SAFELAND
Final Dissemination Event
Concept of Operations

Barcelona
19 October, 2022
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EUROPEAN PARTNERSHIP

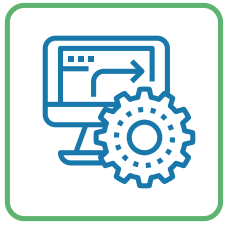
Co-funded by
the European Union

Concept Development

Three implementation options

ATCO Focused: most of the single pilot tasks are assigned to the Air traffic controller

GSP Focused: most of the single pilot tasks are assigned to the Ground Station Pilot



Automation Focused: most of the single pilot tasks are assigned to the cockpit automation

Concept Refinement

Validation Steps towards Final SAFELAND concept

- Development of OESD and Function Allocation Chart (SOCA-CAT) per options
- Advisory Board workshop gathering feedback
- Low Fidelity Simulation for evaluation Ground Station Operator and Procedures
- Refinement of Concept based on feedbacks collected

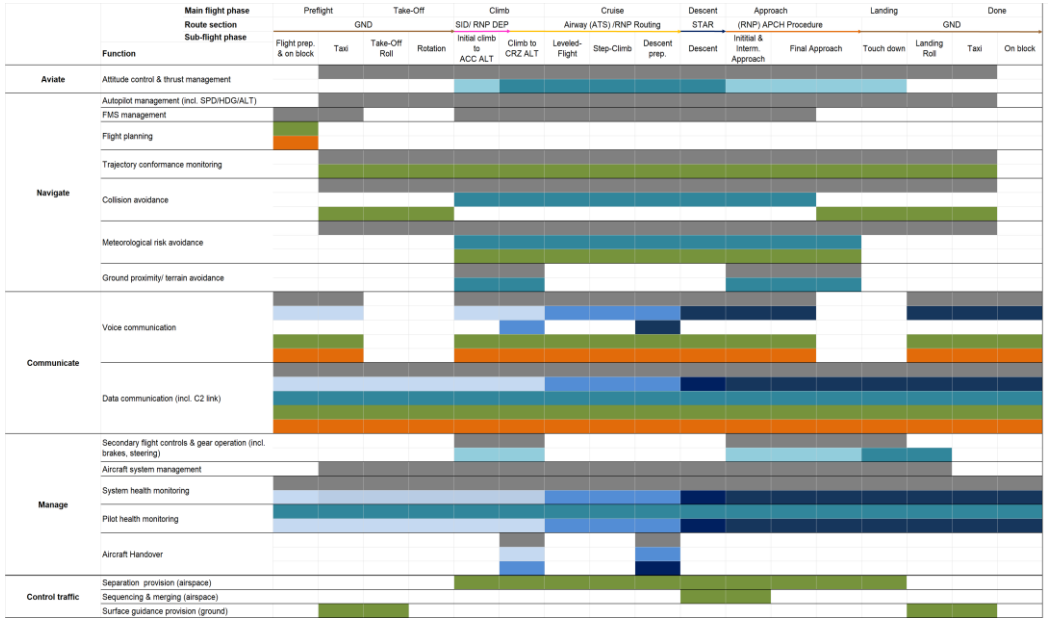


Fig.: Function allocation

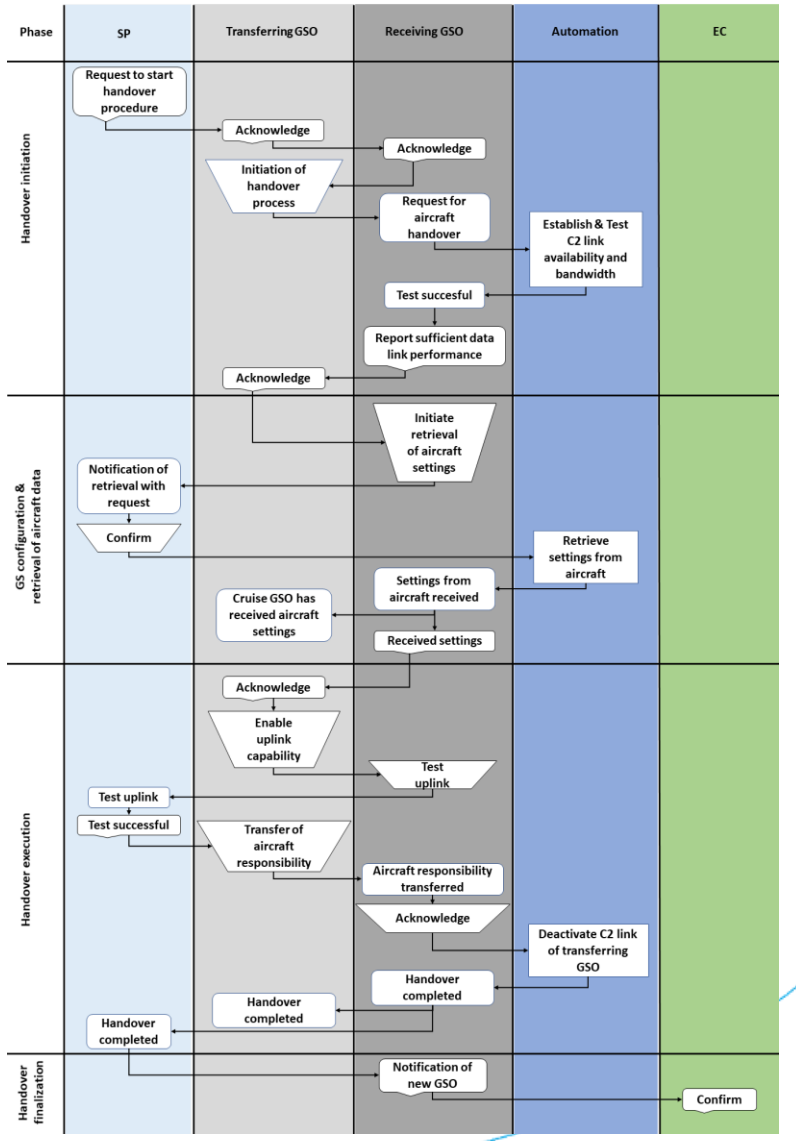
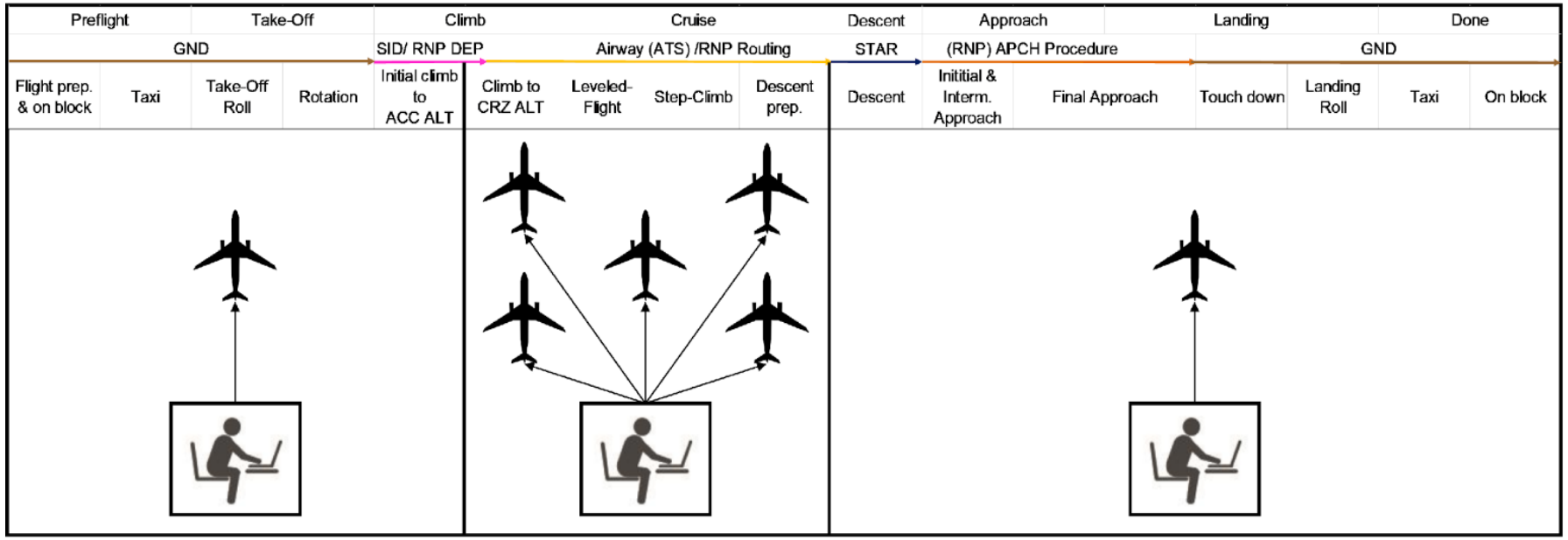


