Technology Transfer and Capability Building in GNSS for Airspace Modernization in Nepal

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Agenda

- DLR GfR AirMeetsSpace Programme
- Nepalese Airspace: Scenario, Demands, and GNSS Application
- Technology Transfer and Capability Building
- International Collaboration
- Conclusion and Recommendation

DLR GfR: Combining Air & Space Know How

- DLR GfR (est. 2008) is a subsidiary of the German Aerospace Center (DLR) with headquarters at the DLR site Oberpfaffenhofen/Munich
- Responsible for operational safety of the Galileo satellites and the control center
- Exploration of topics in space traffic management under European Space Agency (ESA) study
- DLR GfR holds an Air Navigation Service Provider (ANSP) certificate, being the first space control center worldwide to do so
- Joint proposal (with AustroControl) for Airspace Modernization and Performance Based Navigation (PBN) development in **Nepal** (study cancelled due to procedural and economic constraint)

Nepalese Airspace Scenario, Demands and GNSS Potentials

- Importance in landlocked and mountainous country
- Diverse geographical features and difficult terrains
- Airspace limited to Southern Region

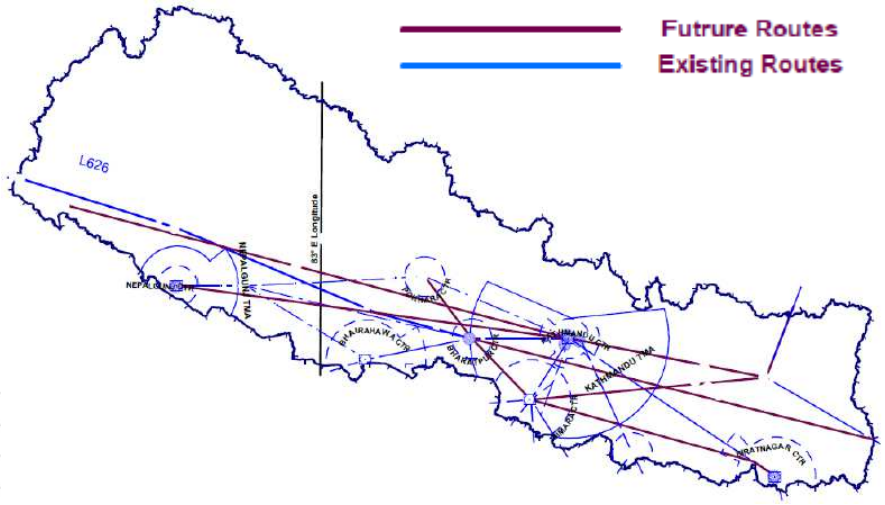

Figure 1. Airspace Routes

