Advanced Certificate in Aircraft Interior Concepts (Switzerland)

In-flight Entertainment and Connectivity Systems

ARINC 429 – a unidirectional, point-to-point data bus used for transmitting avionics information.
Related terms: AFDX, MIL-STD-1553
Explanation: ARINC 429 employs a 32-bit word structure and a single-ended, self-clocking scheme, allowing flight-deck displays, cabin lighting controllers, and IFEC servers to exchange status and control data without complex handshaking.
Example: A seat-back screen receives video-streaming commands via ARINC 429 from the central media server.
Practical application: Integration of cabin lighting systems with the entertainment controller to synchronize mood lighting with onboard movies.
Challenges: Limited bandwidth (≈12.5 kbps per channel) restricts high-definition video transmission; upgrades often require retrofitting to newer buses such as AFDX.

ARINC 664 (AFDX) – Avionics Full-Duplex Switched Ethernet, a deterministic Ethernet protocol for aircraft data networks.
Related terms: ARINC 429, Ethernet
Explanation: AFDX provides guaranteed bandwidth and redundancy through virtual links, supporting high-throughput IFEC services like live TV, Wi-Fi, and passenger-device connectivity.
Example: An Airbus A350 routes cabin Wi-Fi traffic over AFDX virtual links, ensuring QoS for streaming media.
Practical application: Enables simultaneous operation of multiple high-bandwidth services without interfering with safety-critical avionics.
Challenges: Certification complexity and the need for robust EMI shielding to protect passenger network equipment.

AVOD (Audio-Video On-Demand) – a system that stores a library of movies, music, and games on a local server for passenger selection.
Related terms: Live TV, Streaming
Explanation: Content is pre-loaded onto solid-state drives, reducing reliance on satellite bandwidth and ensuring consistent playback regardless of flight path.
Example: A Boeing 787 offers a catalog of 500 movies via AVOD, accessed through seat-back touchscreens.
Practical application: Provides entertainment options on routes with limited satellite coverage.
Challenges: Requires regular content updates and careful DRM management to prevent piracy.

Bandwidth Allocation – the process of distributing the available communication capacity among various IFEC services.

Related terms: QoS, Traffic Shaping
Explanation: Bandwidth is divided between passenger Wi-Fi, live television, cockpit communications, and telemetry, often using dynamic algorithms to prioritize critical data.
Example: During a flight, the system reduces video bitrate when multiple passengers start large file downloads.
Practical application: Maintains a balance between passenger satisfaction and operational safety.
Challenges: Variable satellite link quality can cause sudden drops, necessitating rapid reallocation to avoid service interruptions.

Bluetooth Low Energy (BLE) – a wireless protocol for short-range communication between passenger devices and cabin sensors.
Related terms: Wi-Fi, NFC
Explanation: BLE enables functions such as seat-belt reminders, cabin temperature controls, and proximity-based services with minimal power consumption.
Example: A passenger's smartphone pairs with the seat's BLE module to adjust the personal air vent.
Practical application: Enhances passenger interaction without taxing the main Wi-Fi network.
Challenges: Interference from other wireless systems and the need for secure pairing to prevent unauthorized access.

Cabin Management System (CMS) – the central controller that coordinates lighting, climate, and IFEC functionalities.
Related terms: BMS, FMS
Explanation: CMS integrates inputs from sensors, crew commands, and passenger selections, distributing commands over ARINC buses or Ethernet to actuators and entertainment servers.
Example: When a flight attendant activates "Night Mode," the CMS dims lights, lowers cabin temperature, and pauses video playback.
Practical application: Provides a unified interface for crew to manage passenger comfort and entertainment.
Challenges: Complex software integration and the need for fail-safe operation to prevent cascading faults.

