

# **System for Controlling a Hijacked Aircraft**

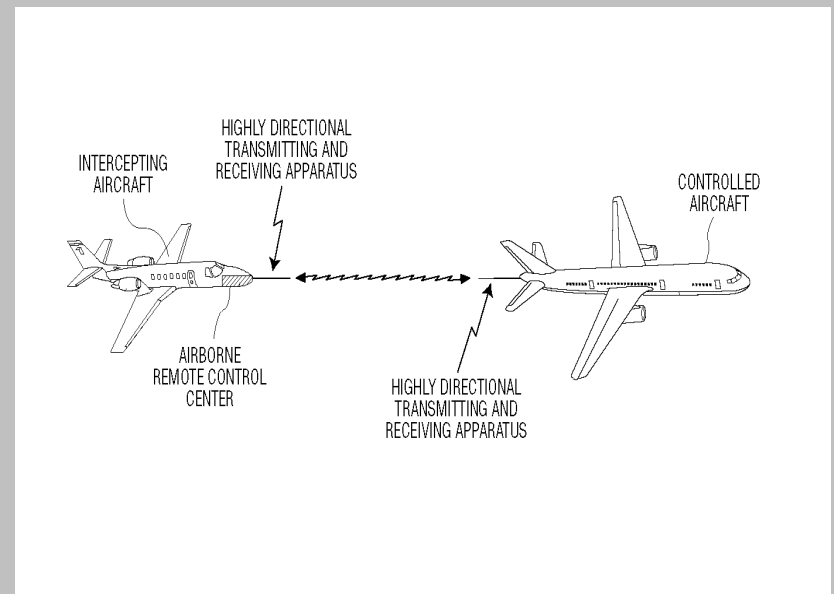
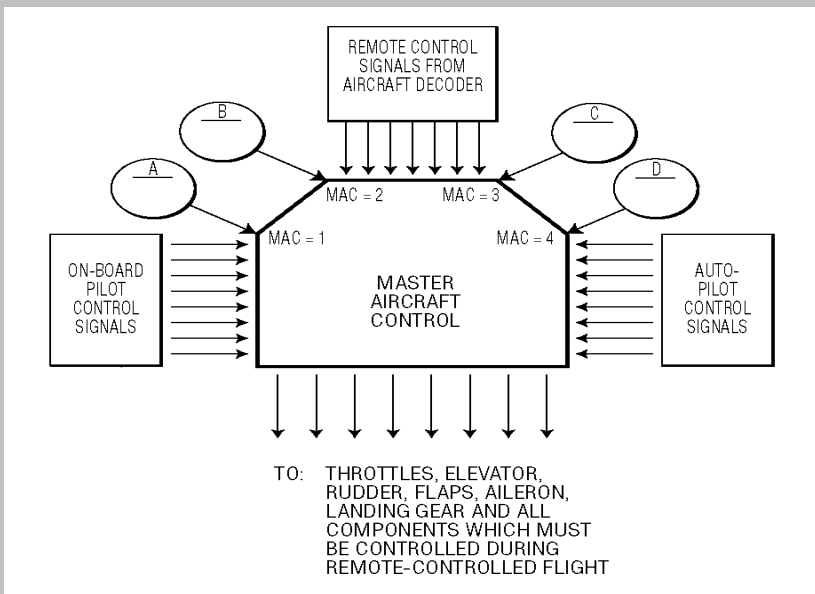
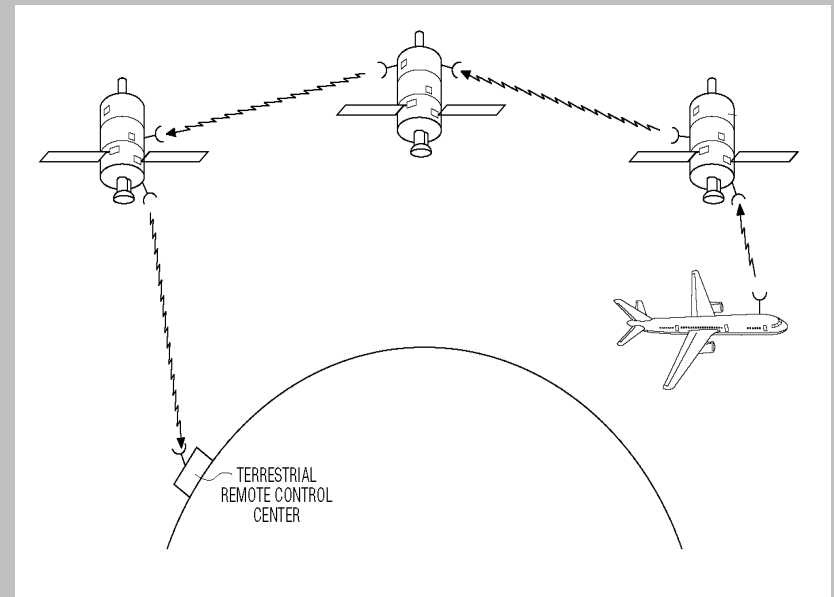
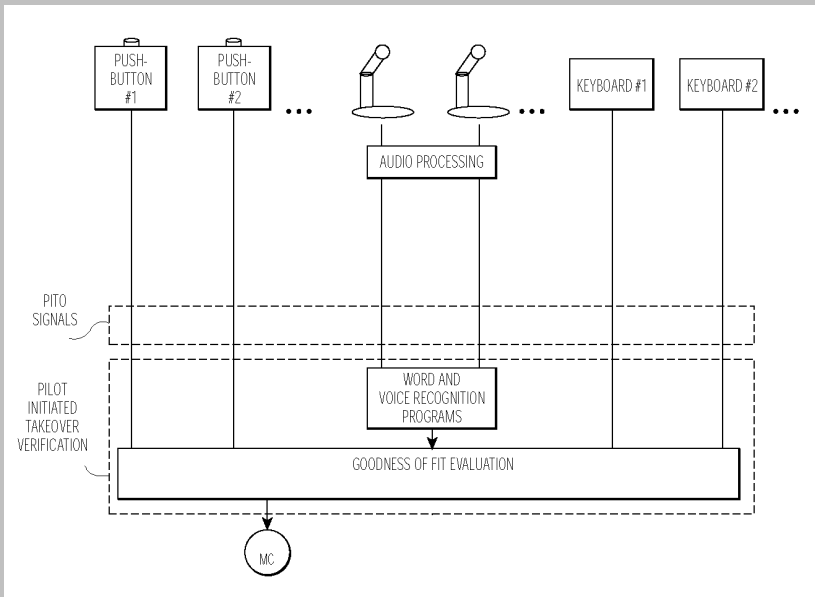
By Jeffrey A. Matos and Karl F. Milde, Jr.

# Motivation for a Better System to Protect Against Aircraft Hijacking

- Given the current state of world affairs and of airport security, it seems unlikely that there will not be future attempts at air-terrorism.
- Given the current state of technology, we can do a far better job of protecting our passenger and commercial aircraft than simply reinforcing the cockpit door and giving the crew a gun.

# Core Concept

- Thwarting of aircraft hijack attempt by:
  - taking control of the aircraft away from the on-board pilot, and
- Giving control to alternate pilot, viz.:
  - autopilot, and/or
    - human pilot aboard local interceptor aircraft, or
    - remotely situated human pilot
- The off-aircraft human pilot lands the hijacked aircraft.



