SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

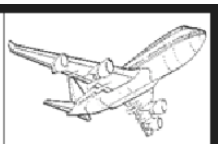
COIMBATORE-35

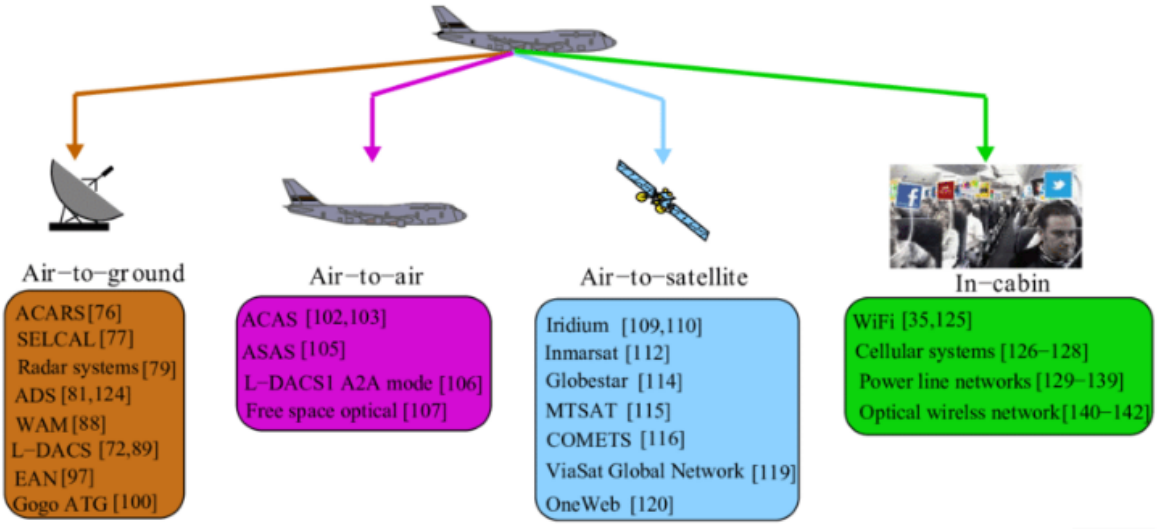
DEPARTMENT OF AEROSPACE ENGINEERING

Course: 19ASB303-Aircraft Maintenance Engineering

UNIT II - Ground Servicing of Various Sub Systems

UNIT II: U2 LP01: Autonomous Aircraft, Communication systems *in Aircraft Maintenance*

	 Terrestrial cellular	 Balloon/Airship	 Rotary–wing quadcopter	 Fixed–wing glider/aircraft	 Civil Aviation
Altitude	Ground–level	Low/High (e.g. below 1200 ft/365 m or above 59000 ft/18 km)	Low (e.g. up to 400 ft/120 m without licensing)	Low → High (e.g. from near–ground to stratospace)	High (e.g. up to 59000 ft/18 km below stratospace)
Speed	Low (e.g. up to 310 mph/500 kmh for high–speed train)	Low (near static)	Low (e.g. up to 100 mph/160 kmh)	Low → High (e.g. may even exceed speed of sound 741 mph/1192 kmh)	High (e.g. generally under speed of sound 741 mph/1192 kmh)
Dynamic Maneuver	Low	Low	High	High	High
LOS Strength	Low	High	High	High	High
Terrain Shadowing	High	Low	High for near–ground	High for near–ground	Low
Multipath fading	High	Low	High for near–ground	High for near–ground	High during taxiing, taking–off, landing
Airframe Shadowing (During Maneuver)	None	None	High for maneuver	High for maneuver	Low for gentle maneuver
Doppler Frequency (Normalized by Symbol Rate)	Low	Low	High for control link	High for control link	High



Communication systems and techniques.

Autonomous aircraft, also known as unmanned aerial vehicles (UAVs) or drones, have been in development for several decades, but recent advances in technology have made them more viable for commercial and military applications. These aircraft can be programmed to fly without a pilot and can perform a wide range of tasks, including surveillance, inspection, and delivery.

One of the key challenges in developing autonomous aircraft is ensuring reliable communication between the aircraft and the ground control station. This communication is critical for controlling the aircraft, receiving data from sensors, and providing situational awareness to operators. There are several communication systems used in autonomous aircraft, including satellite communication, cellular communication, and radio communication.

Satellite communication is the most reliable method of communication for autonomous aircraft, as it provides global coverage and is not affected by terrain or weather conditions. However, it can be expensive and may require specialized equipment. Cellular communication can provide reliable communication in areas with cellular coverage, but it may not be available in remote or rural areas. Radio communication is another option, but it has limited range and can be affected by interference.

