Promoting orderly and safe use of drones in Canada

Industry Spotlight Session

presented to RABC September 2022 quarterly meeting

Agenda

Background

Use cases example Worldwide trends on drones

What is happening in Canada?

Open issues from spectrum perspective

Background (1 of 2)

**Initial commercial and hobby Drones predominantly used Wi-Fi frequency bands (900 MHz and 2.4 GHz) due to easy access, good bandwidth over short range with minimal power** • Realized however it can suffer interference from other Wi-Fi devices

**Request for clearer video over further distances lead to use of Wi-Fi 5.8 GHz frequency range, which provided more reliable video and command and control links, due to frequency hoping and dual transmission for distances over 7km (in open terrain) on even small hobby drones.**

**With the advent of increased permissions for drones to fly further (BVLOS[[1]](#footnote-1)), many efforts spent on increasing range**

* Signal boosters (increased strength but not within regulations)
* Directional antennas (tracking the drone has proved to be too limiting)
* Mesh network (to much prep work required)
* Satellite connectivity (but the latency and cost make this impractical)
* Relay between drones (battery life makes this limiting)
* Private networks (5G network feature such as slicing are not readily available)
* COW (Cell On Wheels, cell on tethered drone in this case, can work but is slow to set up and requires shore power)

Background (2 of 2)

**Led to use of cellular bands as the likely long-term solution since**

* Networks cover much of the country
* Provide sufficient bandwidth
* However, connectivity issue to be resolved as drones are not always on base station antenna’s main lobe

**It should be noted that another important type of unmanned “device”, although less discussed, is ground robots for applications such as delivery, street cleaning, security and many more uses to be developed, requiring reliable command and control and video transmission ability**

* However, these are expected to be mainly operating on the ground and in cities, which could be handled as traditional “devices”

# ÓTherefore, it will not be covered in this deck

Use cases examples

* **Public safety (e.g. disaster relief and real time emergency awareness situation)**
* **Health care (e.g. delivery of essential goods (such as medicaments) in difficult to reach areas)**
* **Tele-Operations Solutions**
* Infrastructure inspection (allowing an engineer or pilot at their desk to activate a drone on site many km away to carry out inspection of bridge, building, tower, etc.)
* Autonomous drones inventory management (warehouse inventory, factory items’ tracking, pits and piles)
* **Commercial (e.g. Oil & Gas, Mining, Utilities, Retail)**
* **Rogue drone detections & UTM (Unmanned Traffic Management)**
* **Drones as flying COW for specific applications**

Worldwide trends on drones (1 of 4)

**Trends from forums and associations**

* GSMA DIG (Drones Interest group) Ø Most recent trials outcomes[[2]](#footnote-2)
* Different spectrum environment for drones versus terrestrial devices
* Taking into account changes in radio coverage due to signal received from antenna sidelobes
* Importance to develop solution so drones can optimize performance according to operator’s network
* Cellular foreseen as the most suitable technology, especially for BVLOS applications
* Consideration of lower bands for control and mmwave for traffic due to its higher capacity, when possible
* Current focus is on 4G and 5G NSA (pilot with 5G SA is ongoing which should improve latency)
* Lawful intercept issue (e.g. rogue detection)
* GUTMA (Global Unmanned Traffic Management Association)[[3]](#footnote-3) and ACJA (Aerial Connectivity Joint

Activity)[[4]](#footnote-4) are also working on optimizing drones’ applications, which could impact use of spectrum

Worldwide trends on drones (2 of 4)

**Trends on standards (1 of 2)**

* 3GPP
* Initial specs on basic functionality and connectivity in Release 15 (Q3 2019)
* Progress on UAV (Uncrewed Aerial Vehicle) specifications on hold in Releases 16 and 17 due to focus on enhancements to 5G-based NR specifications
* Work items secured for Release 18 (RP-213600) with targeted completion in December 2023
* Focus will be on enhancements to UAV capabilities, as well as signaling/reporting
* Work item (WI) on subscription and measurements report
* Study item (SI) on ID broadcasting (also referred as remote ID), due to FAA rule and beamforming capability (bring work in FR2 into FR1)[[5]](#footnote-5)
* There is also ongoing activity on “Location Services for Drones”, related to regulatory requirements, such as lawful interception

