Commercial Space Transportation Advisory Committee (COMSTAC)
Systems Working Group Minutes
April 16, 2013, 1:00 – 2:00 pm EST

I. Introduction

a. Livingston Holder, Chairman of COMSTAC's Systems Working Group, opened the call. He introduced Mike Machula and Tom Martin, both FAA, who will lead the discussion. Randy Repcheck, FAA, also checked in.
b. Livingston reminded everyone that the FAA may not propose regulations concerning occupant safety until October 2015, though they are presently drafting guidance and best practices for the industry. This telecon is the final in a series of eight being used for background research, to get key insights from the industry.
c. He then reviewed the topic of the previous telecon last month, on medical best practices for crew and spaceflight participants, which included discussion of best practices for both occupancy, the physical capability needed to perform tasks and necessary to ensure occupancy from a guidance perspective.
d. The topic for this telecon is voice communications and whether the FAA should command best practices for minimum safety levels.
e. Mike Machula thanked Livingston for the introduction, and reiterated that they were on the call to listen to industry input.

II. Discussion

a. When would communications with the ground (voice, telemetry, command) be recommended?

i. Mike Machula asked the first topic question.
ii. Jon Turnipseed, Virgin Galactic, stated that for sub-orbital air launch systems, ground communication is required to operate in international air space, but telemetry and command were not very critical. In the case of the Virgin Galactic mothership, specifically Part 91 aircraft communication.
iii. Mike asked about orbital, and Jon responded those systems would be satellite based.
iv. Livingston Holder echoed Jon's comment and said that anyone whose flight behaves or operates like an aircraft within the national airspace system probably requires standard communication, falling within current guidelines. Jon then extended the question to ask what happens beyond that, for extreme downrange communication, beyond the national airspace system, and orbital.

b. Should communications to the ground be considered a critical function?

i. Mike asked the second topic question, and more specifically asked what critical functions would drive the need for communication.

ii. Jon stated again that ground communication was a critical system, since in their unique system the safety system is the pilots. Mike asked and Jon clarified that ground communication with pilots specifically was critical, since the pilot in command has control of the vehicle, and operators on the ground need to find out what is happening in order to assist.

iii. Bruce Mahone, SAE, observed that with increased flight rate, communications between the ground and the vehicle would be necessary to accommodate the multitude of reasons vehicles would need to change trajectory in-flight. While industry might be hesitant to suggest pre-emptive requirements, there is a need to reach consensus on an agreement for a reasonable amount of communications, when considering flying through the national airspace on a regular basis.

iv. Livingston suggested that the current communication architecture for aircraft and aviation is sufficient for the vast majority of communication requirements for the suborbital spaceflight community, and taking advantage of that may be the wisest thing to do.

v. Bruce questioned whether others would object that regulations developed for aviation may be too onerous for spaceflight. In his opinion, though, the protocol, frequency, and equipment are already there. Even the move to GPS tracking is more advantageous than radar, which is not uniformly available in all areas.

vi. Pam Melroy, DARPA, contrasted this with non-suborbital space communications, where the frequencies are handled in a different way above a certain altitude. For instance, when using space assets such as TEDRIS, which requires a separate license.

vii. She also stated that while ground communication is inherently desirable, in order to communication the condition of the spacecraft, and to know what is happening on the ground, the real question is how much coverage is required. 100% coverage all the time is expensive, so what is the acceptable amount?

viii. Bruce agreed, and encouraged the industry to step forward with an amount before one is imposed on them. For orbital communication, he also suggested a reasonable approach based on existing equipment and network coverage for things like TEDRIS and Iridium and other networks widely available. Industry could develop a standard that balances what is cost effective and available or feasible technologically.

ix. Livingston agreed, and described the logical boundaries for requirements. Suborbital systems operating within the national airspace would share requirements that look like other aircraft operating within the system. But there would be changes and concerns with rising altitudes. For instance, international protocols above the national airspace.

x. And then orbital concerns, beyond the traditional aircraft and terrestrially based communication systems. He asked what would be important for communication,

including: communication when above the US, percentage of time in the duty cycle, fact of vehicle being tracked as an object. These may be tiers for requirements put upon your flight envelope.

xi. Mike asked, based on the comments, whether communication with pilots was sufficient rationale to require communications.