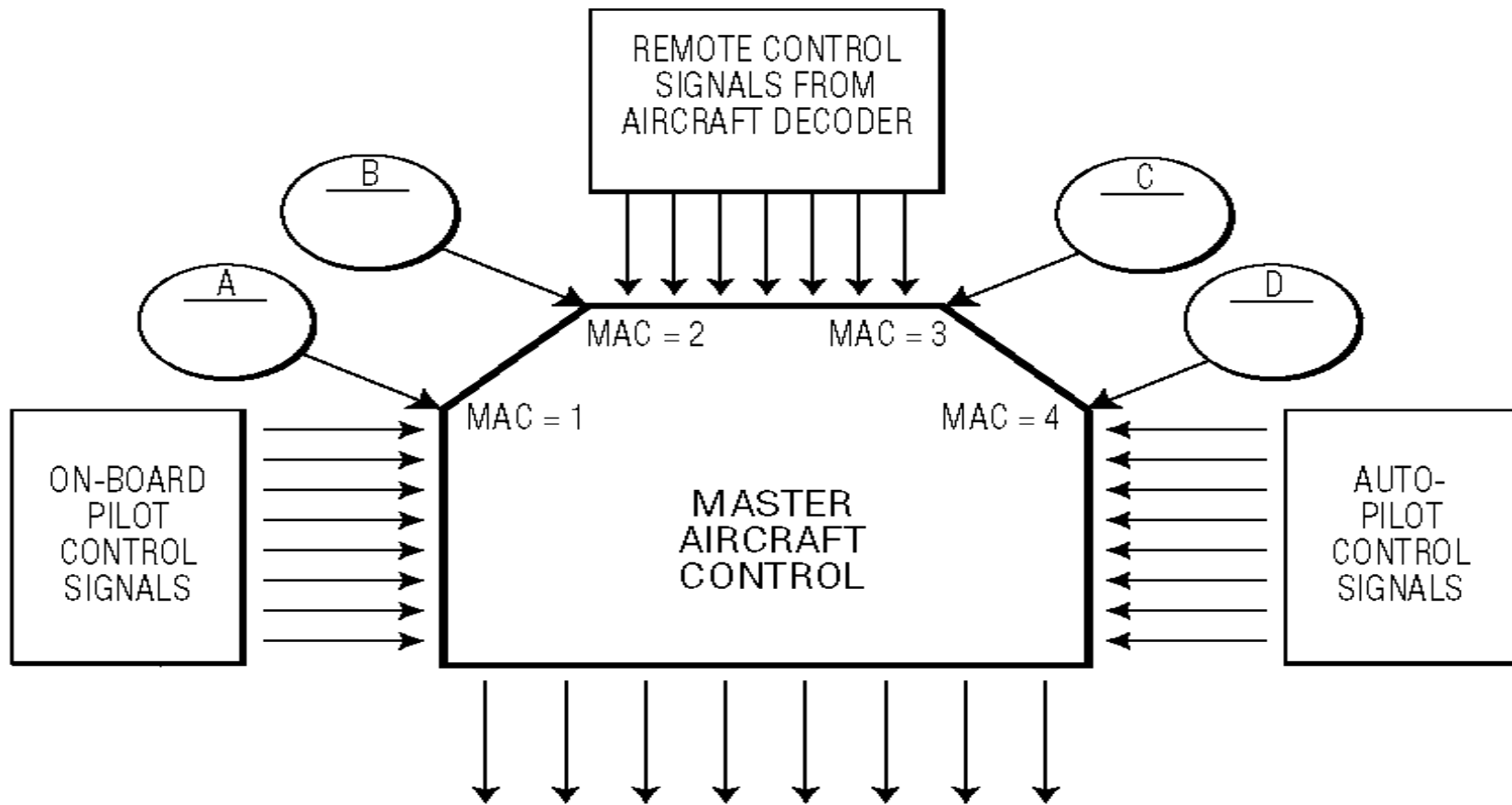
# Three “Axioms”

- 1) Control of HAC (hijacked aircraft) taken from HAC pilot only if he requests.
- 2) Landing of HAC performed by off-HAC pilot, in visual contact with HAC
- 3) Render system “hack-proof” by excluding long distance remote control and allowing off-HAC pilot to communicate by line of sight/ highly directional system/ low sensitivity HAC receiver.

# Method I

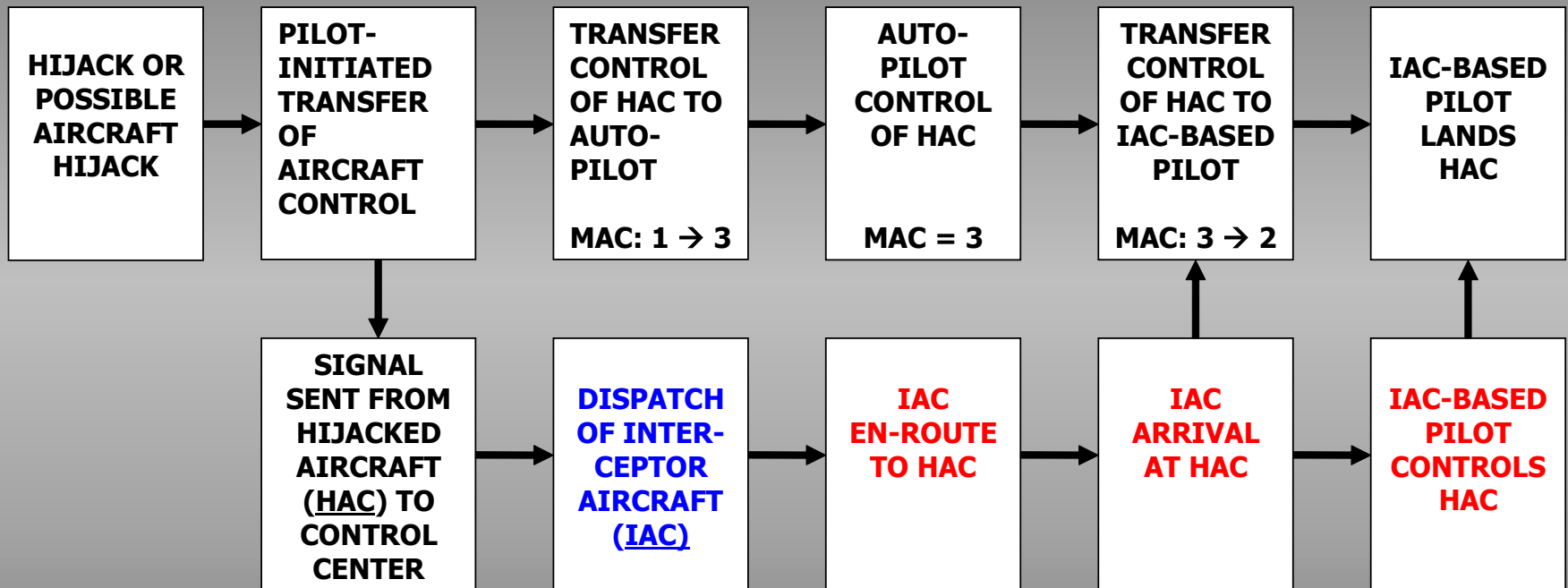
- 1) At HAC Pilot request, transfer control to Autopilot, and send signal to Control Center
- 2) Control Center dispatches IAC (Interceptor Aircraft)
- 3) On arrival of IAC at HAC, transfer control of HAC to IAC-based pilot
- 4) IAC-based pilot lands HAC