Fig.: OESD – Handover process

Nominal Operational Concept

The presence of three different kinds of ground stations (GS) is assumed for SPO:

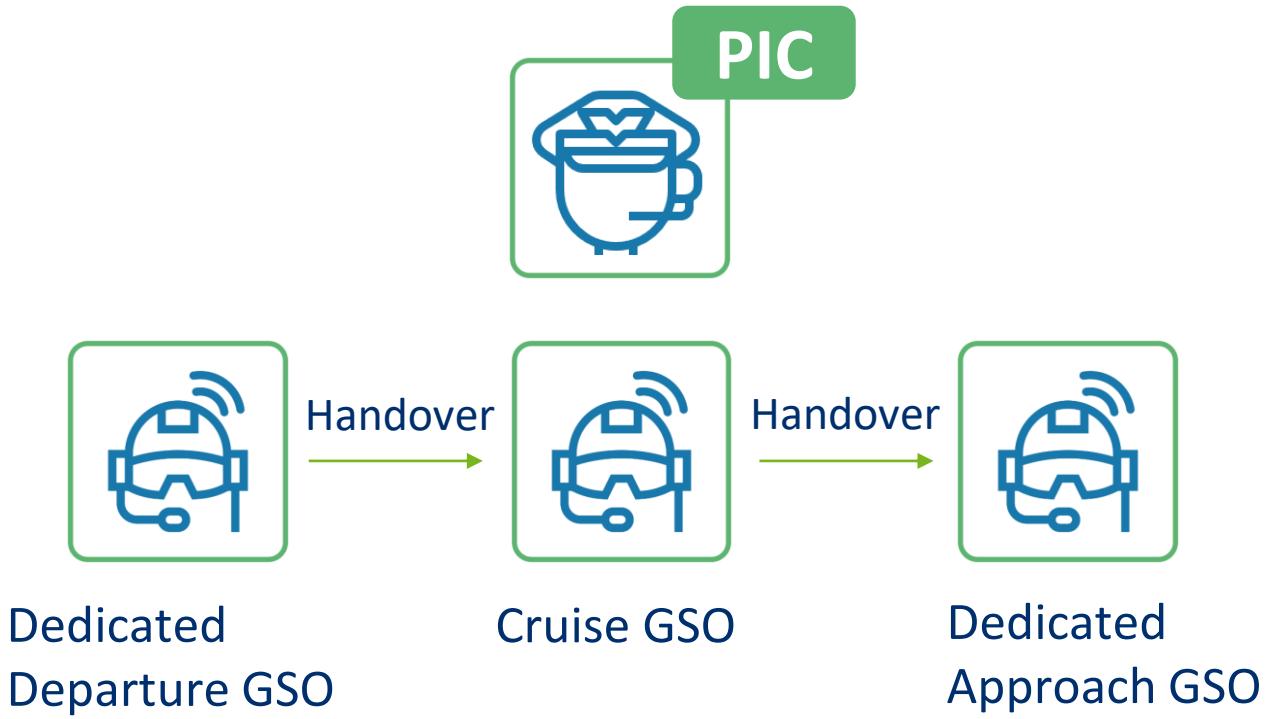
- Departure GS – the GSO supports one single pilot
- Cruise GS – the GSO supports multiple single-piloted aircraft simultaneously
- Approach GS – the GSO supports one single pilot