Carrier-Based Wi-Fi – wireless internet service provided through an aircraft's satellite or air-to-ground (ATG) link.
Related terms: Satellite, ATG
Explanation: The aircraft's antenna connects to a ground or space-based network, delivering broadband to passenger devices via onboard routers.
Example: A Lufthansa A330 offers a 30 Mbps downlink using Ku-band satellite connectivity.
Practical application: Enables real-time email, streaming, and VoIP for passengers.
Challenges: High latency, variable coverage, and costly bandwidth contracts.

Content Delivery Network (CDN) Integration – the use of external servers to cache and stream media closer to the aircraft's location.

Related terms: Edge Computing, Cloud
Explanation: CDNs reduce latency and bandwidth consumption by storing popular titles on ground stations that the aircraft accesses via satellite.
Example: An airline partners with Akamai to pre-position new releases at European ground nodes.
Practical application: Improves start-up times for video playback and reduces satellite bandwidth spend.
Challenges: Synchronizing cache updates with flight schedules and handling regional licensing restrictions.

Digital Signal Processing (DSP) – algorithms that manipulate audio and video streams for quality enhancement.
Related terms: Codec, Noise Reduction
Explanation: DSP filters out noise, balances audio levels, and adapts video resolution based on available bandwidth.
Example: The IFEC server applies a 4-point FIR filter to reduce cabin background noise in in-flight announcements.
Practical application: Ensures clear audio and smooth video even in noisy environments.
Challenges: Real-time processing demands high-performance CPUs and can increase power consumption.

Dual-Band Antenna – an antenna system capable of operating on both Ku-band and Ka-band frequencies.
Related terms: Ku-band, Ka-band
Explanation: Dual-band antennas allow aircraft to switch between frequency bands to optimize link availability and throughput.
Example: A Boeing 777 equipped with a dual-band antenna selects Ka-band for high-capacity routes and reverts to Ku-band when Ka-band coverage is sparse.
Practical application: Maximizes satellite link utilization across diverse flight paths.
Challenges: Increased weight, mechanical complexity, and the need for seamless handover algorithms.

Embedded Systems – dedicated computing units within seats, galley equipment, or lavatories that run specific IFEC functions.
Related terms: SoC, Firmware
Explanation: These systems execute tasks such as touchscreen input processing, local media playback, or sensor monitoring, often using low-power processors.
Example: A seat-back module incorporates an ARM Cortex-A53 SoC to decode MPEG-4 video locally.
Practical application: Offloads processing from the central server, reducing network traffic.
Challenges: Limited upgrade paths and the necessity for robust, aviation-certified hardware.

Ethernet over Power Line (EoPL) – a method of transmitting data through existing cabin power lines.
Related terms: PLC, Power Distribution
Explanation: EoPL enables communication between IFEC devices without additional cabling by modulating data onto the AC power frequency.
Example: A galley coffee-maker reports usage statistics to the CMS via EoPL.

Practical application: Simplifies retrofitting in older aircraft where new wiring is costly.
Challenges: Susceptibility to electrical noise and limited data rates compared to dedicated Ethernet.

Fiber-Optic Cabling – high-speed, low-latency transmission medium used for backbone IFEC networks.
Related terms: MMF, SMF
Explanation: Single-mode or multimode fibers carry gigabit-level data between the galley, cabin zones, and avionics bays, immune to EMI.
Example: A 787's cabin network uses 40 Gbps multimode fiber to connect seat-back servers to the central router.
Practical application: Supports high-definition video streams and large-scale Wi-Fi deployments.
Challenges: Installation complexity, connector durability under vibration, and cost.

Ground-Based Content Management System (CMS) – software platforms used by airlines to curate, schedule, and upload entertainment content to aircraft.
Related terms: DRM, Content Ingestion
Explanation: Operators upload licensed media, set regional restrictions, and push updates to aircraft during turnaround.
Example: An airline's CMS automatically adds new releases to all flights departing from Tokyo.
Practical application: Streamlines content lifecycle management and ensures compliance with licensing agreements.
Challenges: Managing multiple language tracks, synchronizing with varying aircraft storage capacities, and adhering to strict security protocols.