# Master Aircraft Control

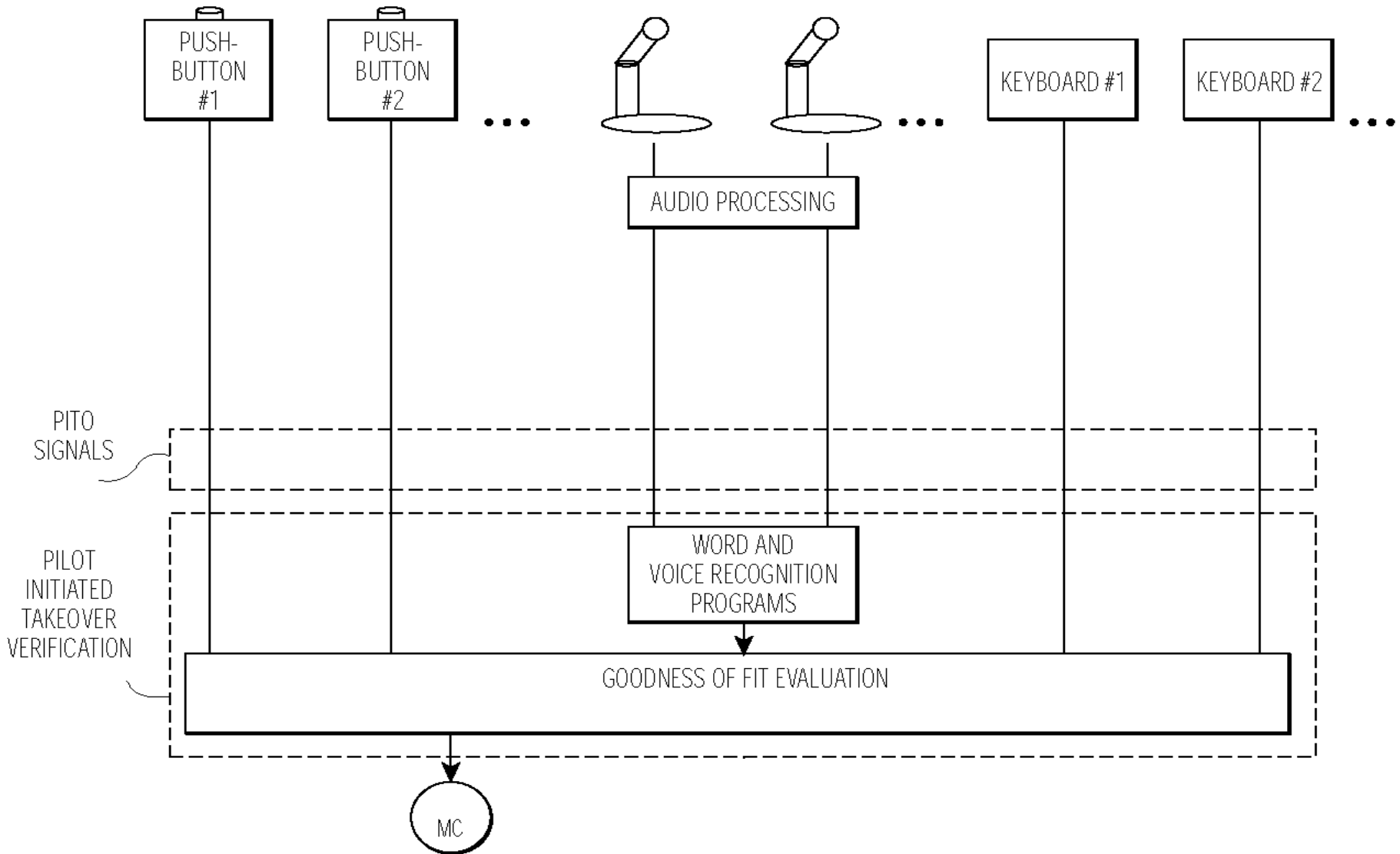


TO: THROTTLES, ELEVATOR,  
RUDDER, FLAPS, AILERON,  
LANDING GEAR AND ALL  
COMPONENTS WHICH MUST  
BE CONTROLLED DURING  
REMOTE-CONTROLLED FLIGHT

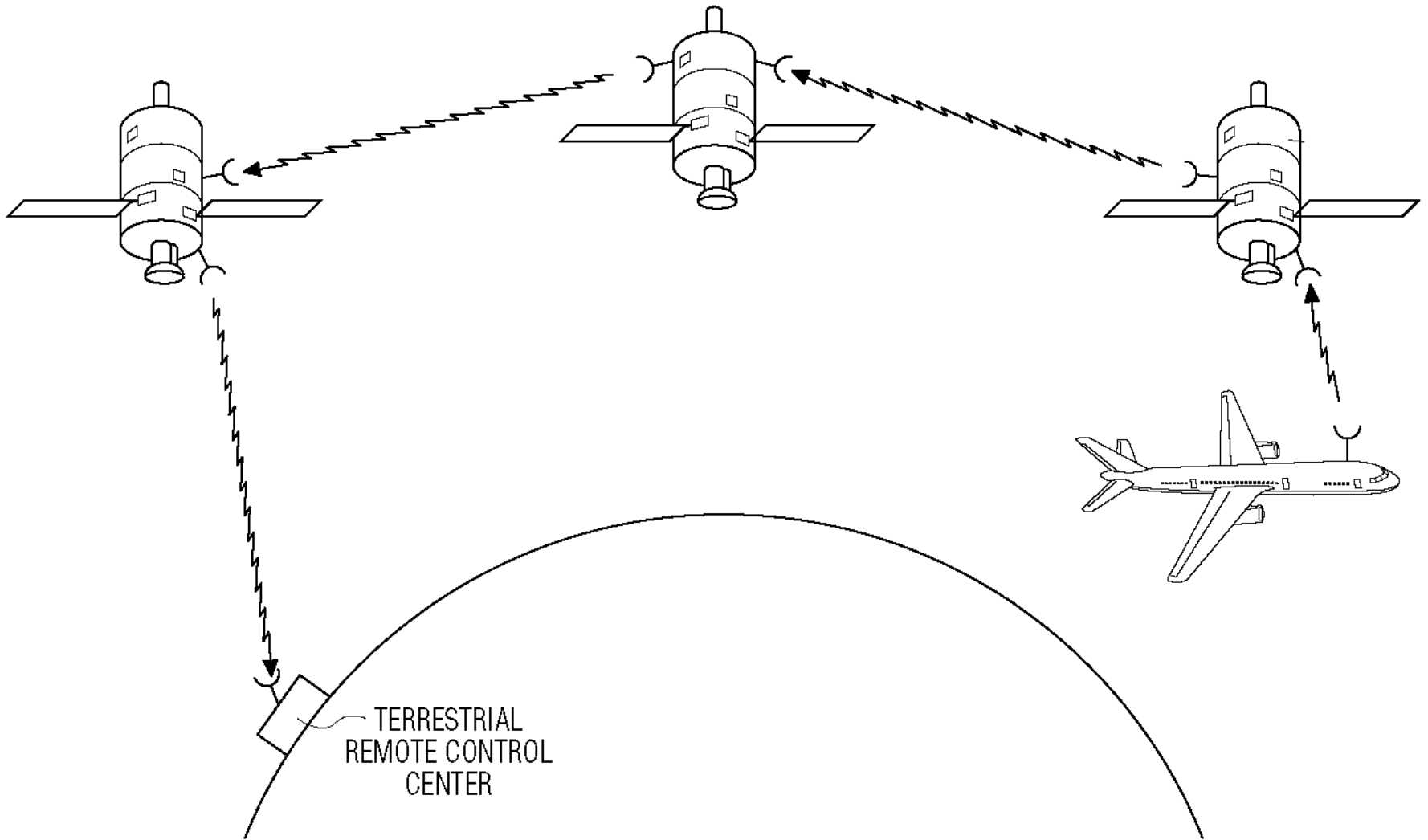
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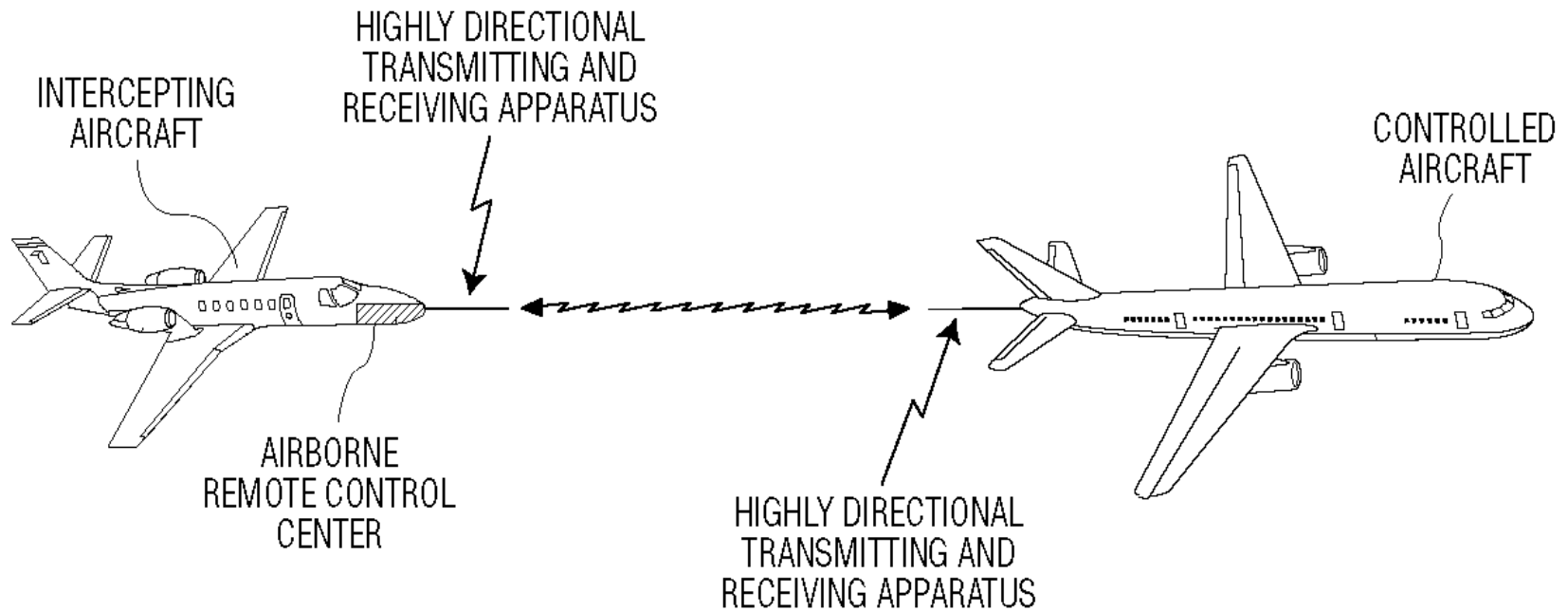
# Pilot-Initiated Takeover