Nominal Operational Concept

Simplified operational concept for SPO

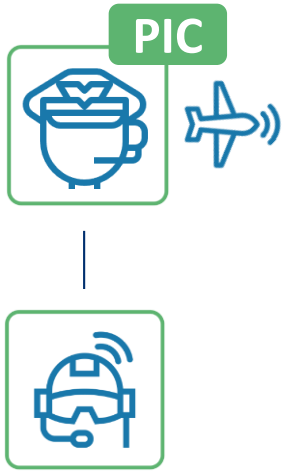
Aircraft pilot always in control



GSO mostly monitoring duties

Non-nominal Operational Concept

Pilot Incapacitation in TMA

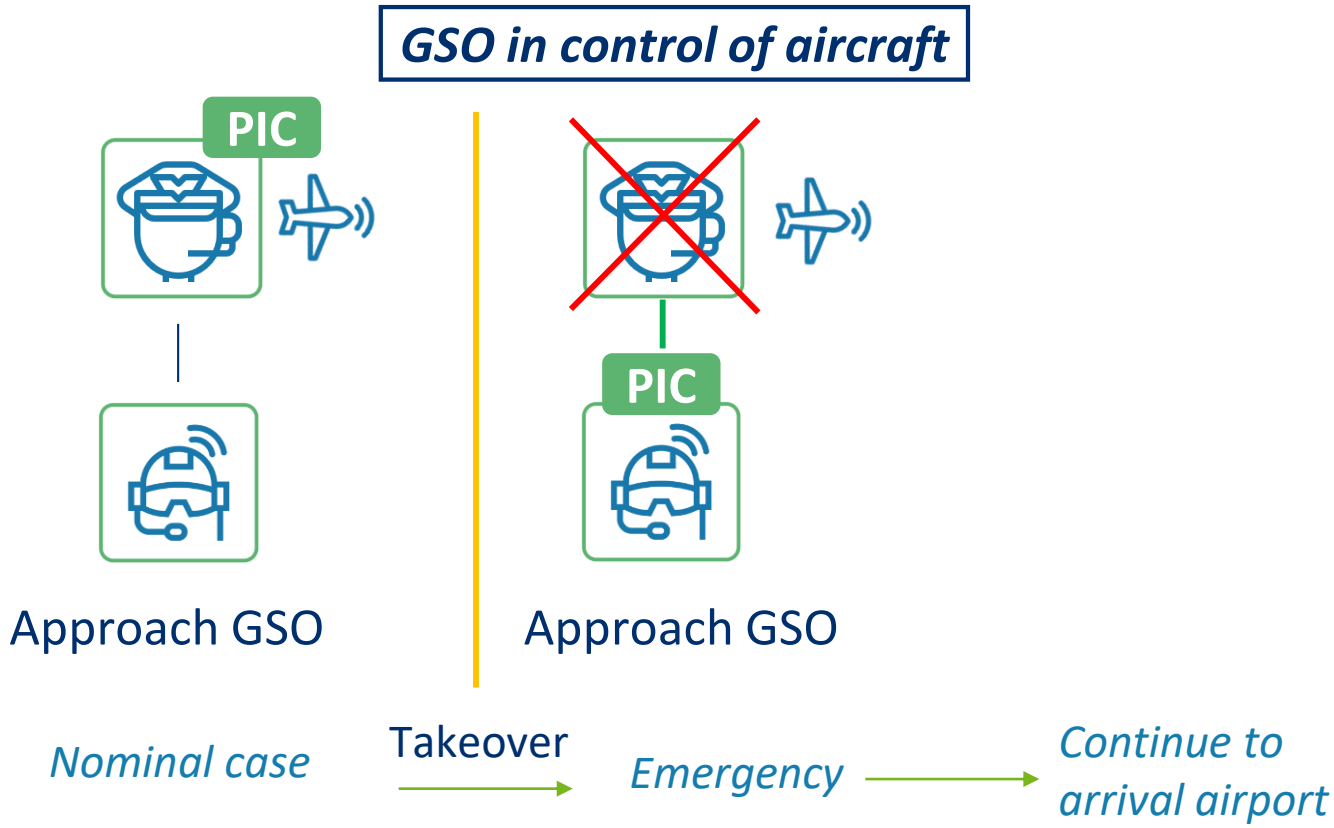


Approach GSO

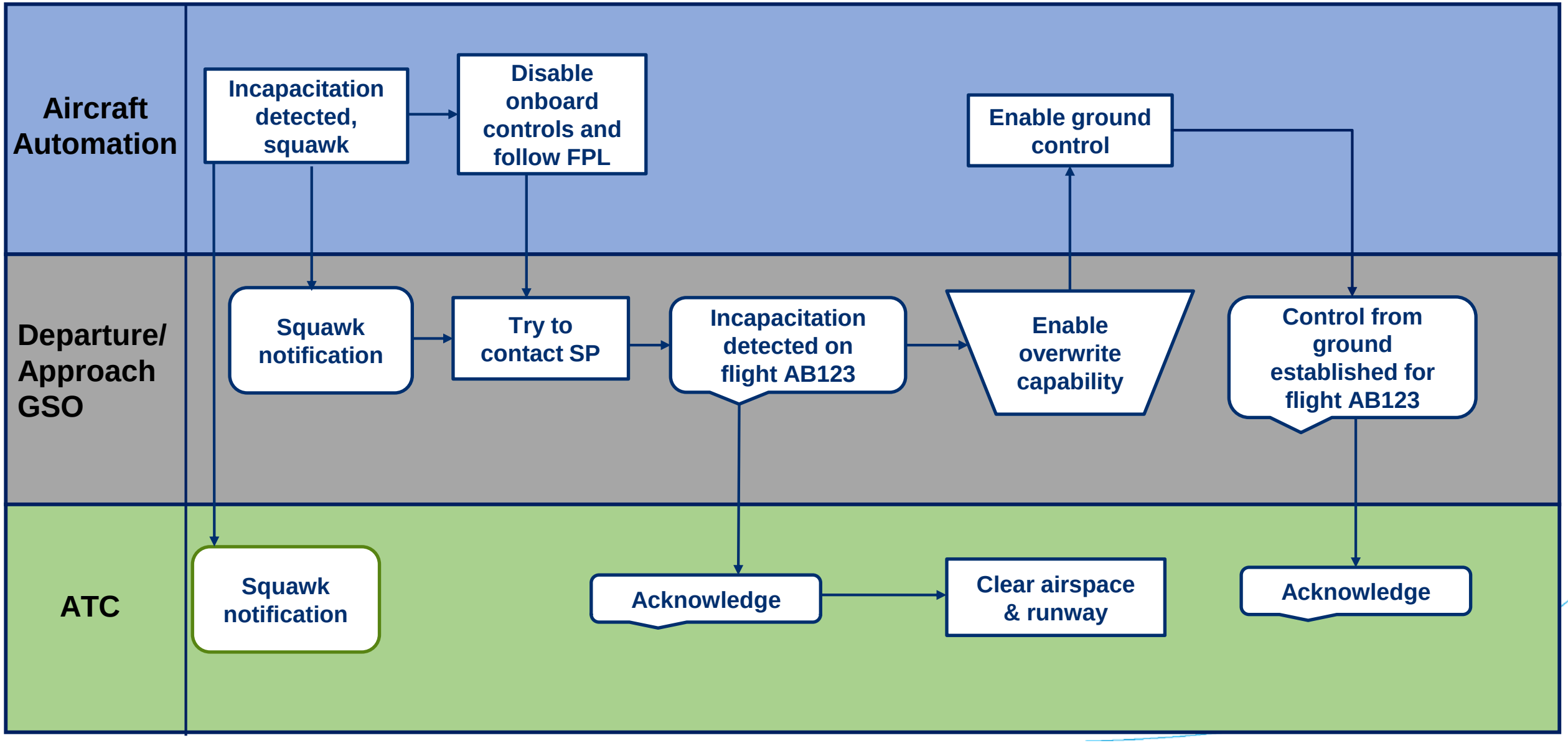
Nominal case

Non-nominal Operational Concept

Pilot Incapacitation in TMA



Takeover Procedure (TMA)



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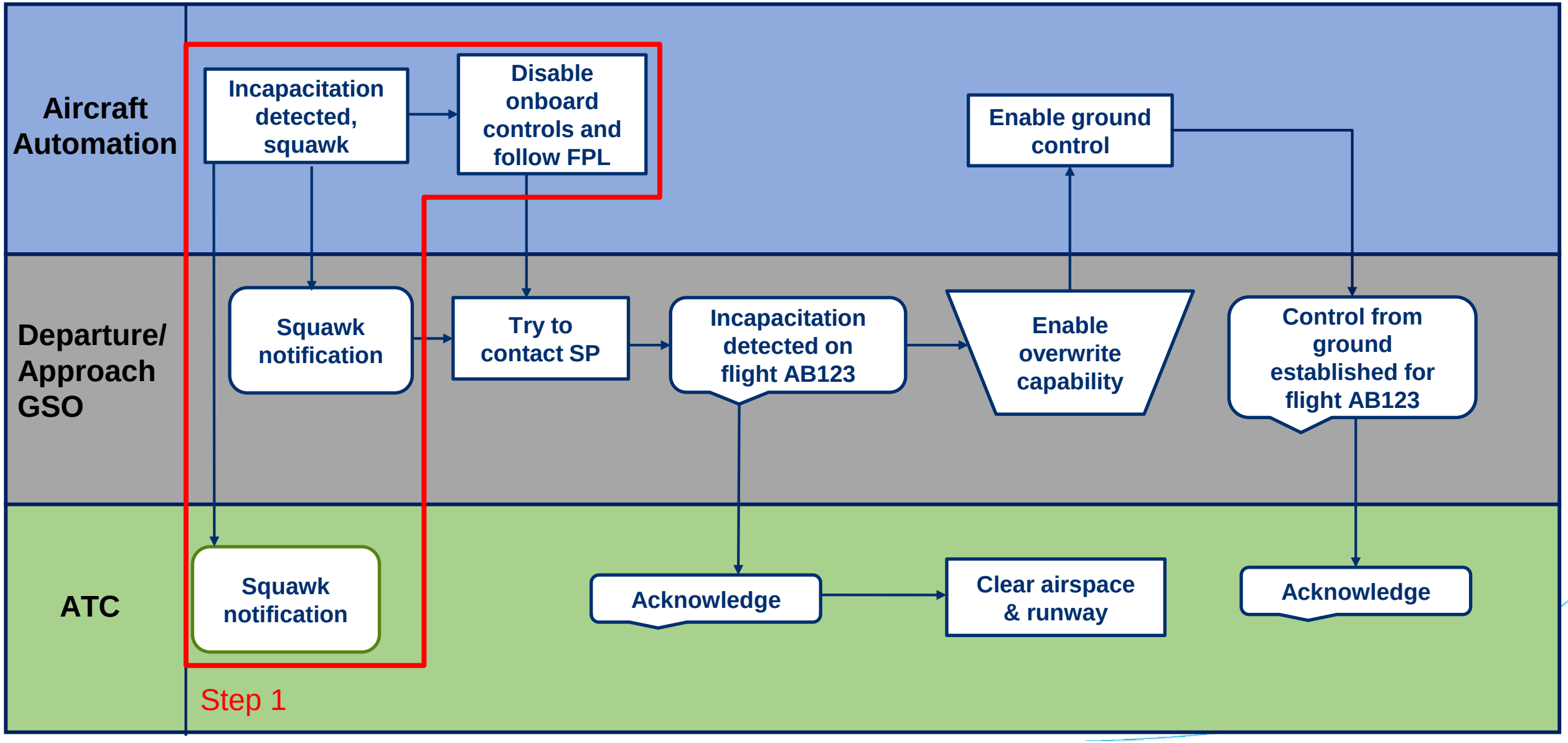