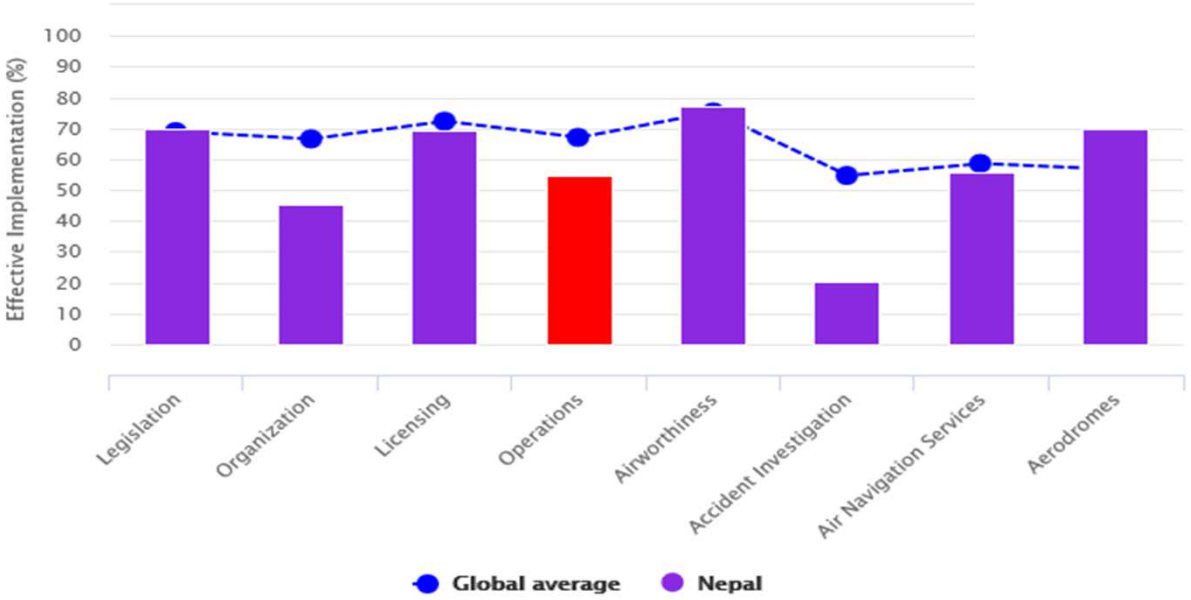

Figure 2. ICAO Safety Oversight audit result 2016

- Operational infrastructure and aviation safety main concerns
- GNSS as a foundation to address these issues.

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GNSS Application

- Performance Based Navigation (PBN) Roadmap (2012-2025)
- Required Navigation Performance Authorization Required (RNP AR) Approach Procedure at Tribhuvan International Airport (TIA) since 2012

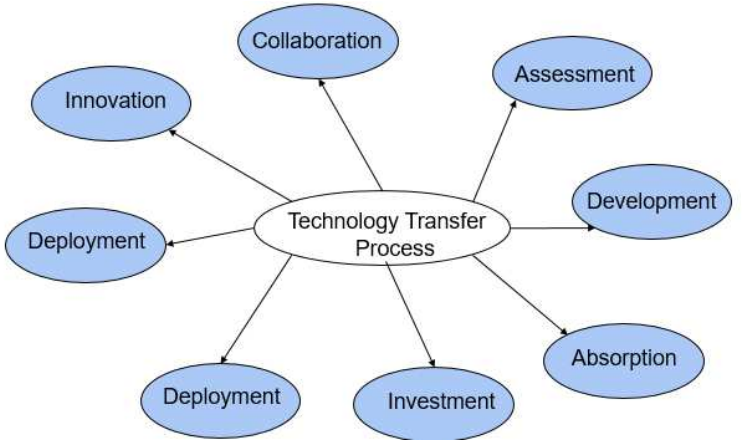
Realized benefits from RNP AR approach procedure at TIA

- Required airport runway visibility reduced from 2800 m (VOR/DME) to 900 m
- Reduction in traffic congestion and flight diversion
- Better accuracy, integrity and reliability
- Economic benefits (reduction in flight time and fuel consumption)

Implementation of RNP approach procedure at other major airports in process!!

Technology Transfer (Know-how) and Capability Building

- Technology learning to gradually move from conventional nav aids to GNSS
- The progress has been slow in the absence of National Innovative System
- Weak technology absorptive capacity
- Issues of technology leap-frog?? Example: GNSS based RNP AR APCH implemented with technical assistance from foreign firm but not enough technology learning in GNSS