xii. Bruce responded that "comm out" procedures are especially important in case of some type of failure, for flight crews to handle situations; to understand what is happening with the vehicle. But safety in flight is still pilot dependent in some configurations.

c. Should ground voice, telemetry, or commanding be allowed to serve as part of a hazard control?

i. Tom Martin segued the discussion to the third topic question, and tried to summarize Bruce's position as that it should always be on board, like the pilots.

ii. Jon stated that it should not be mandated by regulation. It can be used as part of a company's hazard mitigation, but even in complex systems, they are still going to have a "comm out."

iii. Bruce again stated that with increased traffic in the national airspace, it made sense in a regulatory regime to have communication between spacecraft and something like regional control towers. Ideally it would not be overly burdensome financially or technically, but even with current low flight rates, it made sense to develop some kind of protocol to incorporate early, unless it is totally unrealistic. The industry would be better off to have a feasible plan in place.

iv. Livingston reiterated the question of whether it can be allowed to support as hazard control. Pam asked the opposite question of why it would not be, what the down side would be.

v. Tom characterized it by asking if it was a primary control, then what coverage would it require. Otherwise, it would need to be self-contained. Jon agreed with the phrase "self-contained."

vi. Pam added that this sounded like a discussion of fault tolerance. For instance, if a hazard occurs in a mitigating factor that the ground can see or they can call up in time to throw a switch, then the question is whether there is a requirement for a certain level of reliability r coverage to protect from a second failure, which is a communications failure. This is different from linked systems, like an electrical system failure that cascades and knocks out communications at the same time.

vii. Livingston noted that fault tolerance was discussed during the January telecon. He also described a scenario with a requirement to land with a certain amount of propellant, but telemetry to the ground has failed on the vehicle, could ground communication be used as hazard control to complete landing.

viii. Mike clarified that hazard control is about prevention, and the question here is about what ground control can do to prevent a hazard from occurring, as opposed to crew being responsible for monitoring an on board system and preventing it from propagating into a hazard.
ix. He said that not allowing it to be part of hazard control drives the design. For orbital, with extended periods of time, the system has to be highly reliable and cannot count on high percentage of coverage for certain hazards.
x. If it is allowed, then you can distribute that system to the ground depending on where the risk falls and coverage in orbit, either with your own satellites or existing networks. Since it is a design option, the question is whether the FAA should be regulating strict design solutions that are self-reliant or not.
xi. Livingston asked Pam if that answered her question, and she answered that it is probably a function of the hazard and the time to occurrence, so if the hazard is that a failure has a critical outcome, but the critical outcome takes an hour to unfold and you have comm coverage within the hour, it might not drive it. Tom agreed with that summation.

d. Should encryption be required for critical commands?

i. Mike asked the fourth topic question, and specifically asked Jon if they send commands to ship. Jon answered they do not, and clarified for Mike that this topic would not affect them.
ii. Livingston asked if this topic was moot for everyone on the telecon, and Mike agreed. He went on to discuss that it was a NASA requirement, and separately what use encryption was against methods for sending malicious commands.

e. What is the appropriate coverage for the different phases of flight?

i. Hearing no comments on the last question, Mike asked the fifth topic question.
ii. Bruce clarified the name of organization for discussion, C.C.S.D.S. for the Consultative Committee for Space Data Systems, formed from international space agencies to run standards for communications between the ground and spacecraft. He asked whether those standards would be valuable for discussion.
iii. Pam clarified that a U.S. entity licensed by the FAA would need a license from the FCC to transmit on those frequencies. Bruce responded that maybe the C.C.S.D.S. was more than needed for discussion, but where orbital spacecraft are concerned, above and beyond sub-orbitals and the national airspace, it may be useful to consider commonly agreed upon frequencies and protocols, especially over international territory.