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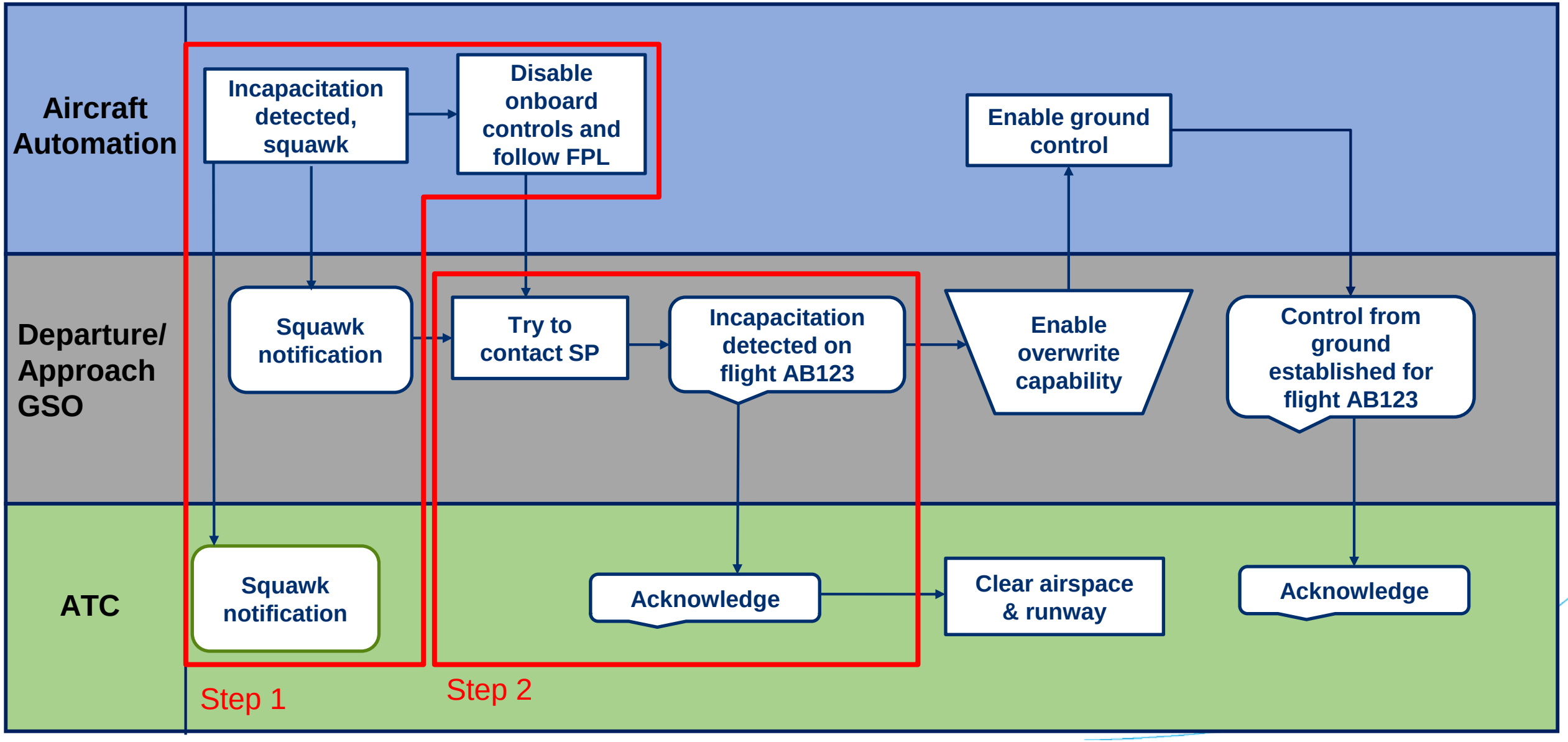

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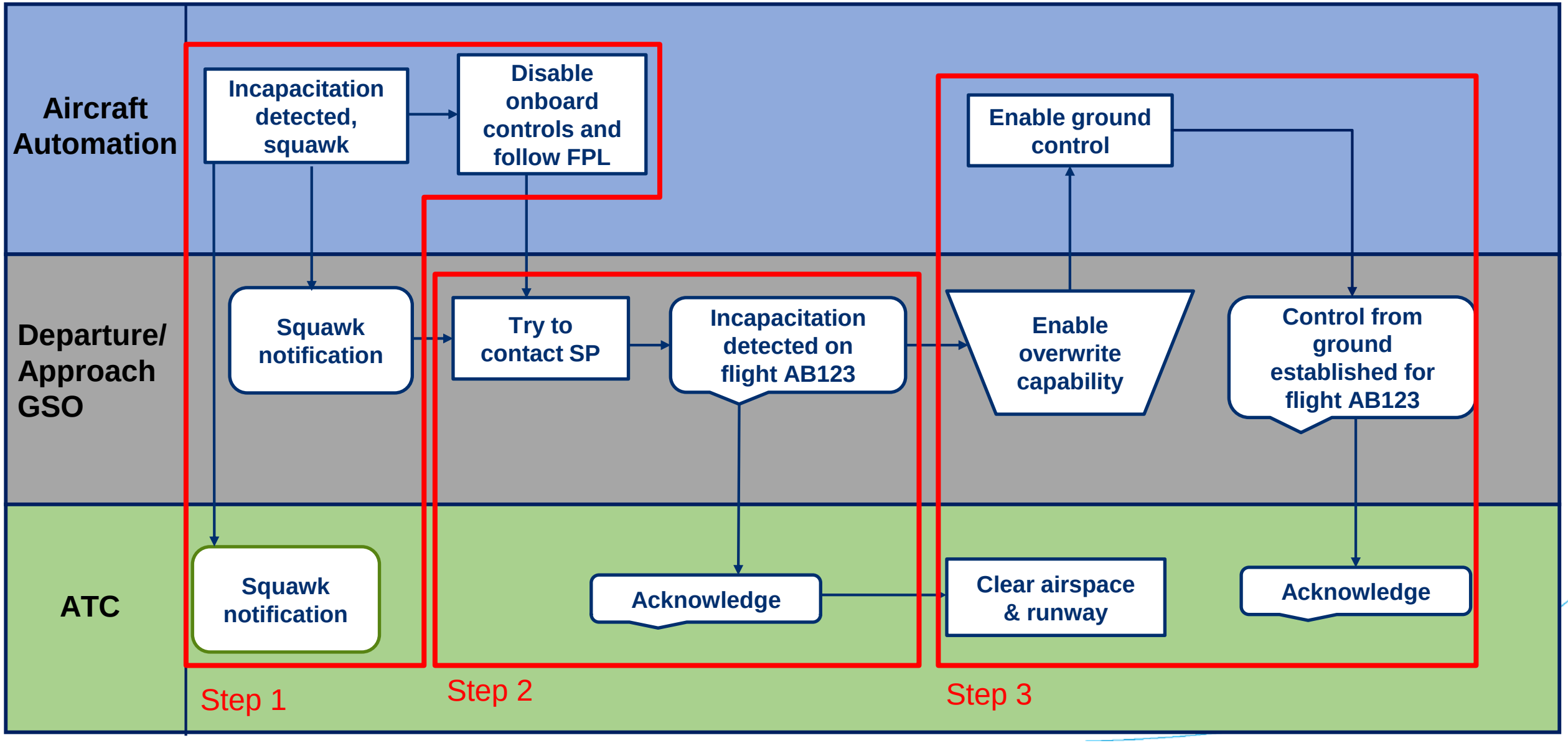
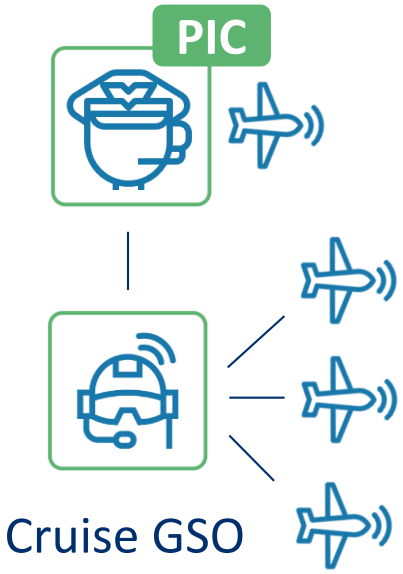