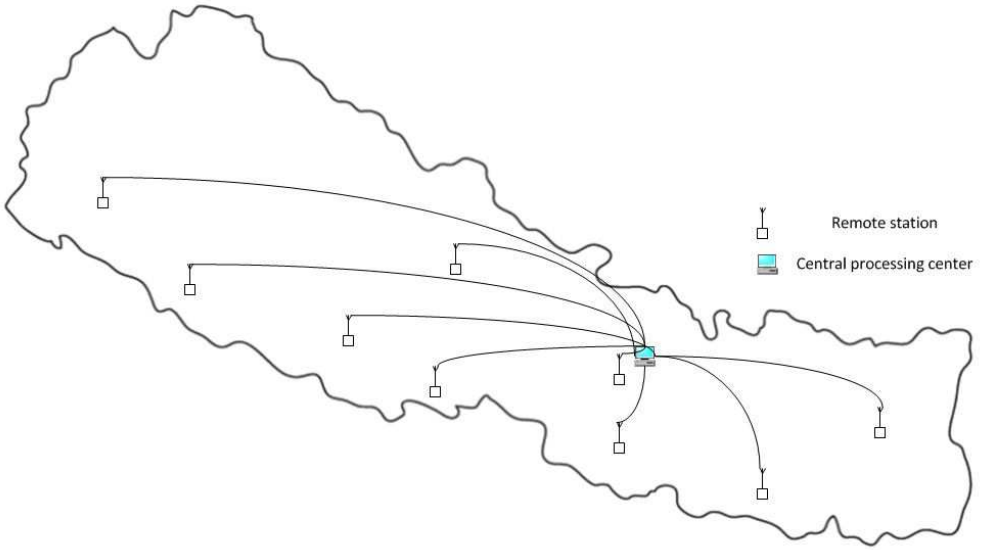
There needs a balance between technology transfer and technology learning!!

Technology learning: GNSS Information Monitoring System

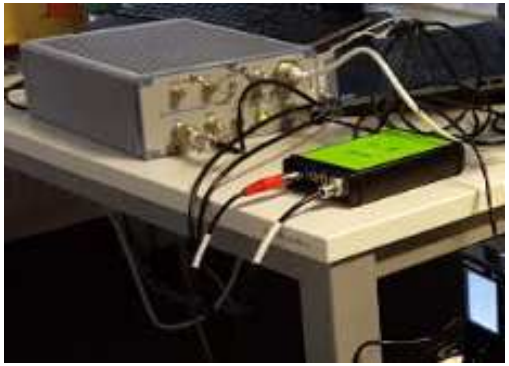
- Allows the state to comply with ICAO requirements – Annex 10

"monitoring and recording of GNSS Information"

- ICAO guidance for "monitoring of GNSS radio frequency interference"