Worldwide trends on drones (3 of 4)

**Trends on standards (2 of 2)**

* ITU-R
* Report ITU-R M.2441 “Emerging usage of the terrestrial component of International Mobile Telecommunication (IMT)” was published in November 2018, highlighting potential use for many diverse UAS applications
* Report ITU-R SM-2486-0 “Use of commercial drones for ITU-R spectrum monitoring tasks” was published in June 2021 with focus on LOS[[6]](#footnote-6) spectrum monitoring and measurements’ applications within a country when ground-based monitoring and measurements are either difficult or unsafe Ø ITU-R WP5B[[7]](#footnote-7) is the expert group for aeronautical mobile service, carrying out studies and developing Recommendations related to aeronautical applications such as unmanned aircraft systems (UAS)
* At this time, the only work within WP5B on UAS is related to use of 5030-5091 MHz for control and non-payload communications links

Worldwide trends on drones (4 of 4)

**Trends from Regulators**

* OFCOM
* Consultation on proposed approach to authorize use of radio equipment on UAS (closing on

September 5, 2022), introducing new drone operator’s spectrum license, especially for BVLOS

* U.S.
* FAA published rules [(link](https://www.faa.gov/sites/faa.gov/files/2021-08/RemoteID_Final_Rule.pdf)) requiring UAS (Unmanned Aircraft Systems) to broadcast remote ID information with compliance deadline for drone manufacturers (September 16, 2022) and operators (September 16, 2023)
* FAA BVLOS Aviation Rule Making Committee (ARC) completed, July 2021 – Feb 2022
* Transport Canada
* Regulations amending the Canadian Aviation Regulations (Remotely piloted aircraft systems – Lower risk – Beyond visual line-of-sight)
* The proposed regulatory changes would seek to enable routine visual line-of-sight operations with larger remotely piloted aircraft systems (RPAS), meaning drones above 25 kg[[8]](#footnote-8), as well as routine lower risk beyond visual line-of-sight operations without the requirement to obtain a Special Flight Operations Certificate. Examples include low-level operations in uncontrolled airspace and outside of population centres. They include new requirements related to pilot certification, airworthiness, and procedural requirements

What is happening in Canada (1 of 2)?

**Transport Canada** is at the forefront of ensuring the safe adoption of drone technology:

* Dedicated task force actively involved with industry and government working groups in Canada and internationally, to ensure integration of best practices allowing industry to grow while ensuring safe airspace for all users
* Give industry permission to carry out trials of BVLOS technology; Provided more permissions for BVLOS missions than in the entire U.S.
* Adopting international JARUS SORA risk modeling
* Providing clear guidelines for future permissions
* NAV Drone is the only app that lets you safely and legally request permission to fly a drone in airspace controlled by **NAV CANADA**

What is happening in Canada (2 of 2)?

**UBC Mini-Cities** 5G Research Program - Leverage UBC’s campus as a living lab concept to demonstrate 5G enabled RPAS missions & UTM systems in urban and rural environments in collaboration with **Rogers**, InDro Robotics, Canada post and Honeywell; Investigate last-mile zero-emissions UAVs for parcel delivery comparing battery and fuel cell-powered UAVs

**Healthcare & Organ transplant delivery by Drone** - Ultimate goal is for drones to fly long-range to deliver organs, blood, etc. to a patient in need; Montreal Blood bank carried out delivery of blood from the blood bank to Montreal General Hospital3; also a lung was transported via drone from Toronto Western Hospital to Toronto General Hospital and implanted in a patient4.