Non-nominal Operational Concept

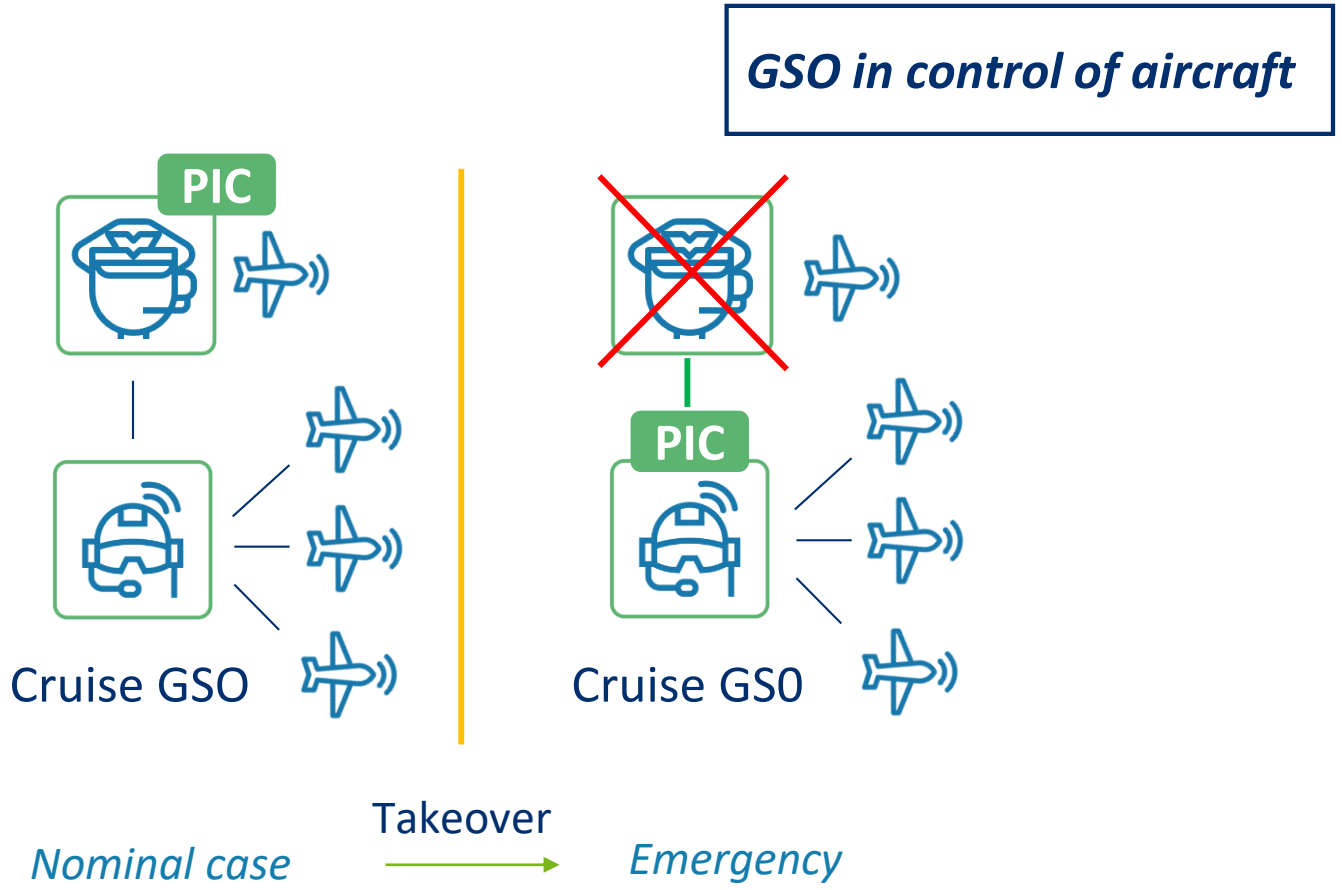
Pilot incapacitation en-route



Nominal case

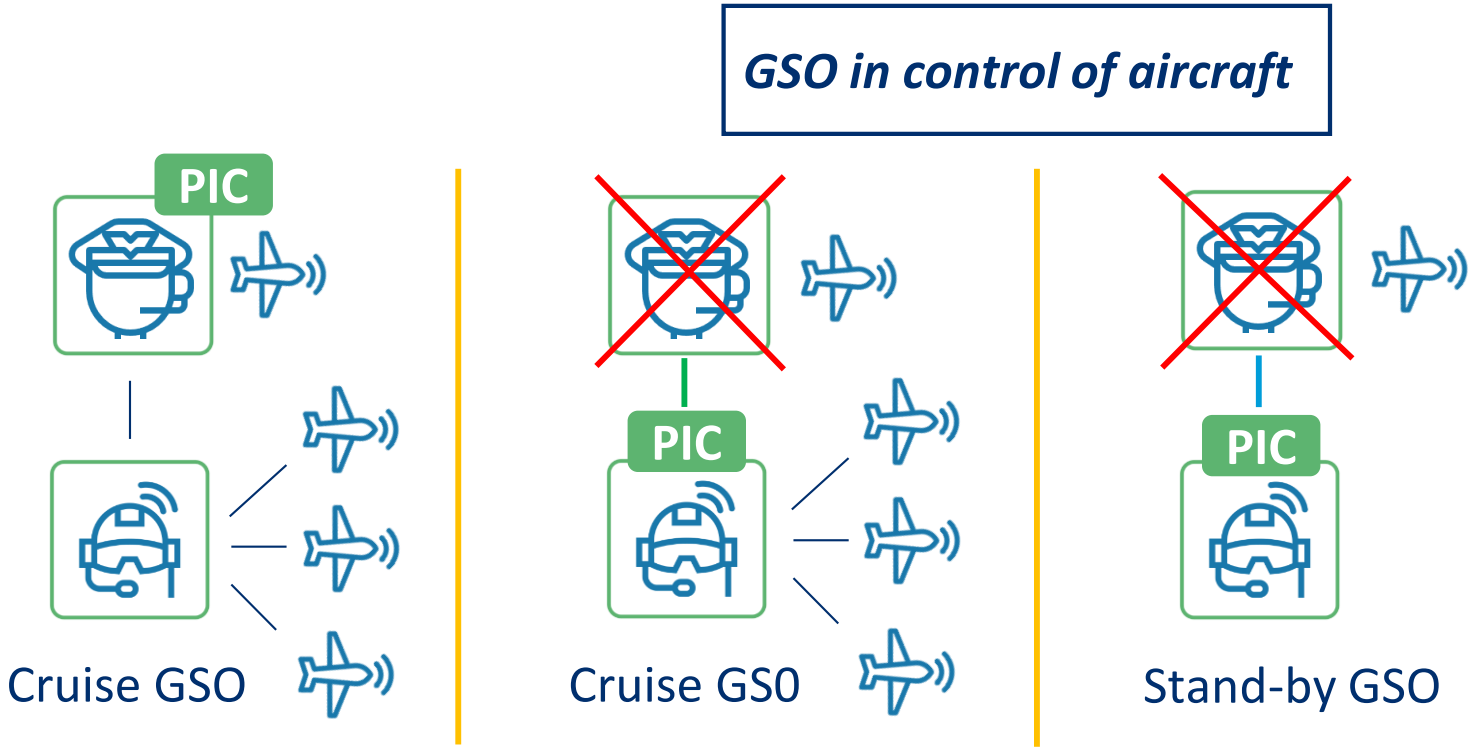
Non-nominal Operational Concept

Pilot incapacitation en-route



Non-nominal Operational Concept

Pilot incapacitation en-route



Nominal case → Takeover → *Emergency* → Handover → *Emergency* → *Land as soon as feasible*

GSO Tasks during en-route (Cruise GSO)

Tasks before incapacitation

- Monitor several aircraft simultaneously with regard to flight (e.g., trajectory conformance)
- Monitor aircraft systems
- Monitor pilots' health monitoring system
- Check (and inform pilots) of potential hazardous weather along the planned flight route
- Support Single Pilots upon request

GSO Tasks during en-route (Cruise GSO)

Tasks before incapacitation	Tasks after incapacitation
• Monitor several aircraft simultaneously with regard to flight (e.g., trajectory conformance) • Monitor aircraft systems • Monitor pilots' health monitoring system • Check (and inform pilots) of potential hazardous weather along the planned flight route • Support Single Pilots upon request	• Contact a/c and confirm pilot incapacitation • Take over control of the a/c, check a/c state • Declare MAYDAY • Communicate control from ground • Communicate start of handover process from Cruise GSO to Stand-by GSO to ATC • Perform handover briefing with Stand-by GSO (incl. a/c position, Flight Level, Heading) • Acknowledge handover to Stand-by GSO

ATC Tasks

Tasks before incapacitation

- Issue clearances and instructions (if needed)