In addition to communication systems, maintenance of autonomous aircraft is also critical for their safe operation. Communication systems play a key role in aircraft maintenance, as they allow for real-time monitoring of the aircraft's performance and health. This data can be used to detect potential issues and schedule maintenance before a failure occurs.

Autonomous aircraft may also have specialized maintenance needs, such as software updates and sensor calibration. These tasks may be performed remotely, but they still require skilled technicians and reliable communication systems. In some cases, autonomous aircraft may require specialized maintenance equipment or facilities, which can add to the cost of operation.

In conclusion, communication systems play a critical role in the safe operation and maintenance of autonomous aircraft. The choice of communication system depends on factors such as the operating environment, cost, and reliability requirements. As autonomous aircraft become more widespread, it will be important to develop standards and best practices for their maintenance and operation to ensure their safe and efficient use.

1. *i.Air Traffic Control System*

This is a system rendered between the Air Traffic Control Institutions and the aircraft to secure the safety and the mobility of aircraft by providing ground navigation or advice, information about aircraft and the airport weather condition.

- *VHF Cordless Telephone, HF Cordless Telephone*
- *Air Route Surveillance Radar (ARSR), Airport Surveillance Radar (ASR), Secondary Surveillance Radar (SSR)*

2. *ii.Air Control Communication System*

This is a communication system that the airline companies use for determining aircraft position to secure the navigation of their proprietary aircrafts.

- *Cordless telephone by way of VHF, HF, and Inmarsat Satellite Communications*
- *Data Transmission by way of VHF and Inmarsat Satellite Communications*

3. *iii.Aircraft Telephone*

This is an on-board public telephone service that aircraft passengers use to communicate.
Now, the satellite communication telephone service which went via the Inmarsat satellite.

4. *iv.Radio Navigation System*

This is a radio navigation system that the navigating aircraft uses to detect its position.

- *VOR/DME, NDB, TACAN*

Furthermore, the development of a satellite navigation system utilizing GPS has been in progress.

5. *v.Aircraft Landing System*

This is a system used for navigating the aircraft by radio waves onto the airport for its landing in safety.

- *Instrument Landing System (ILS)*
- *Landing Navigation by iv. Radio Navigation System*

Furthermore, as a satellite navigation system by GPS has been more popular, the development of a system that utilizes it has been in progress.

6. *vi.Aircraft-loaded Radio Equipment*

There are different kinds of radio equipment loaded on the aircraft, while their two main targets are for navigation and communication.

- *Navigation Equipment*
  VOP/DME, ATC Transponder, Weather Radar, Radio Altimeter, Rescue Radio, ILS Receiver, ADF Receiver
- *Communication Equipment*
  VHF/HF/Inmarsat Satellite Cordless Telephone, VHF/Inmarsat Satellite Data Transmission, Aircraft Telephone