**Ontario Center of Innovation NERD (Network Enhanced Real Time Drones) Research Program** – OCI funded research (InDro & Ericsson) into a drone that can fly over 3/4/5G and transmit near zero latency 4k video back to servers, whilst scanning for best cell signal and monitoring interference.

**Bell** announces development to support Beyond Visual Line of Sight, Command and Control (C2), Remote Identification (Remote ID), and Unmanned Aerial System Traffic Management (UTM), based on 5G and Multi-access Edge Compute (MEC) for autonomous drone performance1.

**Telus** is funding advancements in orchestration of autonomous robotics, including drones; also evaluating technology, standards and operating concepts for RPAS Remote ID & UTM 2

Canada is leading the way in providing extended permissions for emerging drone technology

[1BELL for 5G & MEC initiative for dron](https://www.newswire.ca/news-releases/drone-delivery-canada-announces-collaboration-with-bell-for-5g-and-multi-edge-computing-initiatives-for-drones-843907769.html)es[; 2Connecting people by driving innovation -](https://www.telus.com/en/ventures/news/unmanned-9-november) [About | Telus Ventur](https://www.telus.com/en/ventures/news/unmanned-9-november)es

[3InDro Robotics completes blood delivery trial in Montreal -](https://skiesmag.com/press-releases/indro-robotics-completes-blood-delivery-trial-in-montreal/) [Skies M](https://skiesmag.com/press-releases/indro-robotics-completes-blood-delivery-trial-in-montreal/)ag[; 4Special drone delivery: The world-renowned Canadian taking organ transplants to new heights | Globalnews.c](https://globalnews.ca/news/8583562/drone-delivery-organ-transplants-canadian/)a

Promoting growth in Canada’s drone sector

* According to report from Ontario Society of Professional Engineers[[9]](#footnote-9)
* Canadian governments has prioritized advanced R&D and created many regulations that enable the adoption of drones
* Drone services could benefit industries that contribute over $600 billion to our national GDP
* There is a widely untapped potential in providing drone services for infrastructure and utilities ($220 billion market), natural resource industries ($144 billion market), construction & heavy industry ($143 billion market), agricultural industry ($40 billion market), as well as a host of other industries such as public safety, insurance and media
* Advances in camera sensors, LiDAR[[10]](#footnote-10), and the development of robust data analysis and machine learning (ML), artificial intelligence (AI), & Computer Vision to provide data only obtainable from the sky, creating new value for Canadian businesses
* A new industry of automated aerial operations is emerging, and with most key technologies already mature, there remains a significant gap in Drone commercialization
* Drones are currently not fully integrated into the national airspace, a difficult undertaking requiring advances in technology, infrastructure and greater harmonization between key industry stakeholders

Canada can actively participate in accelerating the commercialization of Drone deliveries, inspections, and automation in this emerging global industry 12

Open issues from spectrum perspective (1 of 5)

Overview

**Foreseen open issues:**

1. **LOS versus BVLOS**
2. **Service reliability and bandwidth**
3. **Access network**
4. **Lawful intercept**

Open issues from spectrum perspective (2 of 5)

LOS versus BVLOS

* Extended communications and increased bandwidth is required to realize full potential for LOS (short range flights) and essential for BVLOS (longer range flights)
* The ability for a first responder to provide livestream drone video over cellular back to the incident command many km away is a perfect example of the need for long range communications even in the LOS environment
* Similarly, an inspection of a bridge or other infrastructure by a drone pilot on the scene can benefit greatly by the ability to hand over control of the camera payload to an engineer back in the office whose skills can better assess the damage

►As the uses for drones mature from simple on site piloting to the essential (safety and commercially wise) collecting of timely data that needs to be shared with users not physically located on site ü Operations will require low latency, robust, high bandwidth communications, which can be all supported by cellular.