HEVC (High Efficiency Video Coding) – a video compression standard that reduces bandwidth usage while preserving quality.
Related terms: H.264, Codec
Explanation: HEVC achieves up to 50 % bitrate savings compared to H.264, making it ideal for satellite-limited IFEC streams.
Example: Live sports broadcasts on a flight are encoded in HEVC to fit within the 10 Mbps satellite link.
Practical application: Allows more simultaneous video channels without exceeding bandwidth caps.
Challenges: Requires hardware acceleration on passenger devices; older tablets may lack HEVC support.

In-Flight Wi-Fi Hotspot – the passenger-facing wireless access point that provides internet connectivity.
Related terms: SSID, WPA2-Enterprise
Explanation: The hotspot aggregates satellite or ATG bandwidth and distributes it via 2.4 GHz/5 GHz radios, often with captive portals for authentication.
Example: Passengers select the "Airline-FreeWiFi" SSID and log in using a flight number.
Practical application: Generates ancillary revenue through tiered service plans.
Challenges: Managing concurrent connections, ensuring security against rogue devices, and maintaining QoS for critical crew communications.

Latency Management – techniques used to mitigate the delay inherent in satellite communications.
Related terms: Jitter, Buffering
Explanation: Buffering, forward error correction, and adaptive bitrate streaming smooth out latency spikes, providing a more responsive passenger experience.
Example: A video player buffers 5 seconds ahead to compensate for a 600 ms round-trip satellite latency.
Practical application: Prevents playback interruptions during high-traffic periods.
Challenges: Excessive buffering can increase perceived delay; balancing buffer size with real-time interactivity is delicate.

Live TV Broadcast – the reception and redistribution of real-time television channels via satellite to passengers.
Related terms: DVB-S2, MPEG-TS
Explanation: Satellite downlinks capture broadcast signals, decode them, and re-encode for distribution over the cabin network.
Example: A passenger watches a live football match on a seat-back screen, with the signal relayed through the IFEC server.
Practical application: Enhances passenger satisfaction on long-haul flights.
Challenges: Limited satellite transponder capacity, regional licensing, and the need for high-definition decoding hardware.

Multicast Streaming – a network method where a single data stream is delivered to multiple recipients simultaneously.
Related terms: Unicast, IGMP
Explanation: By using multicast groups, the IFEC server can send a live video feed once, and all seat-back displays subscribe, reducing bandwidth consumption.
Example: The cabin network assigns group 239.0.0.1 for the “Live News” channel.
Practical application: Efficiently supports dozens of simultaneous video streams without duplicating packets.
Challenges: Requires network equipment that supports IGMP snooping and proper QoS configuration.

Near-Field Communication (NFC) – short-range wireless technology enabling tap-to-connect interactions.
Related terms: RFID, BLE
Explanation: NFC tags embedded in seat-back panels allow passengers to pair their devices with the cabin Wi-Fi by simply tapping.
Example: A passenger taps their smartphone on an NFC-enabled logo to auto-populate Wi-Fi credentials.
Practical application: Simplifies onboarding, reducing the need for manual password entry.
Challenges: Limited range (≤4 cm) and the necessity for compatible devices.

On-Board Server (OBS) – the central computing unit that stores media, manages network traffic, and runs IFEC applications.
Related terms: NAS, Hypervisor

Explanation: The OBS typically runs a hardened operating system, supports virtualization for separate passenger and crew domains, and interfaces with satellite modems.
Example: An OBS with dual 10 TB SSDs hosts a library of 1,200 movies and runs the Wi-Fi authentication service.
Practical application: Consolidates entertainment and connectivity functions, simplifying maintenance.
Challenges: Cooling constraints at altitude, ensuring redundancy, and meeting DO-178C certification for safety-critical components.