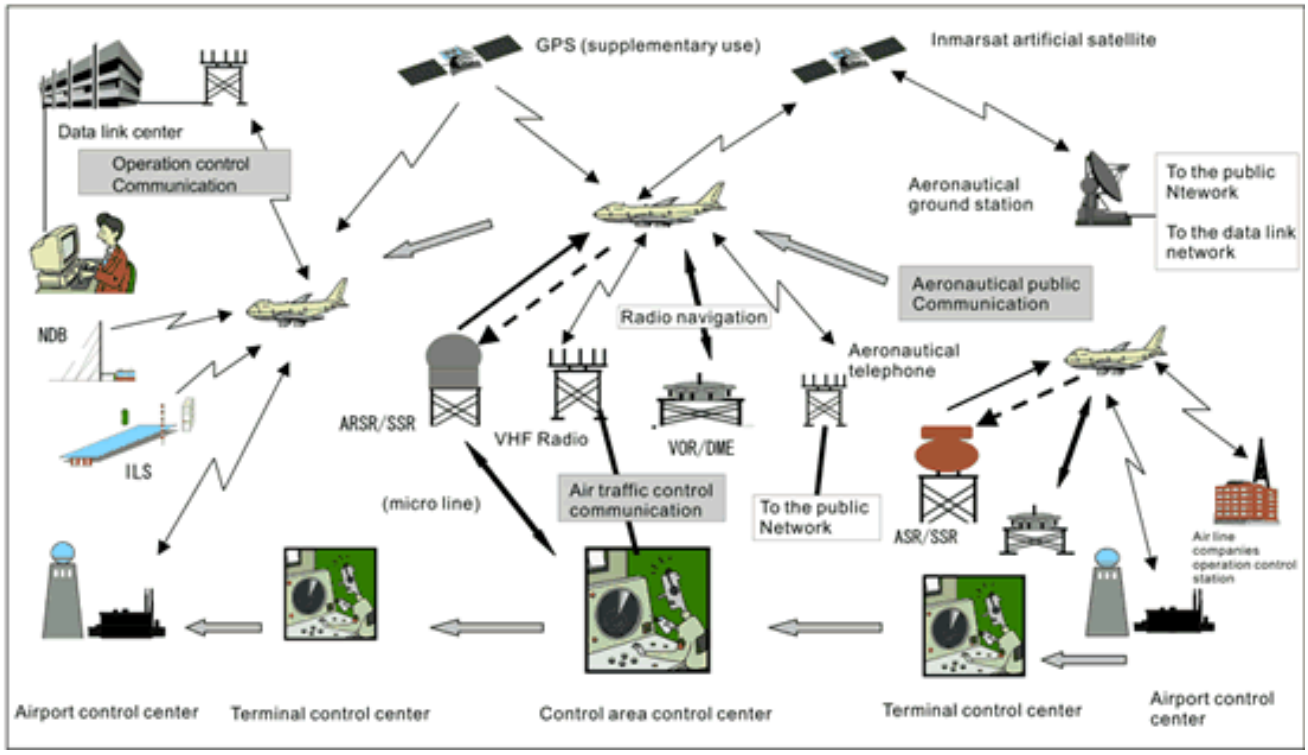


Figure: Concept Diagram of Aircraft Communication

2.Aircraft Communication Type

Aircraft Communication	***Communication***	***Air Traffic Control (ATC) –› VHF Cordless Telephone, HF Cordless Telephone*** ***This is a communication rendered by the air traffic control institutions to the aircraft to secure the safety and mobility of the air traffic.***
		Aeronautical Operational Control (AOC) –› VHF Cordless Telephone, VHF Open Space Datalink, etc. ***This is communication by the aircraft pilot for normal navigation and so forth.***

		Aeronautical Administrative Communications (AAC) –› VHF Open Space Datalink and so forth ***This is business-use communication for airline companies, etc.***
	Navigation	***Radio Navigation –› VOR, DME, TACAN, NDB*** ***This is communication for receiving response radio waves and catching information such as directions or distance by receiving ground radio waves or emitting request radio waves from onboard.***
		Satellite Navigation –› GPS ***This is communication to receive radio wave from multiple artificial satellites and catch 3D position.***
	Surveillance	***Ground Surveillance –› ASR, SSR, ARSR, ORSR*** ***This is communication to determine the position of the aircraft by the ground radar.***
		Automatic Dependent Surveillance –› Communicate the position data by GPS, etc. by Inmarsat, MTSAT, etc. ***This is communication to attain navigation data automatically without any human intervention, based upon the navigation data from the aircraft.***
		Cooperative Information Systems –› Development in progress. ***This is communication to attain 3D position data automatically without any human intervention by using multiple positioning satellites.***

Table: Aircraft Communication Type

	International	***Domestic***
October, 1919	***The "Treaty regarding Aircraft Law" is signed. The International Aircraft Committee (a permanent organization of the***	

	International	*Domestic*
	International Federation) is founded.	
1929		***The Aircraft Communication Work starts. (The medium wave radio telegraph is set in use.)***
1941		***The operation of the radio beacons starts. (The medium wave radio beacon station)***
1945		***The operation, manufacturing, or research of the civil aircraft is banned by the GHQ memorandum.***
June, 1950	***The "Instrument Landing System (ILS)" is adopted as the ICAO International Standard.***	***The "Domestic Transportation " is promulgated and the domestic aircraft transportation is re-started. (The JAL "The Jupiter" commemorates the first flight between Haneda and Fukuoka in October, 1951.)***
July, 1959		***The Air Route Control Right is transferred from the US Army to Japan.***
1977	***ARINC starts the VHF Open Space Datalink Service in the North American continent.***	
1985	***The Insarmat Treaty Amendment***	

	International	*Domestic*
	is adopted. (The Insarmat Satellite Communication Service is introduced into the aircraft.)	
April, 1990 December, 1990		***The VHF Open Space Datalink Service starts. The Insarmat Satellite Communication Service starts.***

Reference: History of Aircraft Communication