- Provide separation between controlled aircraft
- Communication/Coordination with SP

ATC Tasks

Tasks before incapacitation	Tasks after incapacitation
• Issue clearances and instructions (if needed) • Provide separation between controlled aircraft • Communication/Coordination with SP	• Same as before incapacitation • Communicate with pilots and GSO (emergency a/c) • Coordinate with surrounded sectors/ATS units/ground services • Support GSO as needed

SAFELAND Concept

Key Results

- SAFELAND concept proposes **three different GSO** roles (i.e. departure, cruise, approach)
- Concept relies on **more sophisticated** onboard **automation** to support the SP throughout the flight
- Handover procedures are **closely aligned** with current requirement for handovers of remotely piloted aircraft
- **No significant changes** on the tasks and responsibilities of **ATC**
- Remote pilot able to **control multiple** highly automated **aircraft**
- GSO is **not expected** to manually fly the aircraft

THANK YOU FOR YOUR ATTENTION

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GSO Tasks during Approach/Departure

Tasks before incapacitation

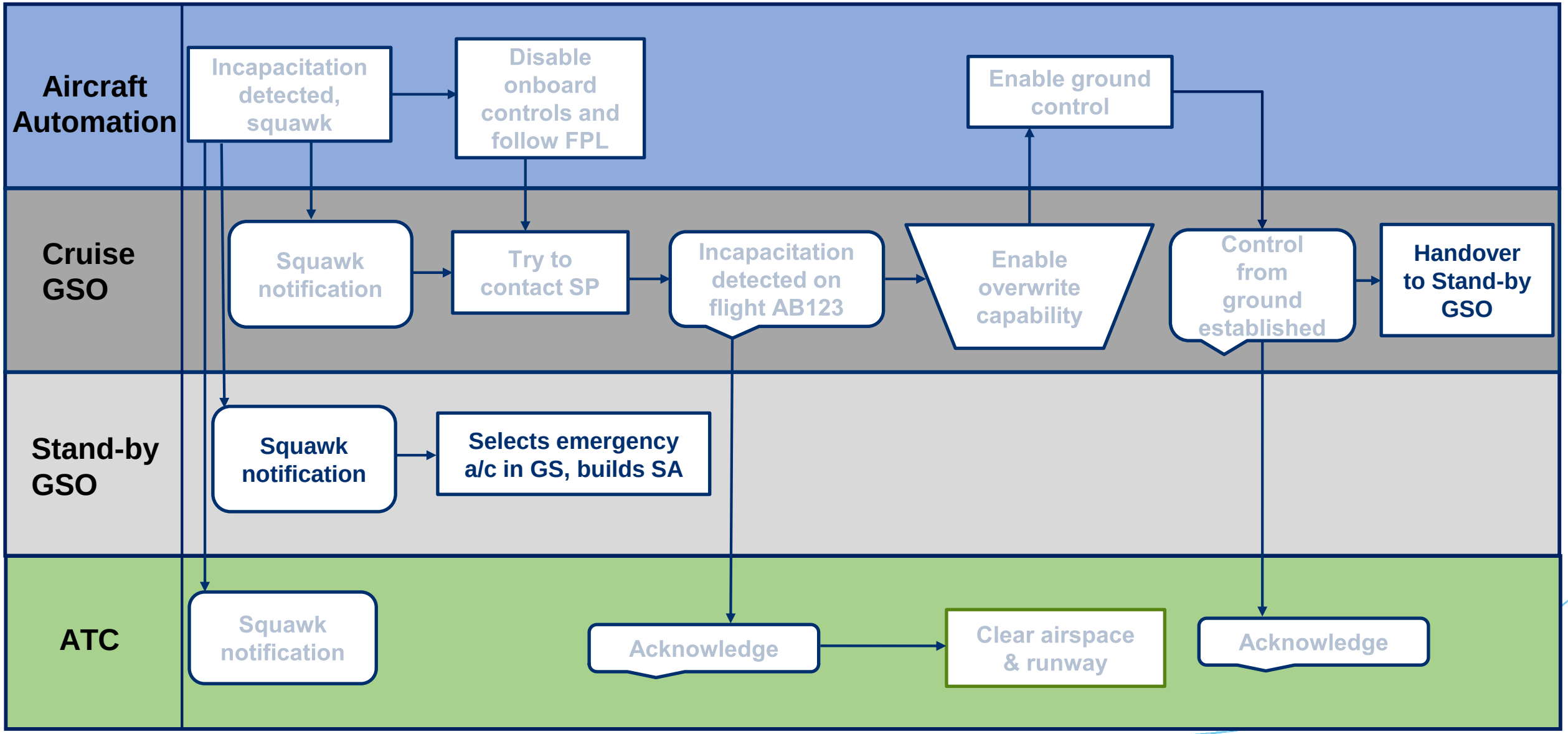
- Departure/Approach Briefings with SP
- Monitor aircraft systems and flight (e.g., trajectory conformance)
- Monitor pilot's health (with support from pilot health monitoring system)
- Check (and inform the pilot) of potential hazardous weather in the airport vicinity
- Support the PIC upon request
- Cross-check and monitor SP actions
- Listen to communications between SP and ATC

