year modernization time horizon.

NASA Research (NRA) with Rockwell Collins per Contract#: NNA12AB82C

High Level Overview of Objectives, Approach, Deliverables, and Schedule

Date: February 7, 2013

2050   2060

Rockwell Collins

Rockwell Collins

OBJECTIVE
Identify long term technology candidates for air-to-air and air-to-ground data exchange for the future next generation commercial air transportation system.

STATE OF TECHNOLOGY
Current aircraft operations use VHF Voice Communications, High Frequency (HF), SATCOM, and ADS-B (1090 Extended Squitter, UAT).

GOAL
Identify, characterize, and assess Communications Technology Candidates ability to meet the expected data communications requirements of the future National Airspace System (NAS).

2050   2060

Statement of Work
- Identify and characterize long-term technology candidates for air-to-air and air-to-ground data exchange for the National Air Transportation System, and investigate how the communications candidates will serve evolving airspace applications over a National Airspace modernization time horizon of 50 years

    ➢ Develop Report: Data Communications Technology Candidates

    ➢ Develop Report: Identify Infrastructure and Architecture Needs of Candidate Technologies

FY13 MILESTONES	Plan	Actual
Kickoff Meeting & Work Plan	Q1	Q1
Conference Presentation	Q3	
Report – Data Com Tech Candidates	Q3	
Report – Identify Infrastructure & Architecture Needs of Candidates	Q4	
Base Year Presentation & Report	Q4	

PROJECT Roles:
Rockwell Collins:
  Principal Investigator (PI) / Project Leader: Joel Wichgers
  Co-Investigator (CoI): James P. Mitchell
  Program Manager: Chris M. Conway
  Contract: Kelly M. Scott
  Program Pricing & Control: Derek J. Zahari
  Many other Subject Matter Experts (SMEs)
NASA Team:
  Technical Monitor: Denise Ponchak
  Contracting Officer: Janessa Schantin
  COTR & NRA Manager: Naz Galeon
  New Technology Officer: Gail Woll

Study Research Approach

- Identify existing technologies being used for air-to-air and air-to-ground communications
- Identify relevant technologies that may mature and be applicable to future air-to-air or air-to-ground communications within the study 50 year time horizon
  – For example, antenna technologies, radio technologies, processing capabilities, optical communications, etc.
- Identify and characterize communication candidates functional attributes and characteristics
- Identify initial requirements for air-to-air / air-to-ground comm. to support future anticipated NextGen applications and map/assess the ability of the candidates to support Air Traffic Management (ATM) applications
- Identify ground and airborne architectural and infrastructure needs of the candidates
- Identify vulnerabilities and security challenges with comm. candidates and outline mitigation methods

Document research results in two study reports

"Technology Candidates for Air-to-Air and Air-to-Ground Data Exchange"

(PI) Brian Haynes & (PM) Dan Johnson
Agile Defense DBA XCELAR

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XCELAR

Program Scope

- The goal of the research:
    - To identify potentially viable solutions to the datalink needs of the air transportation system of the future.
    - Identify future National Airspace System (NAS) scenarios
    - Determine requirements and functions (including gaps)
    - Investigate technical and business issues for air, ground, & air-to-ground interactions
    - Report on the results
    - The project will be conducted under technical direction from NASA and with collaboration with XCELAR's partner, National Institute of Aerospace, and NASA technical representatives

XCELAR

Datalink Study Process

Air-to-Air / Air-to-Ground Datalink Study Process
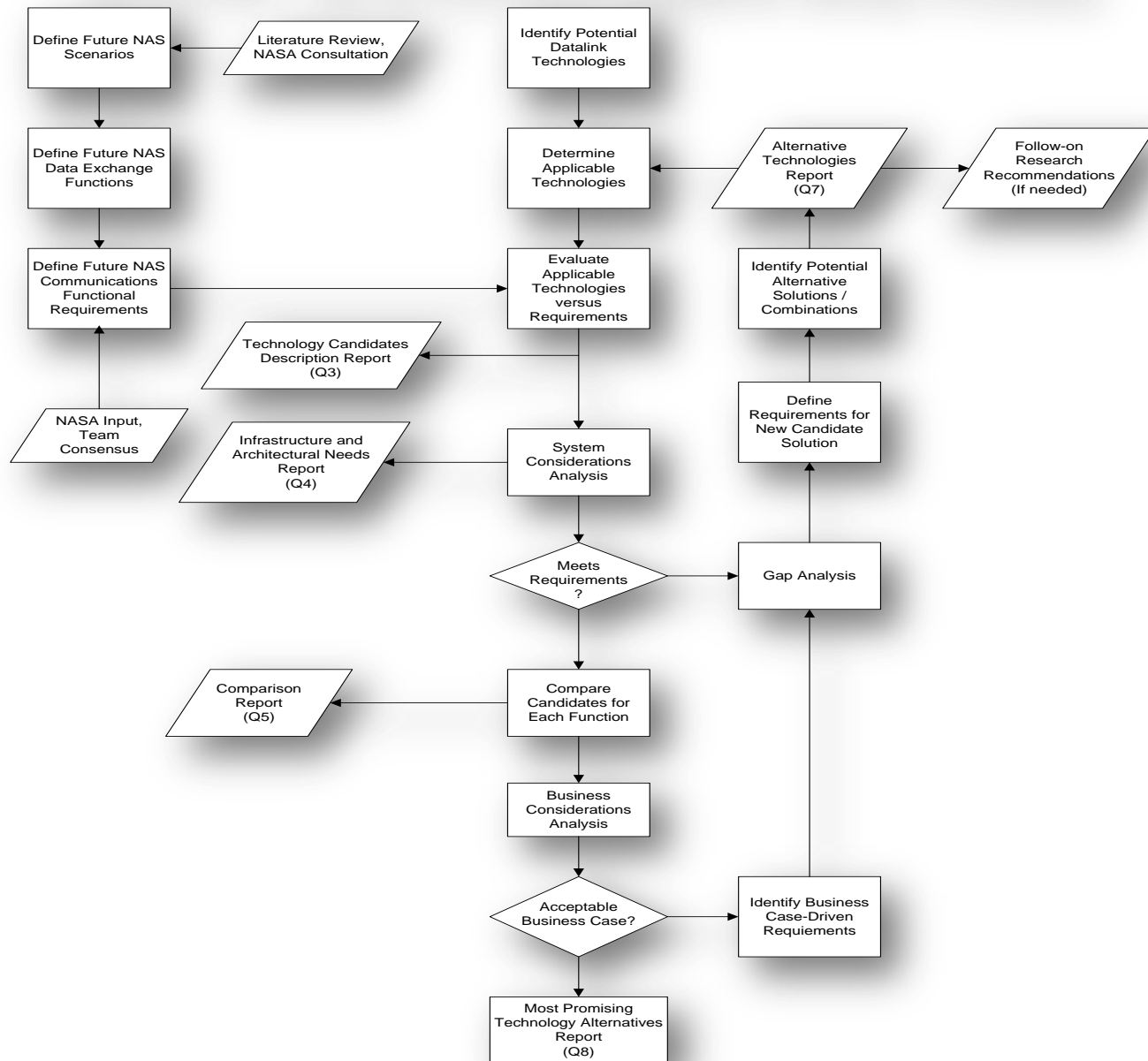
Program Execution (24 months)

- Literature review
- Define future NAS scenarios
- Define data exchange functions
- Define data communication functional requirements for each scenario
- Define potential datalink technologies
- Infrastructure and Architecture needs
- Characterize and compare candidates
- Gap analysis and alternative technologies

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