Network-Centric Airport Surface Communications Network Architecture: An Integrated Approach

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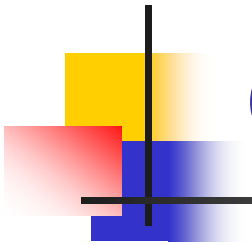

Outline of Presentation

- Introduction
  - From a networking perspective
- Effort to address current state of surface communications
- Communication reference model
- Conclusion

Surface Communications Today

From Networking perspective:

- Fragmented
- Circuit-based vs modern packetized
- Dedicated & separate communication systems architectures
- Different user comm. requirements
- Lack of collaborations among stakeholders

General Airport Stakeholders

- Government
  - Federal: FAA, DHS, Customs, etc.
  - Local: County, City, State
  - Military
- Industry:
  - Airlines
  - Catering
  - Fix Base Operators
  - Cargo
  - Fueling
- General Aviation

Different Comm. Requirements

- FAA
  - Navaids, Surveillance, Weather, Communications, Monitoring
  - Aircraft and Ground Vehicles to ATC
- Airline
  - Aircraft to Airline Operations Center & to maintenance
  - RAMP Tower to RAMP personnel, aircraft
  - Fueling and catering, etc.
- Airport
  - Airport security, checkpoints and maintenance
- Emergency Services
  - Fire & rescue (ATC, Airlines, Port Authority, etc.)

Effort To Address Current State of Airport Surface Communications

- Studies sponsored by NASA Glenn Research Center
  - "Trios Report"
    - Surface Communications Requirements
  - SNAD Report
    - Surface Applications
    - Architecture Definition
- NASA GRC-Sensis Test Bed
- Other

NASA GRC Sponsored Studies

- "Trios Report": Stakeholders Requirements
  - Requirements identified, including technical, performance, security, safety and policy.
  - Major findings of Trios study:
    1. If an airport wireless surface network is implemented, as recommended in this study, air-to-ground communication will meet the required communication technical performance of 770 ms 95% of the time and the continuity, availability and integrity numbers as specified in RTCA DO-284.
    2. If the above airport wireless surface network implemented, it will have the minimum data rates for each segment of the user community:

Stakeholder	**Minimum Data Rate**
FAA	28 Mbps (TRACON to Tower); 15 Mbps (TRACON or ATCT to RTRs, NAVAIDS, ASR-9 Radar, DBRITE, Weather Sensors, etc.)
Airlines	69 Mbps
Airport	7 Mbps for data
Passengers	54 Mbps (based on 802.11g)

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GRC Sponsored Studies (cont.)

3. In order to meet the 200% growth in surface communications needs, new technology may be required to meet this growth.
4. The airport wireless surface network recommended in Trios study will be capable of supporting end-to-end services that have 0.99999 availability with a six second mean-time-to-restore (FAA Order 6000.36 & NAS-SR-1000).
5. The above airport wireless surface network will not exceed 25 ms in one direction when used as a wire-line replacement to an ATC voice & data communication site.

GRC Sponsored Studies (cont.)

- SNAD Report
  - Surface applications collected & categorized:
    - Air Traffic Management (ATM)
    - Aeronautical Operational Control (AOC)
    - Airline Administrative Communications (AAC) and
    - Airport Operation Communications.
  - Building blocks of surface network architecture defined as functions, not physical entities:
    - Addressing/routing
    - Network management
    - Performance
    - Security
    - Other (such as surface wireless infrastructure, applications services and storage).

Surface Network Architecture as Functions, Not Physical Entities

Function	Description of Capability	Mechanisms Used to Achieve Capability
Addressing/Routing	*Providing robust and flexible connectivity between devices*	*Addressing: address space allocation & aggregation* *Routing: routers, routing protocols, manipulation of routing flows*
Network Management	*Providing monitoring, configuring, and troubleshooting for the network*	*Network management protocols* *Network management devices* *Ways to configure network management in the network*
Performance	*Providing network resources to support requirements for capacity, delay, and RMA*	*QoS* *SLA* *Policies*
Security	*Restricting unauthorized access, usage, and visibility within network to reduce threats and effects of attacks*	*Firewalls* *Security policies and procedures* *Filters and access control lists*
Other	Additional capabilities to meet current and future needs	To be defined as additional functions added

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Model Proposed by Y. Wang & Y. Zhao

- Proposed Communication Reference Model:
  - Consolidating disparate surface networks into one integrated network.
  - Consisting of four components: End devices, Access networks, Intelligent core network, External interfaces.