GSO Tasks during Approach/Departure

Tasks before incapacitation	Tasks after incapacitation
• Departure/Approach Briefings with SP • Monitor aircraft systems and flight (e.g., trajectory conformance) • Monitor pilot's health (with support from pilot health monitoring system) • Check (and inform the pilot) of potential hazardous weather in the airport vicinity • Support the PIC upon request • Cross-check and monitor SP actions • Listen to communications between SP and ATC	• Contact a/c and confirm pilot incapacitation • Take over control of the aircraft, check a/c state • Declare MAYDAY • Communicate control from ground • Manage flight via high-level commands (HEAD, ALT, SPEED) or FPL changes • Coordinate with ATC for emergency landing

Takeover procedure en-route (option 2)

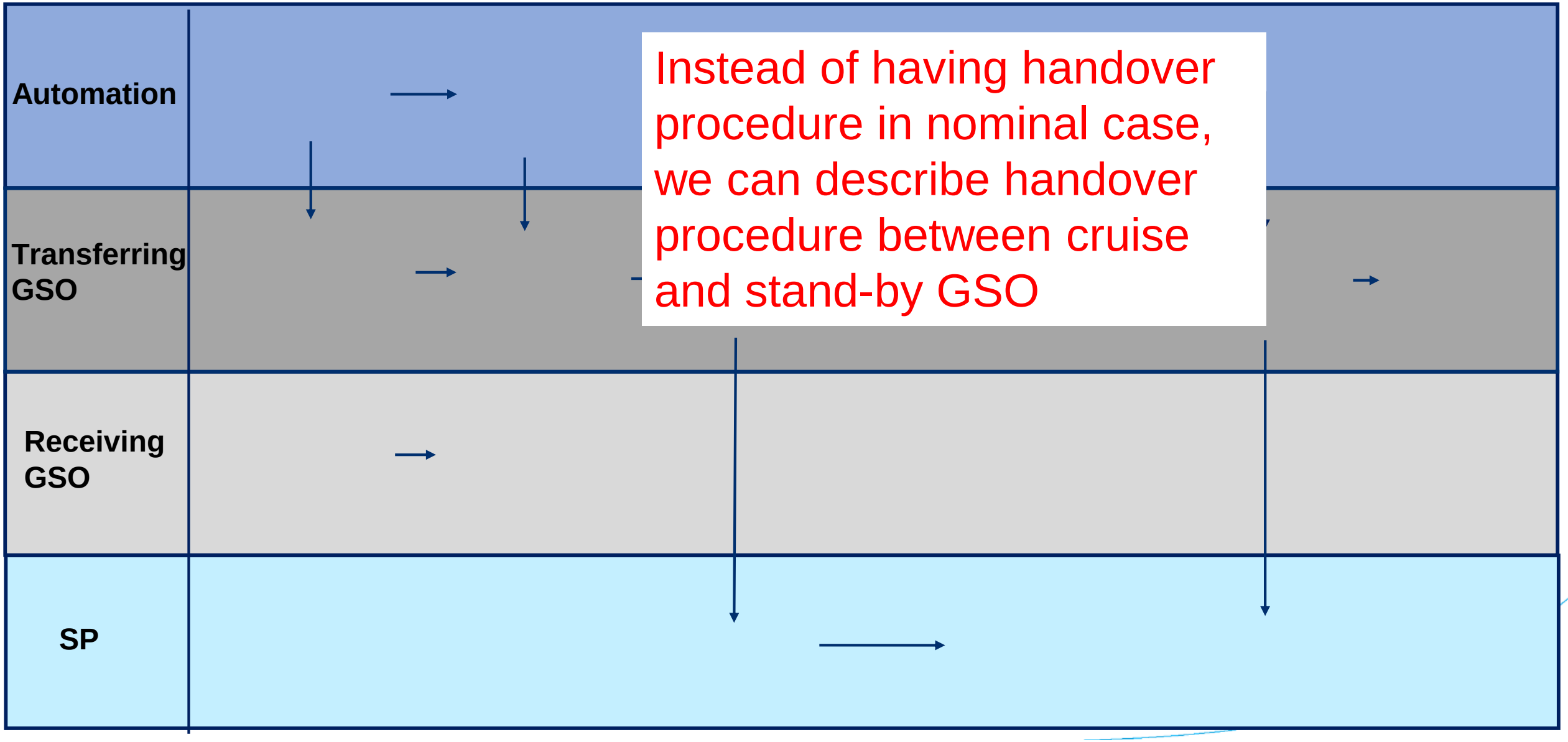
In this slide the steps that are different from those in slide 6 are highlighted



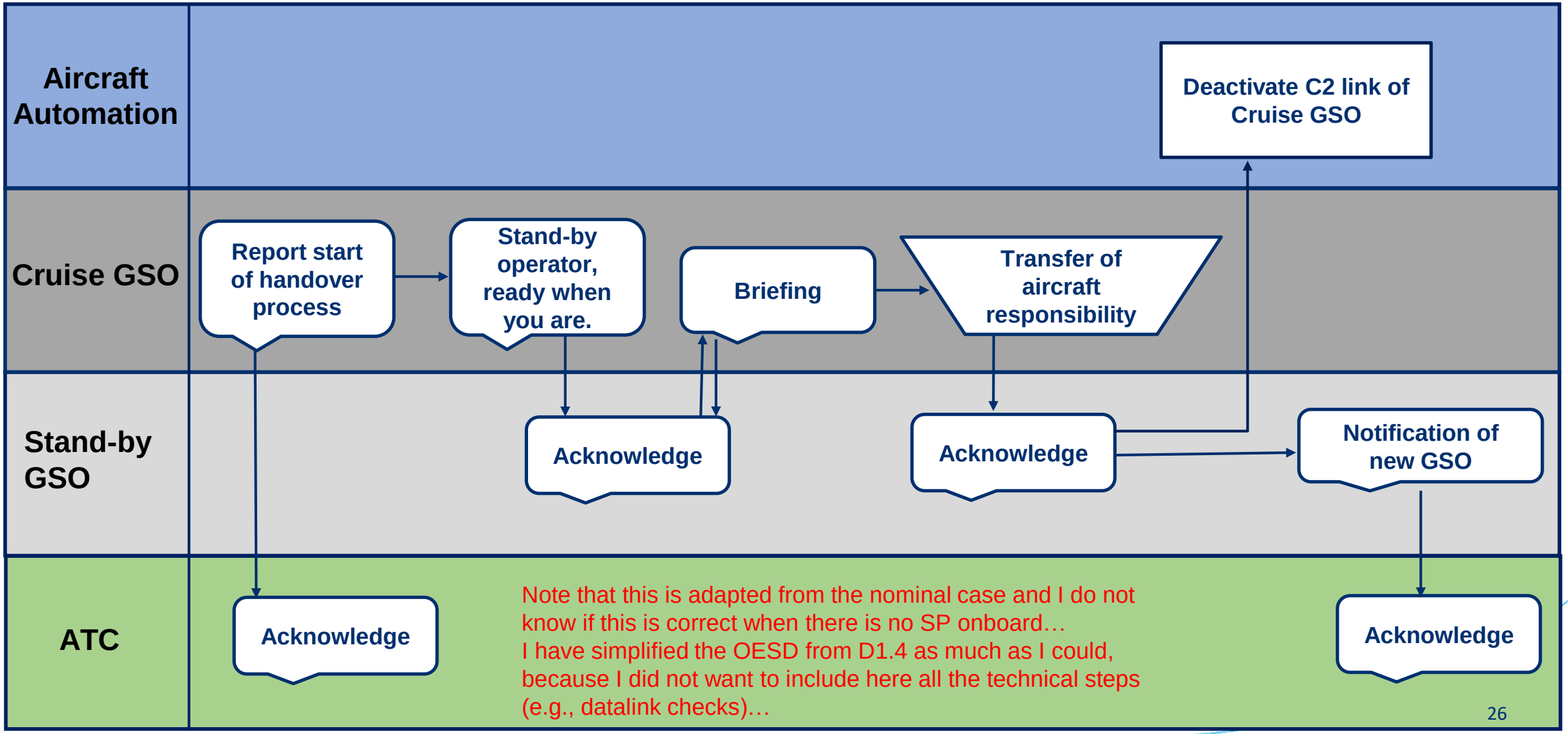
GSO Tasks during en-route (Stand-by GSO)