PCIe (Peripheral Component Interconnect Express) – a high-speed serial interface used to connect storage and networking cards within IFEC hardware.
Related terms: SATA, NVMe
Explanation: PCIe lanes enable rapid data transfer between the OBS and SSDs, supporting 4 K video playback and simultaneous streaming.
Example: The OBS uses a PCIe 3.0 x4 NVMe SSD for the AVOD library.
Practical application: Reduces latency in content retrieval, enhancing user experience.
Challenges: Managing heat dissipation and ensuring vibration-resistant connectors.

QoS (Quality of Service) – policies that prioritize certain data flows over others to guarantee performance.
Related terms: DiffServ, Traffic Shaping
Explanation: In IFEC, QoS may prioritize crew communications and safety data above passenger streaming, while allocating fair share to Wi-Fi users.
Example: The router enforces a high priority tag for cockpit telemetry packets.
Practical application: Meets regulatory requirements for non-interference with avionics.
Challenges: Dynamic bandwidth fluctuations require adaptive QoS algorithms.

Radiated Emissions Compliance – ensuring that IFEC equipment does not exceed electromagnetic interference limits.
Related terms: EMC, Shielding
Explanation: Certification tests measure emissions across frequency bands to protect avionics and external aircraft systems.
Example: Seat-back displays undergo CE marked testing for compliance with DO-160G standards.
Practical application: Guarantees safe operation alongside navigation and communication radios.
Challenges: Tight margins in modern aircraft where many electronic devices coexist.

Satellite Ku-Band – a frequency range (12–18 GHz) commonly used for commercial in-flight broadband services.
Related terms: Ka-Band, L-Band
Explanation: Ku-band offers moderate bandwidth with relatively forgiving rain-fade characteristics, making it suitable for most routes.
Example: An airline contracts with a Ku-band provider for a 15 Mbps downlink on its fleet.

Practical application: Provides a balance of coverage and capacity for mid-range flights.
Challenges: Susceptible to signal attenuation during heavy precipitation; antenna size constraints on smaller aircraft.

Satellite Ka-Band – a higher frequency range (26.5–40 GHz) that delivers greater bandwidth but is more sensitive to weather.
Related terms: Ku-Band, Rain Fade
Explanation: Ka-band supports multi-gigabit links, enabling high-definition live TV and fast Wi-Fi for premium cabins.
Example: A business jet utilizes Ka-band for a 50 Mbps link, offering 4 K streaming.
Practical application: Enhances premium passenger experience on high-value routes.
Challenges: Requires precise antenna pointing and robust link-budget calculations to mitigate rain fade.

Software-Defined Radio (SDR) – a radio communication system where signal processing is performed in software rather than hardware.
Related terms: RF Front-End, DSP
Explanation: SDRs can switch between frequencies, modulation schemes, and protocols, allowing flexible IFEC connectivity (e.g., switching between Ku and Ka bands).
Example: An aircraft's SDR module updates its firmware to support a new ATG network without hardware changes.
Practical application: Future-proofs the connectivity architecture and reduces fleet-wide retrofits.
Challenges: Requires rigorous certification of the software stack and protection against cyber-intrusion.

TCAS (Traffic Collision Avoidance System) Integration – ensuring IFEC networks do not interfere with safety-critical collision avoidance communications.
Related terms: ADS-B, Mode S
Explanation: Network design isolates passenger Wi-Fi and entertainment traffic from TCAS transponder frequencies, often using physical and logical segregation.
Example: The cabin router places TCAS data on a dedicated ARINC 429 bus, separate from passenger traffic.
Practical application: Maintains compliance with ICAO safety standards.
Challenges: Balancing the need for high-capacity passenger services with strict isolation requirements.

UHF Band (Ultra-High Frequency) – frequency range (300 MHz–3 GHz) used for certain air-to-ground communication links.
Related terms: VHF, L-Band
Explanation: Some regional ATG networks employ UHF to provide broadband services in dense urban environments where satellite coverage is limited.
Example: A European low-cost carrier uses UHF-based ATG to deliver 5 Mbps Wi-Fi on short-haul flights.
Practical application: Complements satellite links for better overall coverage.
Challenges: Requires line-of-sight with ground stations, limiting availability over remote areas.