# PITO Signal Relayed to Control Center



# Interceptor Aircraft-Based Pilot Flies Hijacked Aircraft



# Axiom Notation

## (METHOD II USED AS EXAMPLE)

### AXIOM NOTATIONAL

#### RULES:

- 1) Axioms which are “violated” are shown in large, white italic style. In the case of Method II, this obtains for Axiom (1).
- 2) Axioms which are left intact are shown in gray, with a smaller font size. In the case of Method II, this includes Axioms (2) and (3)

### METHOD II AXIOMS

- 1) *Control of HAC (hijacked aircraft) taken from HAC pilot only if he requests.*
- 2) Landing of HAC performed by off-HAC pilot, in visual contact with HAC
- 3) Render system “hack-proof” by excluding remote control and allowing off-HAC pilot to communicate by line of sight/ highly directional system/ low sensitivity HAC receiver.

# Method II: Axiom 1 Eliminated

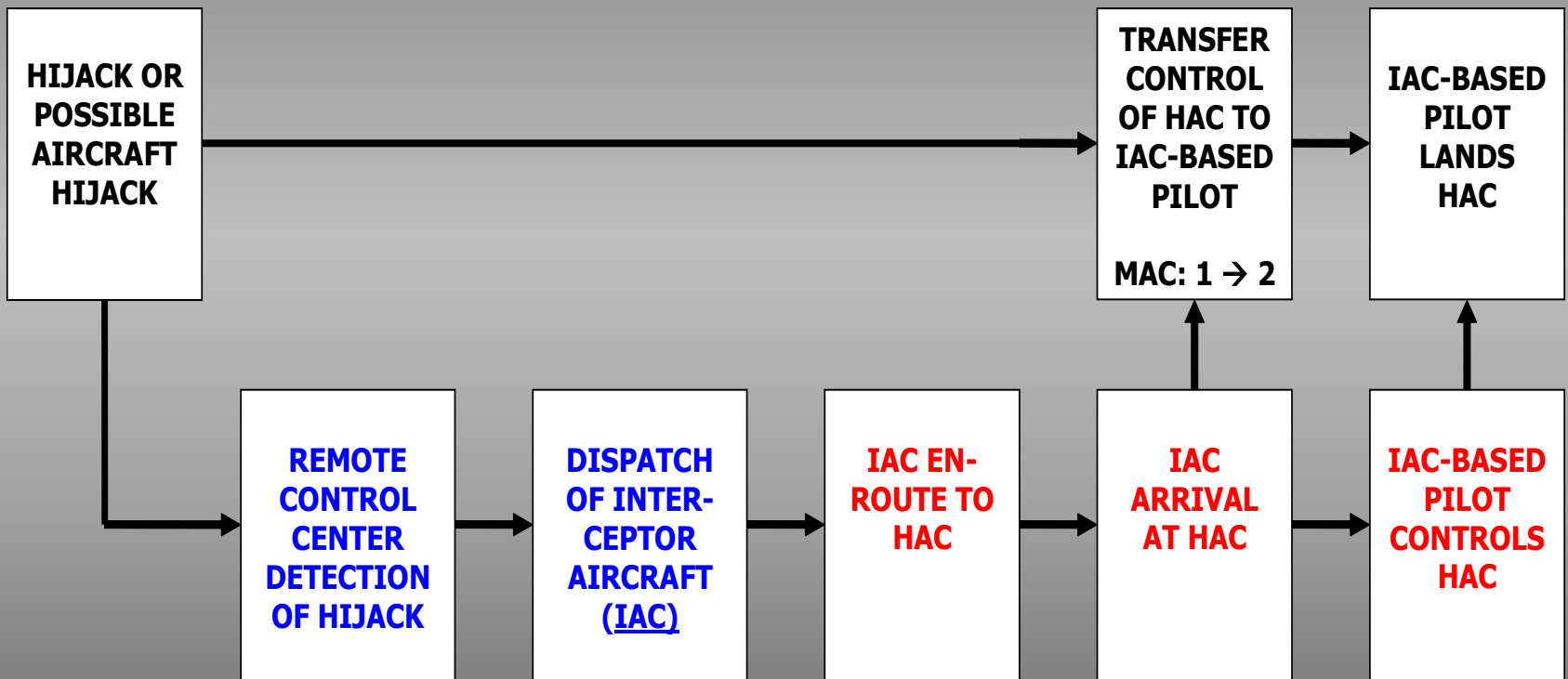
## AXIOMS

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## METHOD II

- 1) At off-HAC request, Control Center dispatches IAC (Interceptor Aircraft)
- 2) On arrival of IAC at HAC, transfer control of HAC to IAC-based pilot
- 3) IAC-based pilot lands HAC