Tasks before incapacitation	Tasks after incapacitation
• Ground Station Centers would have GSO available to support GSO in any type of emergency and/or GSO waiting to start their shift. New!	• Check a/c status, flight plan/next waypoint (build Situation Awareness) • Perform handover briefing with Cruise GSO • Request and accept a/c control from Cruise GSO • Decide for suitable alternate airport with AOCC support • Report intentions to ATC • Manage flight via high-level commands (HEAD, ALT, SPEED), send new FPL • Coordinate with ATC

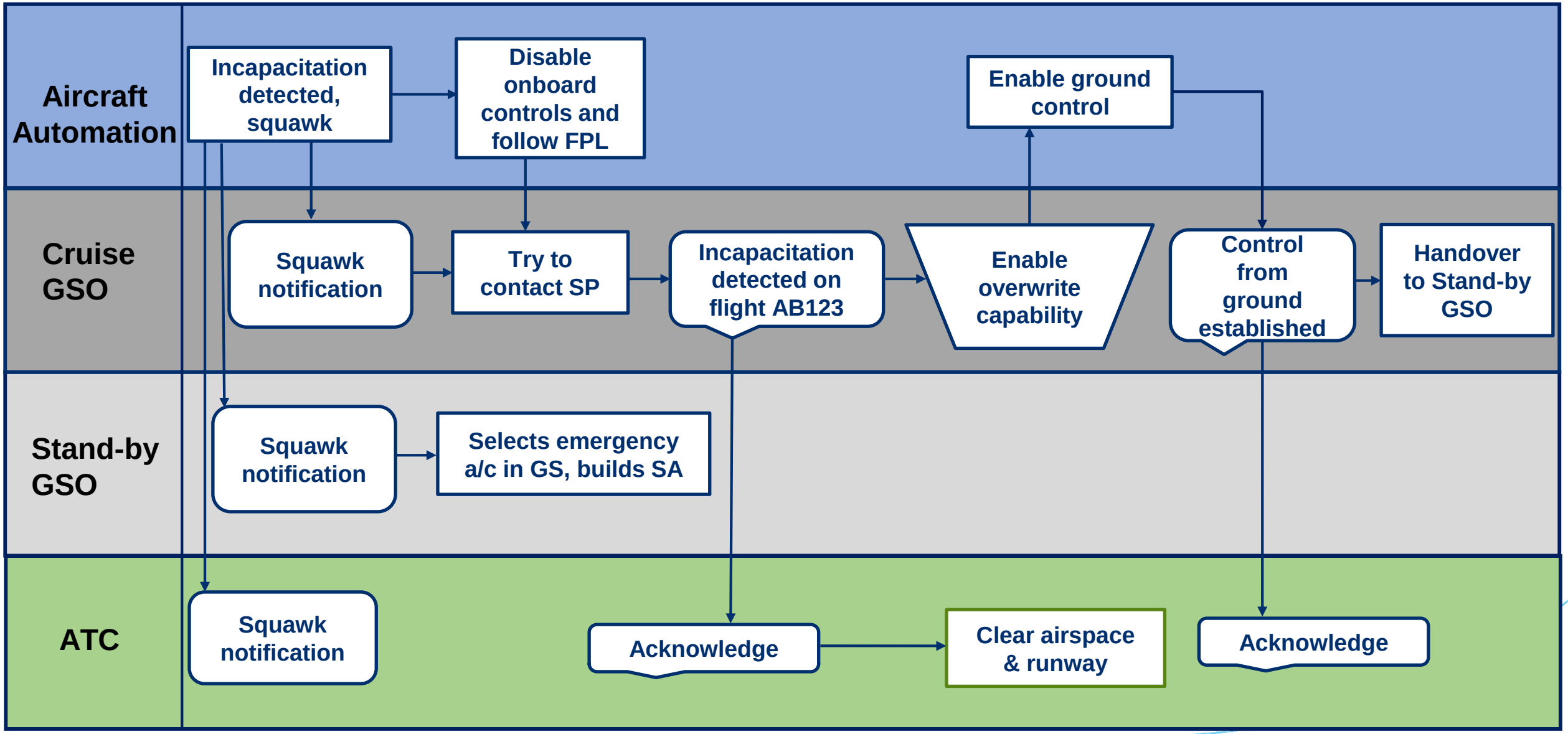
Handover procedure between GSOs (nominal case)



Handover procedure between Cruise and Stand-by GSOs



Takeover procedure en-route



Roles/ Responsibilities/ Tasks

Note that these correspond to tasks during the RTS, but they could be discussed here

Onboard Single Pilot

Responsibilities: Pilot in Command (PIC), responsible for flight safety and thus main decision-maker.

Tasks before incapacitation

- Manage flight until incapacitation
- Communication and coordination with ATC and GSO, as needed

Tasks after incapacitation

- N/A

Roles/ Responsibilities/ Tasks

ATCO

Responsibilities: Ensures air traffic operation and management. Responsibilities are not expected to change compared to current operations.

Tasks before incapacitation

- Issue clearances and instructions (if needed)
- Provide separation between controlled aircraft
- Communication/Coordination with SP

Tasks after incapacitation

- Same as before incapacitation
- Communication/Coordination with GSO
- Support GSO as needed
- Coordinate with ground services

Roles/ Responsibilities/ Tasks

Approach GSO ~~– Run 1~~

Responsibilities: Support the PIC, contributing to a safe and efficient flight. Act as PIC after SP becomes incapacitated.

Tasks before incapacitation

- Monitor aircraft systems and flight
- Monitor pilot's health
- Support the PIC upon request
- Cross-check and monitor SP actions
- Listen to communication between SP and ATC

Tasks after incapacitation detection

- Confirm pilot incapacitation
- Take over control of the aircraft
- Declare MAYDAY and communicate control from ground
- Communications with ATC
- Manage flight via high-level commands (HEAD, ALT, SPEED) until landing

Roles/ Responsibilities/ Tasks

Cruise GSO ~~(not a participant) – Run 2~~

Responsibilities: Support several single pilots, contributing to a safe and efficient flight. Act as PIC after SP becomes incapacitated until a/c is transferred to stand-by GSO.

Tasks before incapacitation

- Monitor several aircraft systems and flights
- Monitor pilots' health
- Support the PICs upon request
- Cross-check and monitor SP actions
- Listen to communication between SP and ATC

Tasks after incapacitation detection

- Confirm pilot incapacitation
- Takeover control of the aircraft
- Declare MAYDAY and communicate control from ground
- Manage flight via high-level commands (HEAD, ALT, SPEED) or FPL changes (if needed)
- Hand over control to stand-by GSO
- Communications with ATC and stand-by GSO

Roles/ Responsibilities/ Tasks

Stand-by GSO ~~– Run 2~~

Responsibilities: Become PIC after pilot incapacitation, responsible for flight safety and thus decision maker.

Tasks before incapacitation

- (RTS: Monitor several A/C)

Tasks after incapacitation

- Receive control of aircraft from Cruise GSO
- Build Situation Awareness
- Decide for suitable alternate airport with NOC support
- Manage flight via high-level commands (HEAD, ALT, SPEED) or FPL changes
- Communications with ATC