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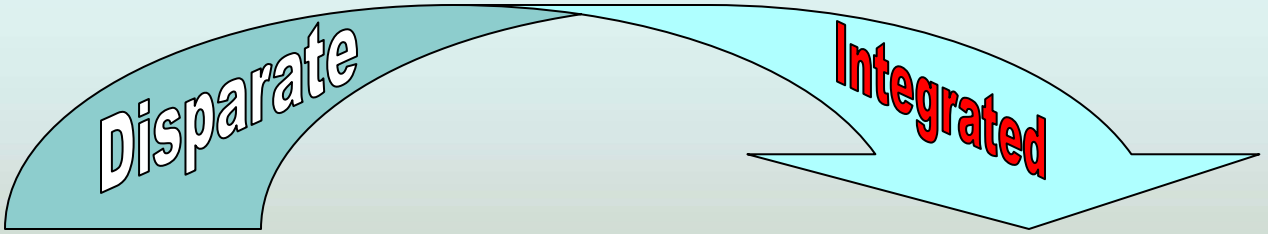
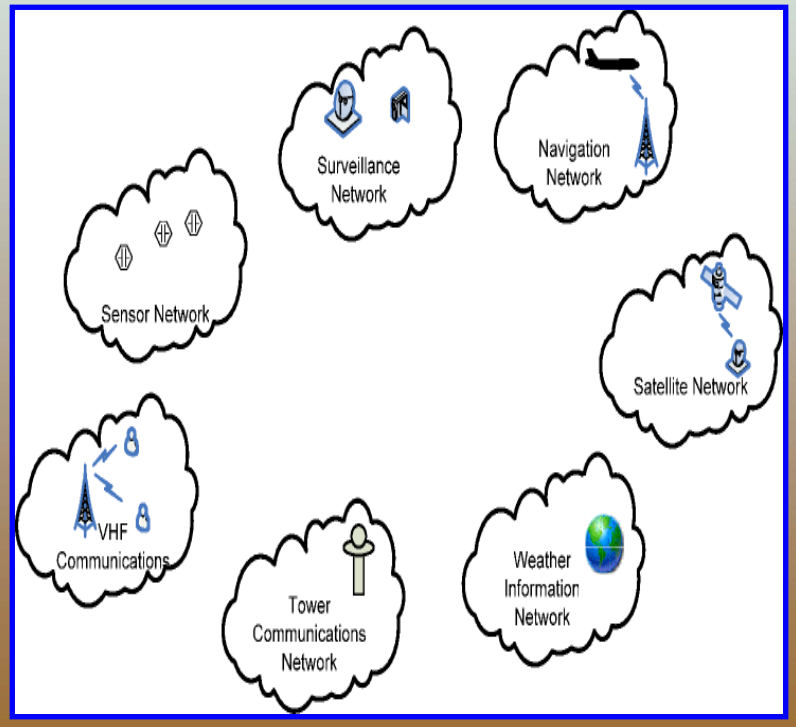
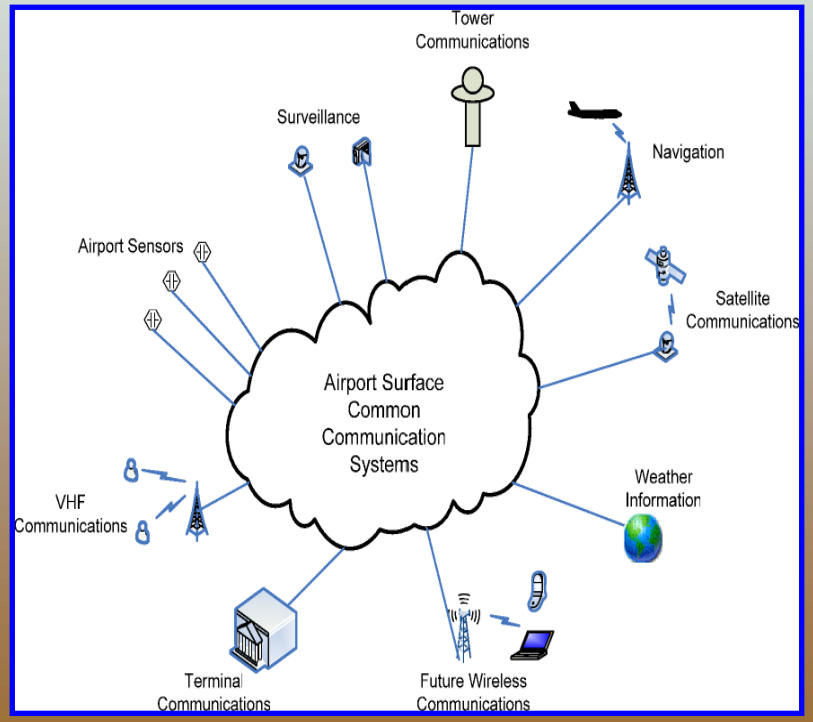
Consolidating Disparate Networks into an Integrated One







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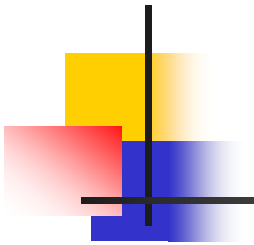
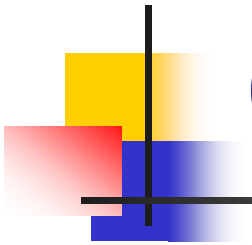
Example of External Interfaces for Surface Communications

- Systems that network may transport:
  - Communication: RTR
  - Navigation: ILS
  - Surveillance: ASR, Beacon
  - Lightning: ALSF, VASI, MALSR, PAPI, REIL
  - Weather: ASOS, AWOS, RVR
  - FAA Maintenance: Maintenance and Monitoring systems
  - Mobile platforms: Aircraft Data Communications



Benefits

- Obvious benefits:
  - Integrated solution for airport surface operation communications at different levels and communities of airport users
  - Support mission critical & non-critical voice, data, & video for various airport users
  - Flexible and scalable to integrate new technologies



Conclusion

- Real need for an integrated approach
- The reference model proposed can be used as a guide for integration of surface communication systems
- Hard to meet needs & expectations of surface users because of demanding security and interoperability requirements with legacy systems and user collaborations
- A long-term commitment by government & industry needed if a truly integrated surface network will ever become a reality

References

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