# Method II



# Method III: Axiom 1 Eliminated and Axiom 3 Transiently Eliminated

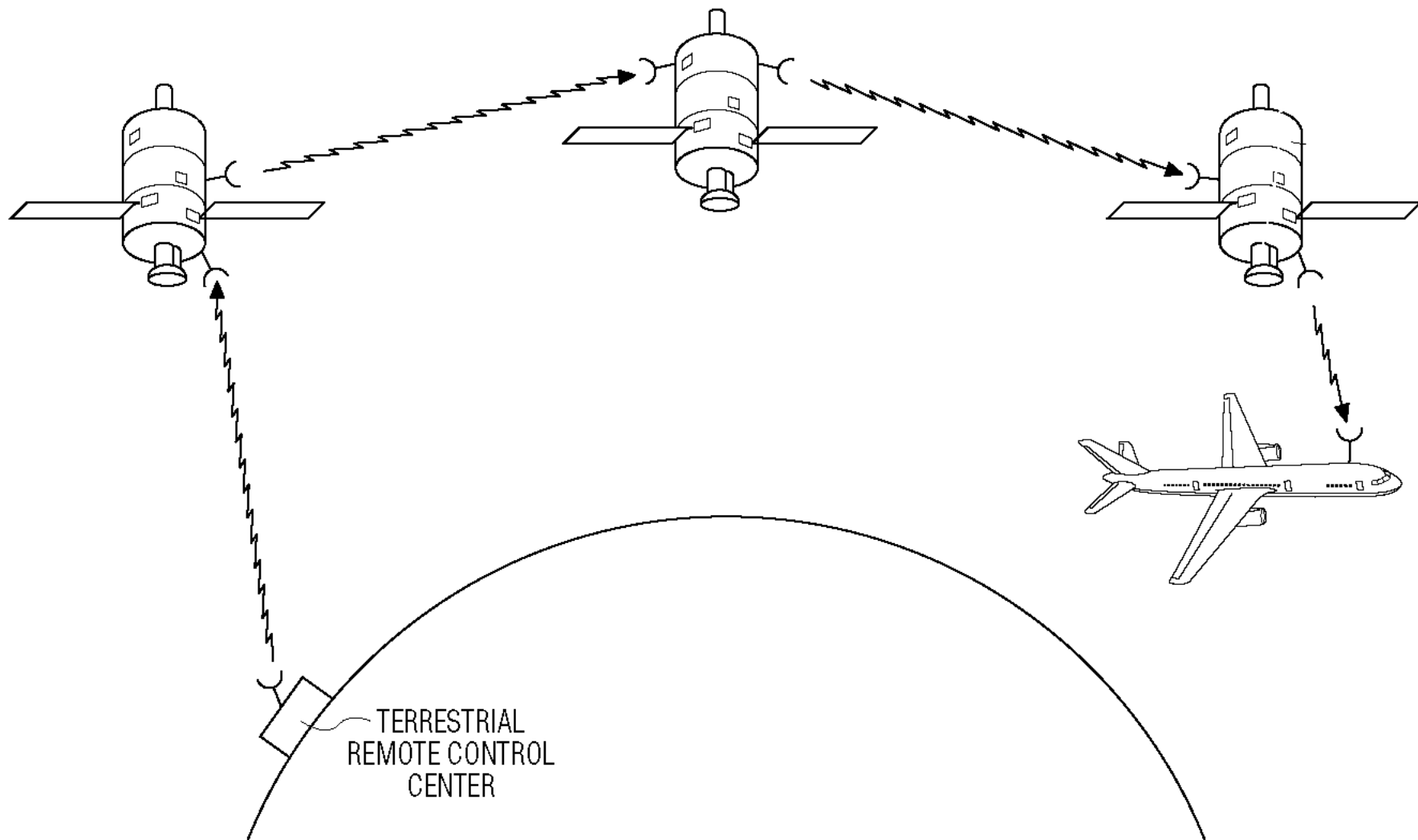
## AXIOMS

- 1) *Control of HAC (hijacked aircraft) taken from HAC pilot only if he requests.*
- 2) *Landing of HAC performed by off-HAC pilot, in visual contact with HAC*
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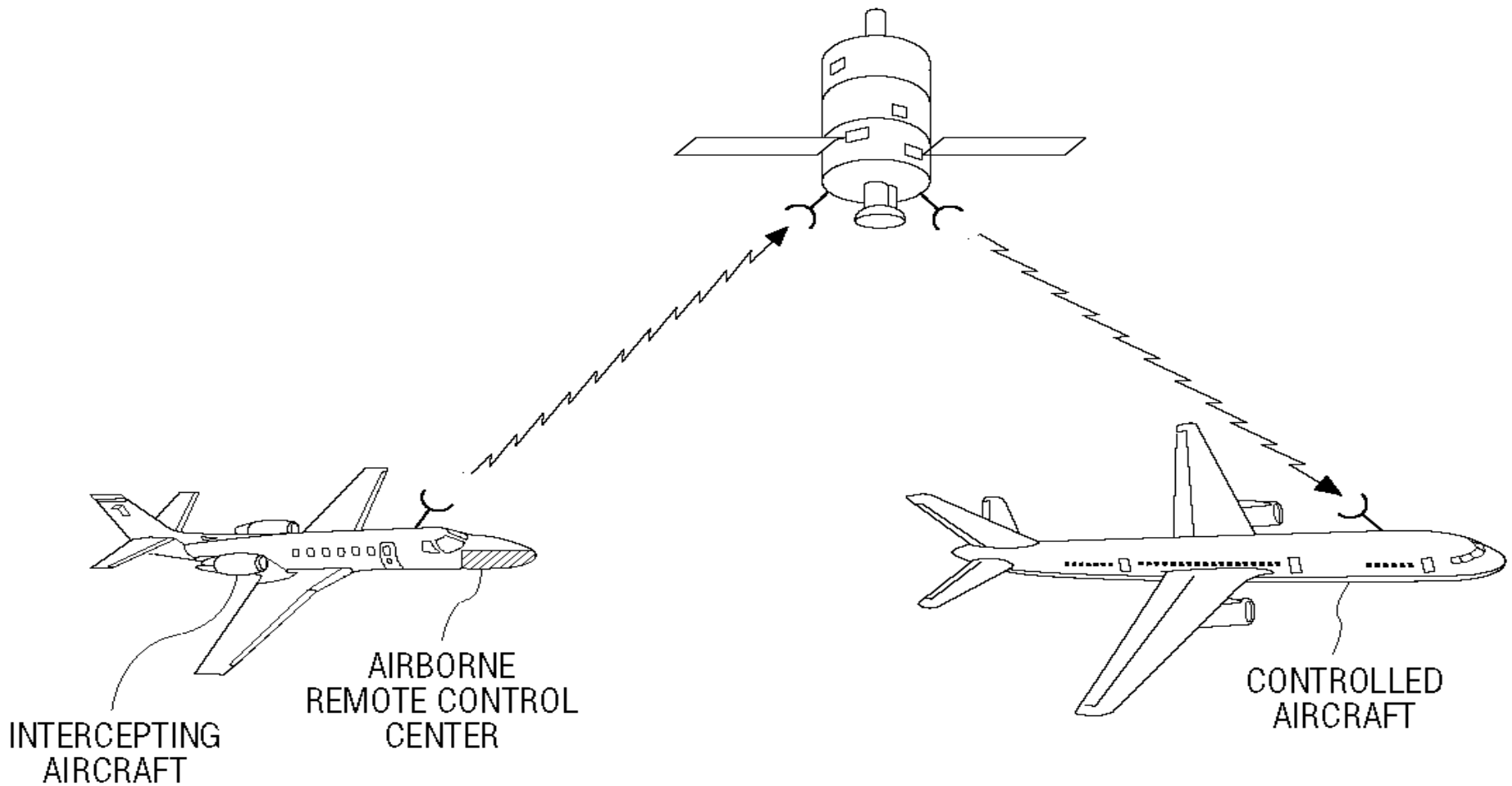
## METHOD III