iv. Pam responded that current technology did not work that way, and was not analogous to keeping in the frequency for the tower you are flying over. It does not work that way in orbital space. You get a set of frequencies that go from a satellite down to a control room.
v. Mike asked Jon whether he was planning 100% comm coverage, and Jon responded in the affirmative, with contingencies for "comm out." Mike asked whether that was reasonable or available, and Jon responded yes, for suborbital.
vi. Mike then asked if there were any cost drivers that would tempt Jon to reduce that coverage. Jon responded only that if 100% coverage at all times was a regulatory requirement, it would drive redundant systems and weight to the vehicles.
vii. Livingston asked what the redundancy requirement was for aircraft operating in the national airspace system. Jon responded that there was none, but they did file a flight plan, and "comm out" procedures include getting permission to land before the spaceship actually goes into ballistic flight.
viii. Livingston observed that as a matter of course, many operators may choose to have redundant communications, and Jon agreed.
ix. Mike asked about if comm was required but operators were free to have a backup plan, like root signals at the airport tower. Jon declined to go into that discussion with the time remaining on the telecon.
x. Mike moved on by observing that NASA requires more coverage of ascent and entry than on orbit.
xi. Livingston also observed that historically the ability to communicate on orbit was limited, and only grew over time, which is why protocols for orbital communication are not as developed.
xii. Mike asked if this goes with earlier comments to look at current state of the art technology, and Livingston agreed.

f. What should be included in the telemetry?

i. Mike asked the sixth topic question. Livingston additionally asked whether there is an easy telemetry requirement. Just because we are used to that for orbital systems, does not mean it can be self-contained for sub-orbital.
ii. Mike compared it to the third question on hazard control.

g. When would intra-vehicle voice communication be recommended?

i. Mike segued to the seventh topic question. Livingston answered that crew to crew communication should be available at all times. Crew to spaceflight should be available to advise participants of upcoming events, like safety requirements to

strap in or prepare for an emergency. Both of those would be required on a continuous or as needed basis.

ii. Livingston then said communication between spaceflight participants would be nice, but not required, at least for enjoyment of flight, but perhaps under conditions where individuals are required to participate with each other for safety of flight.

iii. Mike summarized those comments as safety situational awareness driving communication requirements from crew to crew, and crew to participants. Livingston agreed that it was about function from a safety standpoint. He contrasted this with the role of spaceflight participants, who are not going to be as well trained, and could interfere with crew communication during complex operations. Participant chatter could become a hazard, unless there's a separate passenger channel.

iv. Jon Turnipseed agreed on the last point, and was reticent to make it a regulatory requirement. He said it depends on the vehicle shape and size, and considered the shuttle, where crew would need to communicate between decks. On a smaller vehicle with one cabin, participants could yell, except during rocket firing.

v. Pam Melroy suggested that if the requirement was performance based, then smaller vehicles could meet the requirement through non-electronic, or non-technical means, like hand signals. Jon agreed.

vi. Livingston voiced a safety concern in the situation where participants were required to wear spacesuits, but could not yell intelligibly in an emergency. He compared it to aviation, where passengers can press the flight attendant button even during phases where attendants cannot get up, but it at least informs the crew of something. He asked if there was an equivalent case in commercial space flight, and if it could overcome non-technical means of communication. Even during short flights, communication to crew could help them alert ground emergency personnel to be ready at the landing site. Even if this is already standard protocol for some companies, it should be considered.

h. Should a minimum threshold be set for intelligibility level?

i. Mike segued to the eighth and final topic question. Livingston stated he was not aware how that was measured.

ii. Mike answered that there were standards available. NASA set it at 80% intelligibility, and he could discuss how that was measured in a longer discussion. During Constellation, a concern was data rates, and the military uses a codec designed for a male voice that uses various data rates so you can understand them, just get enough intelligibility through.

iii. Livingston commented that would not work, and Mike agreed, saying it was 2 kilobytes per second versus 32. Very little rate, more appropriate for emergency

comm kind of leverage. An example of where it only works for one type of pilot in there.

iv. Hearing no other comments, Mike handed the discussion back to Randy Repcheck.

III. Conclusion

a. Randy asked everyone to take a look at the list of all eight telecons in the series, and invited anyone to submit comments on any of the topics to Docket FAA-2012-0818. Comments can be submitted at regulation.gov, or e-mailed to Randy.
b. Brenda Parker, FAA, reminded everyone that PowerPoints and minutes for all the telecons are available on the FAA-AST website.
c. Randy thanked everyone on the call, and stated that after the FAA does issue guidelines, they would definitely continue to engage COMSTAC.
d. Livingston and Mike also thanked everyone.

Teleconference Participants:

Livingston Holder
Bruce Mahone (SAE)
Pam Melroy (DARPA)
Jon Turnipseed (Virgin Galactic)

Participants from the FAA Office of Commercial Space Transportation (AST) included:

Mike Machula
Tom Martin
Brenda Parker
Randy Repcheck