



Webinar Date: August 8, 2018

This webinar explored the current and evolving use of Unmanned Aerial Systems (UAS) in the railroad and highway environments including Line of Sight (LOS) and Beyond Visual Line of Sight (BVLOS) use of drone technology. Todd Graetz (BNSF) and Paul Wheeler (Utah DOT) presented during the webinar. This document provides responses to questions asked during the course of the webinar.

1. Is the BVLOS surveillance linear or radial?

BNSF: The BVLOS surveillance is linear. Sensors focused on our track, right of way, and property.

2. Does BNSF feed their received ADS-B data to FAA?

BNSF: No. This is an option for FAA to consider, but at this time, they are not using the data received from our supplemental sensors. We fuse the FAA SBS data with data from our supplemental sensors to give our team a visual of all cooperative ADS-B equipped aircraft.

3. The surveillance sensor determines the "view". ADS-B is an omnidirectional beacon. Radar can be fixed direction or sweeping.

BNSF: This is correct. We use omnidirectional ADS-B and in the cases of radar, it is directional.

4. Did you lose any UAS (drones)?

BNSF: Yes, we have lost a number of smaller drones in the earliest days of the program (smaller line of sight drones, no injuries or damage to property other than the drone). We have had various hard landings and forced system failures of our larger aircraft at our test site. No damage to people or property.

UDOT: Fortunately we haven't lost any drones in our operations.

5. What is the battery life used?

BNSF: Our small VTOL systems use lithium ion – flight times vary from 20 minutes to over 45 minutes. Our larger drones use a mix of gasoline and battery and 'life' (flight duration) is between 6-8 hours.

UDOT: Typically on our quadcopter aircraft it ranges from 20-25 minutes depending on the aircraft. On our Wingtra VTOL Fixed Wing it usually has a battery life of 40-50 minutes. All of these times can degrade due to winds, density altitude, and temperature.

6. What are the size/thickness of cracks your automated technology can detect down to? What is the accuracy when compared to manual inspection?

BNSF: Highly accurate to ¼” resolution. Our sensors are trained to see both visual and, in some cases, non-visual conditions.

UDOT: It ultimately depends on the altitude flown and the ground sampling distance achieved from the camera sensor and megapixels achieved. The higher the ground sampling distance the better it can detect the cracks. It can also depend on how well the cracks show up on the image and if there is motion blur. Typically what we have seen as well as some other studies we see a 90-95% detection rate. There are issues if there is debris or other substances on the concrete that can create false positives.

Here are links to some research completed in the area:

https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=4589&context=cee_facpub

<https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201202fa3.html>

https://www.researchgate.net/publication/281898001_Automated_Crack_Detection_on_Concrete_Bridges

7. Can you have a live stream from the camera?

BNSF: Yes.

UDOT: Yes, our aircrafts have the capability to live stream to a tablet as well as send a live stream to a remote location in a variety of formats.

8. Have you been able to determine fairly accurate rail profile geometry measurements?

BNSF: Yes - gauge, skew and changes.

9. How close does the drone fly to the structures?

BNSF: For bridges, we get within 12”.

UDOT: Depending on the winds we can fly very close to the structures. Typically we fly 10-15 feet away for safety reasons and can still see small details due to the high resolution cameras equipped on the aircraft.

10. Can we use this technology in tunnels... where light may not be sufficient?

BNSF: Yes. We have not used in tunnels, but this is possible.

UDOT: Yes, depending on the camera technology used. If you are using a RGB camera you would need to supplement it with light in order for it to capture the image. Our Albris has a flash for photos and an LED light for vides that can be turned on to light up darker areas.

11. Have you identified any gaps in the hardware of the UAVs that you feel must be addressed? e.g. payload cap/overheating/debris mitigation/etc.

BNSF: Cost is always an issue. Less cost, more use. Cost reductions will come from more entrants into the market and more use (thus expanded production of aircraft, sensors etc.).

UDOT: Overheating of tablets has been a problem for us on hot days. Typically once the aircraft is in the air we haven't had issues of them overheating. The main problem is when using a tablet it can overheat and shut down the software along with the tablet. Then it requires cooling the tablet before it can be turned back on. Luckily due to redundancy that is built in you still have control of the aircraft from the remote control.

12. Can Paul provide his e-mail address?

UDOT: pwheeler@utah.gov

13. Is there ready-to-go mapping software available?

BNSF: Yes. We use internal GIS systems and internally generated mapping and also many 3rd party apps – Bentley, Pix4D, PCC, and others.

UDOT: Yes. We use Map Pilot and Pix4D for our flights and use Pix4D, Bentley Context Capture, and Autodesk Recap 360 Pro for processing.

For more Information:

To learn more about *Railroad-DOT Mitigation Strategies (R16)*, contact Kathleen Hulbert at FHWA, Kathleen.hulbert@dot.gov; Kate Kurgan at AASHTO, kkurgan@aaashto.org; or Pam Hutton at AASHTO, phutton@aaashto.org.

[FHWA GoSHRP2 Railroad-DOT Mitigation Strategies \(R16\) Webpage:](#)

FHWA's product page includes presentations from various workshops, links to source documents, and a map showing which states are participating in the IAP program to implement *Railroad-DOT Mitigation Strategies (R16)*.

[AASHTO SHRP2 Railroad-DOT Mitigation Strategies \(R16\) Webpage:](#)

AASHTO's product page offers case studies, training modules, presentations, factsheets, reference documents, and innovation library, and a list of other states implementing the R16 product.