- 1) At off-HAC request, transfer control to Autopilot, and send signal to Control Center
- 2) Control Center dispatches Interceptor Aircraft (IAC)
- 3) On arrival of IAC at HAC, transfer control of HAC to IAC-based pilot
- 4) IAC-based pilot lands HAC

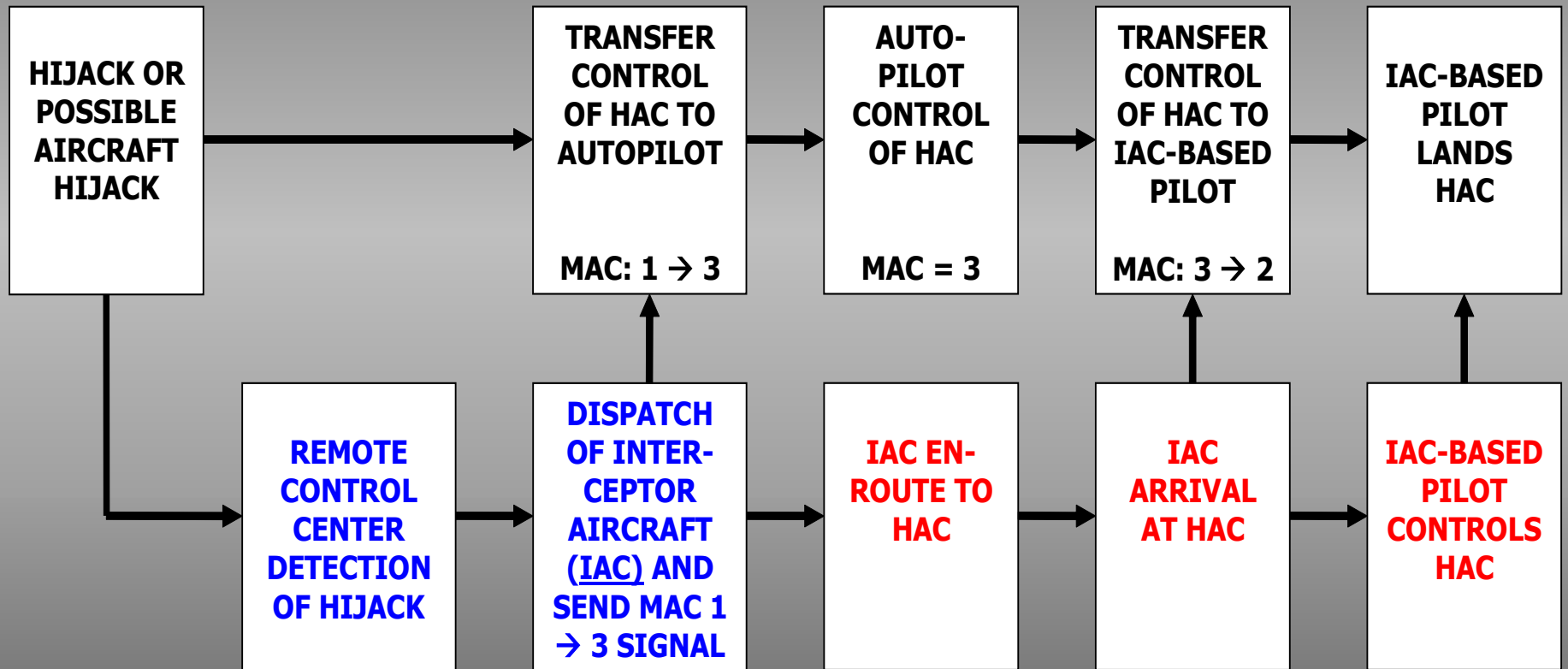
# Takeover Signal Sent from Terrestrial Control Center