Virtual Private Network (VPN) – an encrypted tunnel that secures data transmission between the aircraft and ground servers.
Related terms: TLS, IPsec
Explanation: VPNs protect passenger credentials, crew communications, and maintenance telemetry from interception over public satellite links.
Example: The OBS establishes an IPsec VPN to the airline's ground firewall before uploading flight data.
Practical application: Meets GDPR and other data-privacy regulations.
Challenges: Additional processing overhead and the need for robust key management in an airborne environment.

Wi-Fi 6 (802.11ax) – the latest Wi-Fi standard offering higher throughput, lower latency, and improved device density handling.
Related terms: Wi-Fi 5, OFDMA
Explanation: Wi-Fi 6 introduces OFDMA and MU-MIMO, allowing the cabin hotspot to serve many passengers simultaneously with better efficiency.
Example: A 777 equipped with Wi-Fi 6 can support 200 concurrent device connections at 300 Mbps aggregate.
Practical application: Enables seamless streaming and cloud gaming for premium cabins.
Challenges: Requires compatible passenger devices; older smartphones may fall back to slower standards, reducing overall performance.

Zero-Touch Provisioning (ZTP) – an automated process that configures IFEC hardware upon power-up without manual intervention.
Related terms: DHCP, Auto-Discovery
Explanation: ZTP pulls configuration files from a central server, assigns IP addresses, and registers the device in the fleet management system.
Example: A newly installed seat-back module boots, contacts the airline's provisioning server, and receives its firmware and content list.
Practical application: Accelerates aircraft turnaround and reduces human error during installations.
Challenges: Network security must prevent rogue devices from hijacking the provisioning process.

Air-to-Ground (ATG) Network – a terrestrial communication system where aircraft communicate with ground stations via radio links.
Related terms: GPRS, LTE
Explanation: ATG uses dedicated frequency bands (often in the 800 MHz-2 GHz range) to provide broadband connectivity, especially over continental routes.
Example: An airline's domestic fleet relies on an ATG provider offering 10 Mbps downlink across the United States.
Practical application: Offers lower latency compared to satellite for short-haul flights.
Challenges: Coverage gaps over oceans and mountainous regions; regulatory approvals for frequency use.

Content Encryption Standard (CES) – a set of cryptographic methods used to protect media files stored on IFEC servers.
Related terms: AES, DRM
Explanation: CES typically employs AES-256 encryption combined with digital rights management to prevent unauthorized copying or distribution.
Example: All movies on the AVOD library are encrypted with a 256-bit key that rotates daily.
Practical application: Satisfies licensing agreements with studios.
Challenges: Key management complexity and the need for decryption hardware on passenger devices.

Dynamic Bandwidth Allocation (DBA) – a real-time algorithm that reallocates network capacity based on current demand.
Related terms: QoS, Traffic Shaping
Explanation: DBA monitors active streams, passenger Wi-Fi usage, and crew communications, adjusting priority weights to maintain service levels.
Example: When a passenger initiates a video conference, the system temporarily reduces live TV bitrate to preserve voice quality.
Practical application: Optimizes limited satellite resources for mixed-use scenarios.
Challenges: Requires predictive analytics to avoid abrupt service degradation.

Edge Computing Node – a localized processing unit placed within the aircraft to perform compute-intensive tasks close to the data source.
Related terms: Fog Computing, Cloud
Explanation: Edge nodes can transcode video, run analytics on passenger usage, and cache content, reducing latency and bandwidth consumption.
Example: An edge server on a 787 transcodes 1080p movies to 720p on-the-fly based on current link capacity.
Practical application: Enhances adaptability of IFEC services to varying connectivity conditions.
Challenges: Limited space, power, and cooling; must meet aviation certification standards.