Open issues from spectrum perspective (3 of 5)

Service reliability and bandwidth

**Reliability**

* Current trend is to explore use of two frequency bands for drone solutions where possible, to provide redundant systems
* Also considering allocating different spectrum bands for command & control and traffic

**Bandwidth**

* Important for drones to provide sufficiently detailed and accurate information to support applications
* Consideration of 5G to convey such information (e.g. video and/or data transmission)

Open issues from spectrum perspective (4 of 5)

Access network

**Support of “except aeronautical mobile” for mobile service allocation**

* Need to ensure spectrum rules are in place identifying which frequency bands can be used to provide service to drones

**Antenna pattern sidelobe**

* Current networks optimized for end devices on the ground
* Need to find ways to support use of drones without impacting service to end device on the ground (e.g. beamforming)

**Support of multiple frequency bands**

* Consideration of different bands for command and control and traffic

Open issues from spectrum perspective (5 of 5)

Lawful Intercept

While drones can be used to enhance public safety, they can also be used for more nefarious or illicit activities, in a terrorist event, or an attack against critical infrastructure

Drone and network vendors and operators will need to work with public safety organizations and law enforcement agencies to ensure that technologies and regulatory frameworks are in place to support appropriate lawful intercept and interdiction of rogue drones

Standards and protocols are underway within some international standards bodies but further developments will be needed in this area

Lawful intercept requirement will have impact at least on providing accurate location of drones to public safety agencies, which involve access network

What is needed to maintain Canada’s leadership in this industry

1. Sustained worldwide trends on growing interest for drones from business, SDO and regulators
2. Canadians can benefit from use of drone for their safety, their health and the economy
3. Canada is involved into increasing efficient and safe use of drones
4. As cellular is becoming THE technology for drones’ optimal use, it is seen as important that rules are put in place to support it
5. RABC, thanks to its very diverse membership, can play a role in providing guidance to ISED in developing support this from spectrum perspective
6. Consideration should be given to create a group in RABC to provide such guidance

1. BVLOS stands for “Beyond Visual Line-of-Sight” [↑](#footnote-ref-1)
2. [GSMA | GSMA Drone Interest Group –](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/) [Deep Dive #1 –](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/) [How cellular networks are capable to handle the UAV layer | Internet of Things; GSMA | GSMA Dron](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/)e [Interest Group -](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/) [Deep Dive #2 -](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/) [5G Autonomous Drones | Internet of Things](https://www.gsma.com/iot/resources/gsma-drone-interest-group-deep-dive-2-5g-autonomous-drones/) [↑](#footnote-ref-2)
3. GUTMA goal is to foster “global ecosystem in a fair global drone services market”, while ensuring drone operations at all altitudes are safe and efficient [↑](#footnote-ref-3)
4. AJCA is a joint GSMA and GUTMA initiative to build communication and cooperation between the aviation and mobile industries [↑](#footnote-ref-4)
5. These are terms used by 3GPP where currently FR1 refers to frequency bands between 410 MHz 7125 MHz and FR2 refers to frequency bands between 24.25 and 52.6 GHz [↑](#footnote-ref-5)
6. LOS stands for “Line-of-Sight” [↑](#footnote-ref-6)
7. ITU-R WP5B is the expert group, among other things, on aeronautical mobile service [↑](#footnote-ref-7)
8. There is relevance to speed that Transport Canada expresses in KJoules of energy, used to calculate safety on drones over 25kg, which involves weight and size [↑](#footnote-ref-8)
9. [Growing-the-Drone-Industry-in-Ontario.pdf (ospe.on.c](https://ospe.on.ca/wp-content/uploads/2020/03/Growing-the-Drone-Industry-in-Ontario.pdf)a) [↑](#footnote-ref-9)
10. LiDAR stands for “Light Detection and Ranging” and is remote sensing method that uses pulsed laser to assist in generating precise, three-dimensional information about the shape of the Earth and its surface characteristics [↑](#footnote-ref-10)