# Takeover Signal Sent from Airborne Control Center



# Method III



# Method IV: Axiom 3 Eliminated

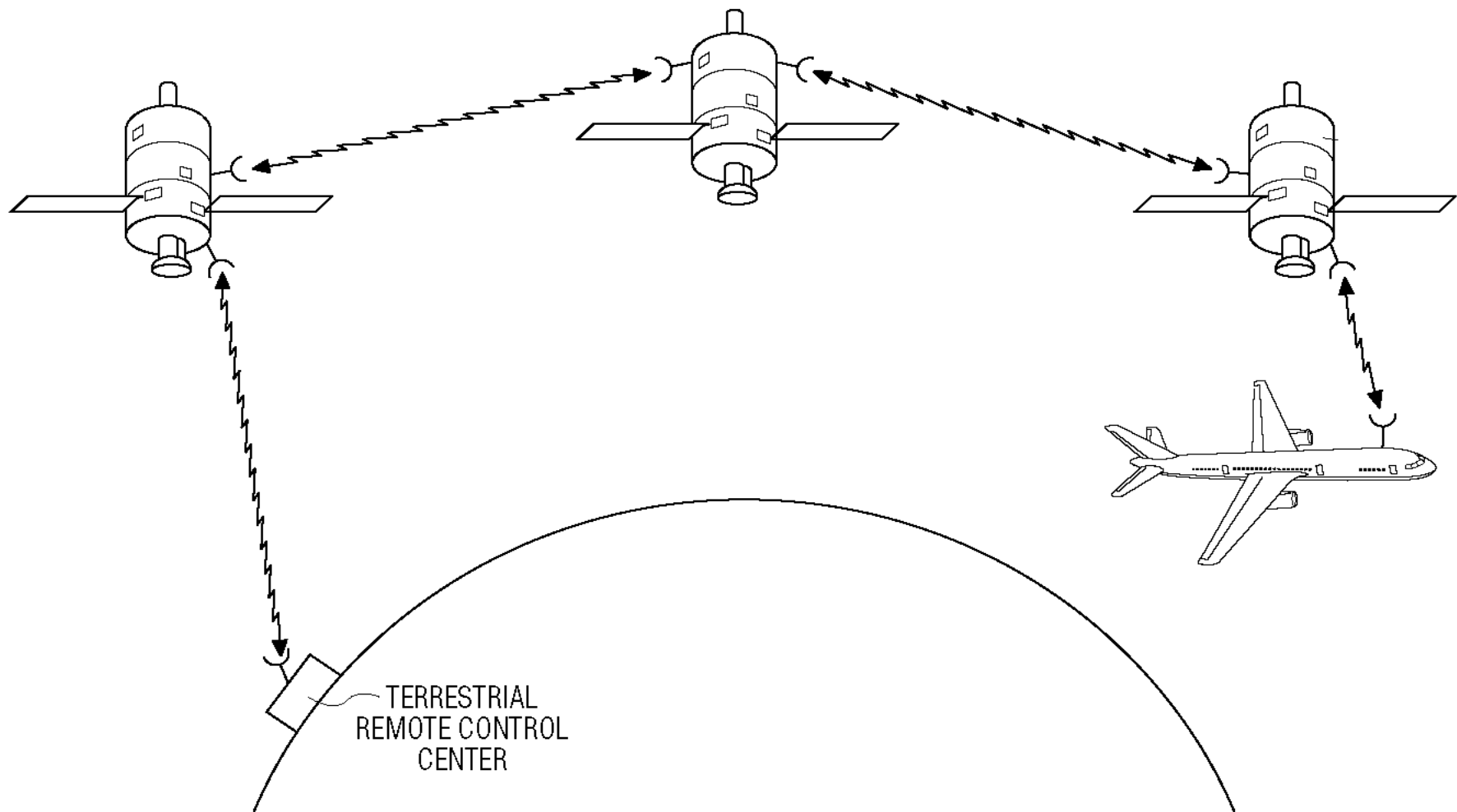
## AXIOMS

- 1) Control of HAC (hijacked aircraft) taken from HAC pilot only if he requests.
- 2) Landing of HAC performed by off-HAC pilot, in visual contact with HAC
- 3) *Render system “hack-proof” by excluding remote control and allowing off-HAC pilot to communicate by line of sight/ highly directional system/ low sensitivity HAC receiver.*

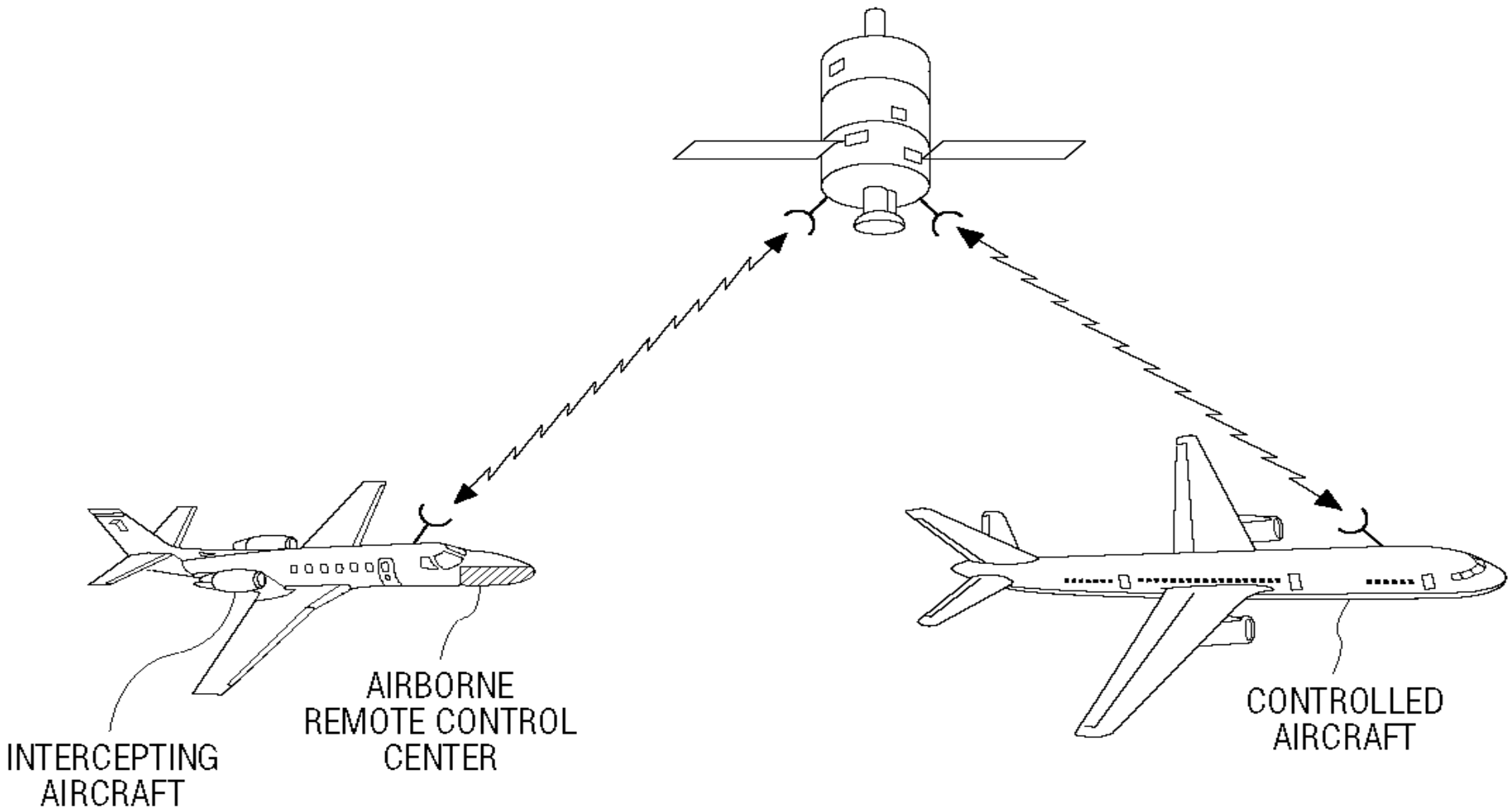
## METHOD IV

- 1) At HAC pilot request, send signal to Control Center and transfer control to remote pilot
- 2) Control Center dispatches Interceptor Aircraft (IAC)
- 3) HAC Control by remote pilot until IAC arrives
- 4) On arrival of IAC at HAC, transfer control of HAC to IAC-based pilot
- 5) IAC-based pilot lands HAC