Frequency Reuse – a technique where the same radio frequency spectrum is used in different cabin zones to increase overall capacity.
Related terms: Cell Planning, Interference
Explanation: By segmenting the cabin into multiple Wi-Fi cells with careful power control, the system can serve more devices without additional spectrum.
Example: A large aircraft divides the cabin into four Wi-Fi zones, each reusing the 5 GHz channel.
Practical application: Supports high device density in premium cabins.
Challenges: Managing co-channel interference and ensuring seamless roaming for passengers moving between zones.

Ground-to-Aircraft Data Link (GDL) – the pathway for transmitting non-voice data, such as maintenance

logs or passenger surveys, from ground stations to the aircraft.
Related terms: ACARS, VHF Data Link
Explanation: GDL uses narrowband channels (often VHF or HF) to send small packets, complementing high-bandwidth satellite links for bulk data.
Example: After landing, the aircraft receives a firmware update via GDL before the next flight.
Practical application: Enables timely software patches without ground crew intervention.
Challenges: Limited throughput and higher latency compared to broadband links.

Head-Mounted Display (HMD) Integration – the capability of the IFEC system to stream content to wearable devices such as VR goggles.
Related terms: VR, AR
Explanation: The OBS provides low-latency, high-resolution video streams compatible with HMD protocols, often using HEVC and adaptive bitrate.
Example: Passengers on a long-haul flight watch immersive 360° documentaries through a supplied VR headset.
Practical application: Differentiates premium cabin offerings and opens new revenue streams.
Challenges: Managing motion-sickness, ensuring sufficient bandwidth, and complying with safety regulations for wearable electronics.

In-Flight Messaging (IFM) – a service that delivers airline announcements, promotions, and personalized offers to passenger devices.
Related terms: Push Notification, OTA
Explanation: IFM uses the cabin Wi-Fi network to push short messages, often linked to the passenger's seat number or loyalty status.
Example: A passenger receives a push notification offering a discounted duty-free purchase during the flight.
Practical application: Increases ancillary revenue and improves passenger engagement.
Challenges: Avoiding message fatigue and ensuring compliance with privacy regulations.

Interference Mitigation – strategies employed to reduce the impact of unwanted radio signals on IFEC performance.
Related terms: Filtering, Shielding
Explanation: Techniques include frequency planning, antenna isolation, and active noise cancellation for RF signals.
Example: The aircraft uses band-pass filters on Wi-Fi transceivers to reject adjacent-channel interference from the cockpit radios.
Practical application: Maintains reliable connectivity in congested electromagnetic environments.
Challenges: Continuous monitoring is required as new wireless devices (e.g., passenger drones) emerge.

Latency-Sensitive Applications – services that require minimal delay, such as VoIP calls, video conferencing,

or real-time gaming.
Related terms: Jitter, QoS
Explanation: These applications demand strict QoS policies, priority routing, and often lower compression ratios to preserve interactivity.
Example: A business traveler conducts a live video conference using the cabin Wi-Fi while the aircraft is cruising at FL350.
Practical application: Supports corporate travelers who need connectivity for mission-critical tasks.
Challenges: Satellite latency (≥500 ms) can degrade performance; solutions may involve edge computing or hybrid ATG/satellite links.

Low-Earth Orbit (LEO) Satellite Constellation – a network of satellites positioned at altitudes of 500-2000 km, providing reduced latency broadband.
Related terms: MEO, GEO
Explanation: LEO constellations (e.g., Starlink, OneWeb) offer round-trip latencies as low as 30-50 ms, dramatically improving IFEC experiences.
Example: An airline equips its fleet with LEO terminals, delivering near-ground-level internet speeds.
Practical application: Enables high-quality video conferencing and cloud gaming on board.
Challenges: Frequent handovers as the aircraft moves through satellite footprints, requiring sophisticated tracking and seamless session continuity.