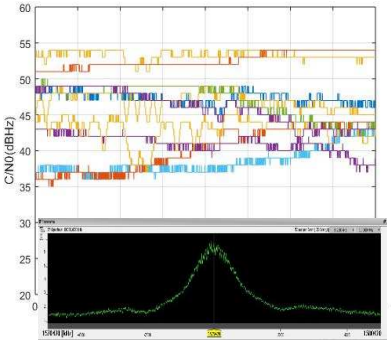


Remote monitoring station



Integrated interference monitoring system

Performance assessment



Signal quality & interference

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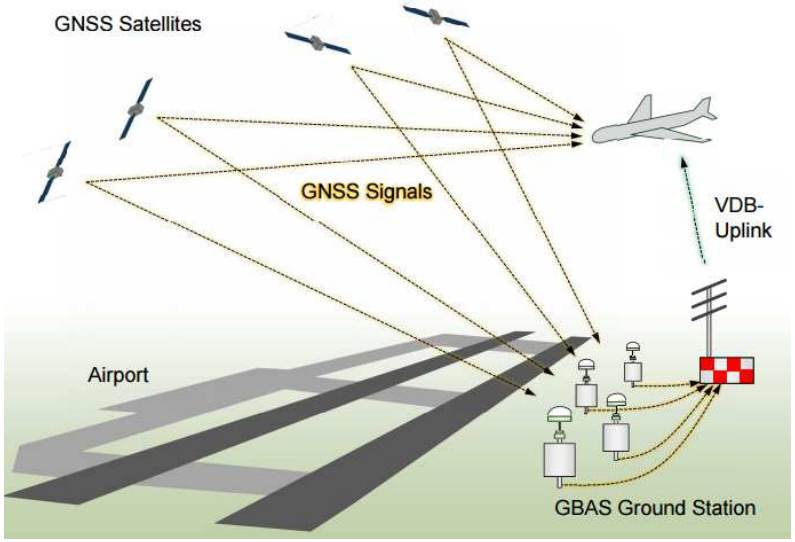
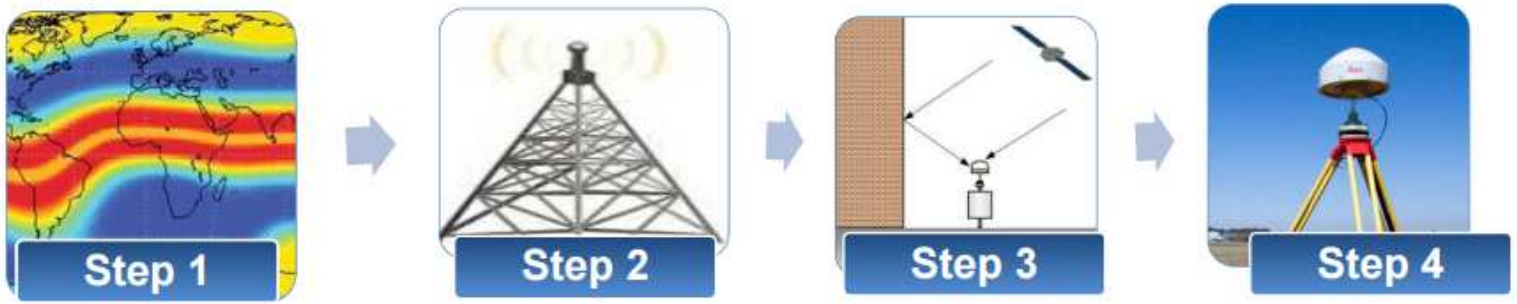
Technology learning: GNSS Augmentation System



- Ground based augmentation system (GBAS)
- Precision approach and landing
- Extension to nation wide augmentation system
- Data available as a CORS network

Feasibility Study



Technology learning: Challenges of drone operation

Drone related incidents increasing in Kathmandu
(The international airport is very close to the city)

Technology	Regulations	Acceptance
• Optimization of flight path over long distance Beyond Visual Line of sight (BVLOS) • Availability and reliability	• Airworthiness • Airspace integration • Public and environmental safety	• Safe operation • Low noise level • Accepted use case (huge potential in remote health care) • Privacy policy

Necessity of drone identification and reporting system

- Radio communication link monitoring
- Monitoring fence around the protected zones

Technology learning: Automatic Data Surveillance Broadcast System (ADS-B)

- RADAR surveillance coverage limited in mountainous regions of Nepal
- ADS-B ground station feasibility study envisaged in Nepal by CAAN

Fig. 3: Space based ADS-B
Source: ADS-B Technologies

Based on GNSS

Nr.	ICAO24	Regist.	Ident	Alt	Lat	Long	Speed	Head.	Climb	Type	T-out
2	4692D0	SX-DVP	AEE34	35000						A321	23 M
1	424258	VP-BME	AFL2390	32000	47.84	11.23	399	261		A320	11
0	461E1F	OH-LKP		39000						E190	0

Fig. 4: ADS-B ground station (at DLR GfR, Munich) tracking aircraft

Regional and International Collaboration

- Collaboration in GNSS for Aviation nonexistence
- Utilize the regional CORS newtwork
- Potential of GNSS technical assistance project through ICAO SAFE Fund (e.g. Support from Germany, ICG and UNOOSA)
- Continuous support from Asian Development Bank, Government of Japan and other nations.

ADB

Conclusion and Recommendations

- GNSS is becoming the key capacity for Airspace modernization
- Technology transfer for the successful GNSS implementation
- GNSS Information Monitoring and Recording System a good learning step
- Drone a real threat to civil aviation
- Active cooperation and collaboration inevitable
- Potential of ICAO SAFE Fund to strengthen safety oversight

Thank you for your attention!!!