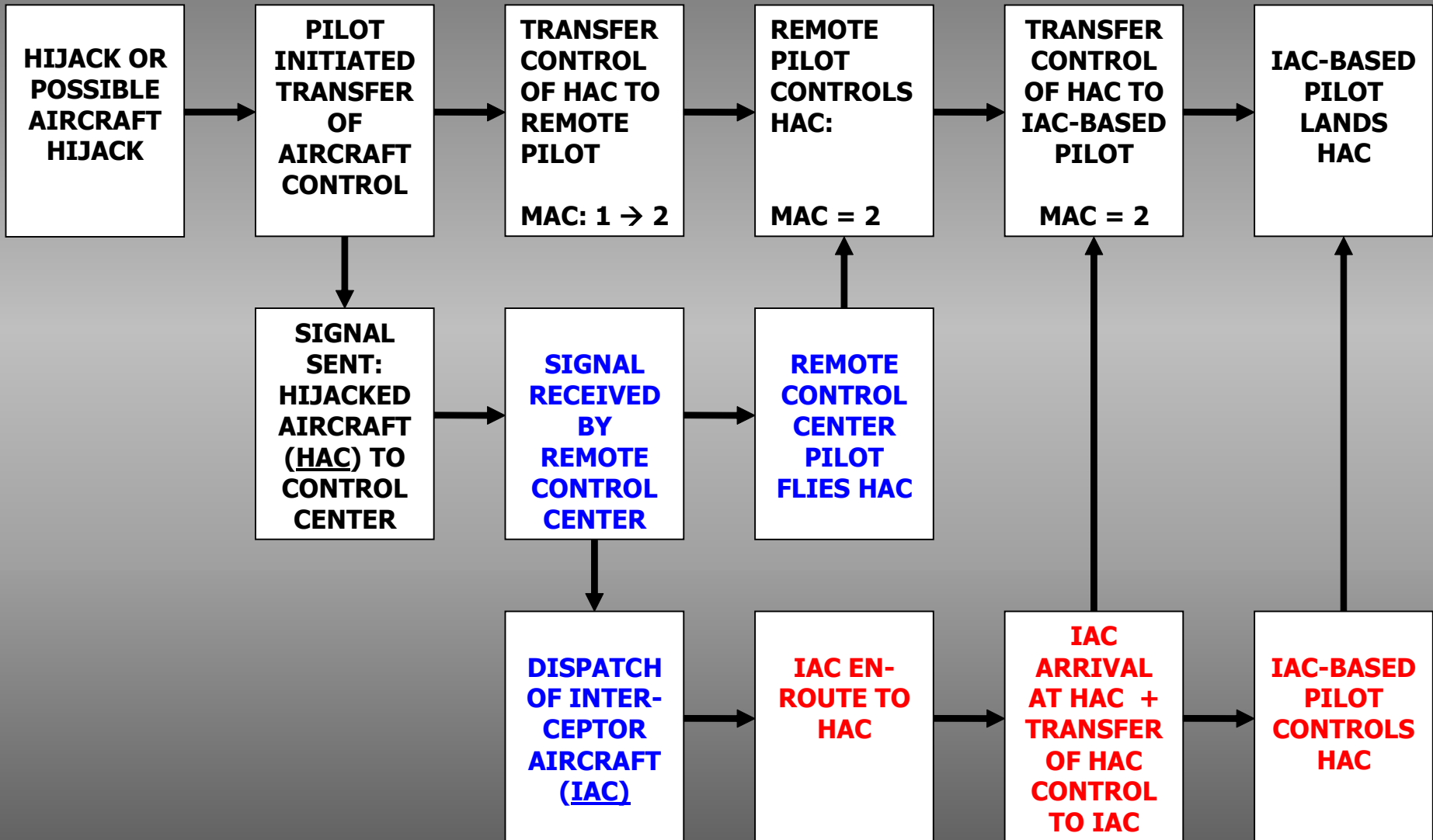
# Hijacked Aircraft Piloted From Terrestrial Control Center



# Hijacked Aircraft Piloted From Airborne Control Center



# Method IV



# Method V: Axioms I & III Eliminated

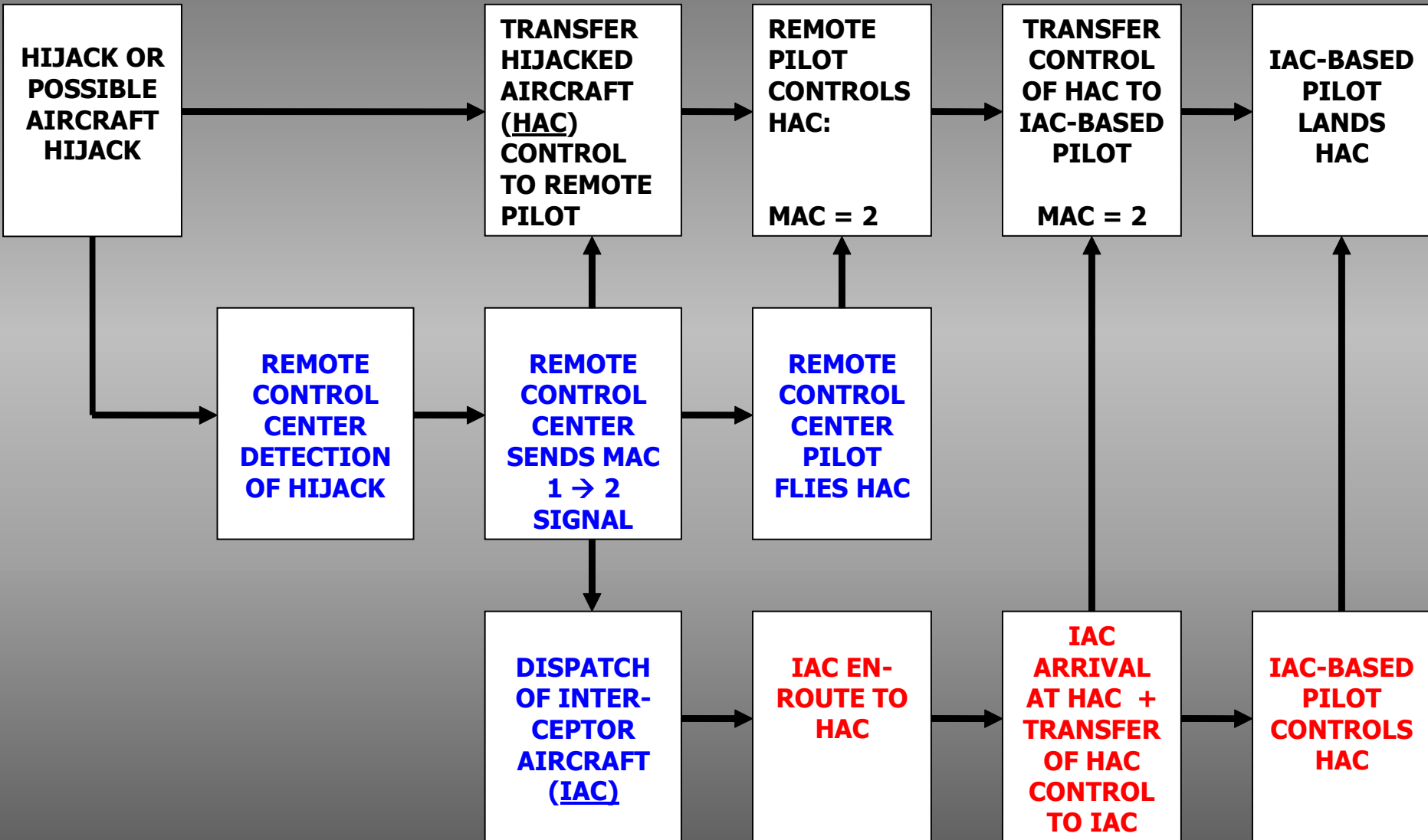
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## METHOD V

- 1) At off-HAC request, transfer control to remote pilot
- 2) Control Center dispatches IAC (Interceptor Aircraft)
- 3) HAC Control by remote pilot until IAC arrives
- 4) On arrival of IAC at HAC, transfer control of HAC to IAC-based pilot
- 5) IAC-based pilot lands HAC

# Method V



# Summary of Methods

<u>METHOD</u>	<u>AXIOM 1</u>	<u>AXIOM 3</u>	<u>PILOT PRE IAC</u>
<b>I</b>	+	+	<b>AUTOPILOT</b>
<b>II</b>	-	+	<b>HAC PILOT</b>
<b>III</b>	-	+/-	<b>AUTOPILOT</b>
<b>IV</b>	+	-	<b>CONTROL CENTER</b>
<b>V</b>	-	-	<b>CONTROL CENTER</b>

**Axiom 1:** + means that only hijacked pilot can initiate control transfer

**Axiom 3:** + means that post control transfer, only the autopilot and a local interceptor-based human pilot can control the hijacked aircraft

# Hardware Requirements

- Protected Aircraft:
  - Communications Equipment
  - Autopilot Modifications
  - User Identification Coding Equipment
- Interceptor Aircraft:
  - Communications Equipment
  - Remote Pilot Console
- Terrestrial or Airborne Control Center

# Dual Effect of System Implementation

- Direct Aircraft Protection
- Event Deterrence