Media Management Interface (MMI) – the graphical user interface through which crew configure entertainment options and monitor system health.
Related terms: HMI, GUI
Explanation: The MMI runs on cockpit or cabin crew tablets, providing real-time status of content servers, bandwidth usage, and passenger requests.
Example: A flight attendant uses the MMI to pause a movie on a seat that is experiencing playback errors.
Practical application: Allows quick troubleshooting without technical support.
Challenges: Designing an intuitive interface that complies with ergonomic standards and avoids clutter.

Multilingual Support – the capability of the IFEC system to present menus, subtitles, and audio tracks in multiple languages.
Related terms: Localization, i18n
Explanation: Content metadata includes language tags, and the system dynamically selects the appropriate track based on passenger profile.
Example: A French-speaking passenger selects a movie and automatically receives French subtitles.
Practical application: Enhances comfort for international travelers and meets regulatory requirements for accessibility.
Challenges: Managing large libraries of localized content and ensuring synchronization across audio and subtitle streams.

Network Time Protocol (NTP) Synchronization – the process of aligning clocks across all IFEC devices to a common reference.
Related terms: PTP, GPS
Explanation: Accurate timekeeping ensures proper ordering of data packets, correct logging of events, and seamless handover between satellite links.
Example: The OBS synchronizes to the aircraft's GPS-derived UTC time via NTP.
Practical application: Facilitates coordinated playback of live TV across all seats.
Challenges: Variations in network delay can cause drift; high-precision protocols like PTP may be required for stricter timing.

On-Demand Advertising (ODA) – targeted commercials delivered to passengers based on profile data or flight phase.
Related terms: Personalization, Ad-Insertion
Explanation: ODA inserts short video ads before or during content playback, leveraging the seat-back or personal device screen.
Example: A passenger who selected a travel-related documentary receives a 15-second ad for a partner hotel.
Practical application: Generates additional revenue streams and promotes airline services.
Challenges: Balancing ad frequency to avoid annoyance, ensuring compliance with privacy laws, and maintaining ad quality over variable bandwidth.

Payload Power Management – the allocation and monitoring of electrical power to IFEC equipment.
Related terms: DC-DC Converter, UPS
Explanation: IFEC devices draw power from the aircraft's DC bus; power controllers balance load, prevent overloads, and provide backup during brief voltage dips.
Example: The seat-back screens are supplied via isolated DC-DC converters that limit draw to 5 W per unit.
Practical application: Guarantees reliable operation without impacting primary aircraft systems.
Challenges: Managing heat dissipation and ensuring redundancy in case of power failures.

Quality of Experience (QoE) Metrics – measurements that reflect passenger satisfaction with entertainment and connectivity services.
Related terms: MOS, NPS
Explanation: QoE combines objective data (e.g., buffering events, bitrate) with subjective feedback (surveys) to assess service performance.
Example: After a flight, passengers rate the streaming service, generating a Mean Opinion Score (MOS) of 4.2.
Practical application: Guides service improvements and informs pricing strategies.
Challenges: Collecting unbiased data and correlating it with technical parameters.

Radio Frequency (RF) Planning – the design process for positioning antennas, selecting frequencies, and

configuring transmit power.
Related terms: Site Survey, Link Budget
Explanation: Proper RF planning ensures optimal satellite link reliability while minimizing interference with other aircraft systems.
Example: Engineers conduct a site survey to determine the best placement for a Ka-band antenna on the fuselage.
Practical application: Maximizes link availability across diverse flight routes.
Challenges: Accounting for aircraft structural shadowing and aerodynamic constraints.

Redundant Network Architecture – a design that incorporates backup paths and equipment to maintain IFEC service continuity.
Related terms: Dual-Homing, Failover
Explanation: Redundancy may involve dual routers, mirrored storage, and automatically switching to an alternative satellite provider if the primary link degrades.
Example: The OBS contains two independent Ethernet switches; if one fails, traffic reroutes through the second without interruption.
Practical application: Meets airline service level agreements (SLAs) for uninterrupted entertainment.
Challenges: Added weight, cost, and the need for rigorous testing to validate failover mechanisms.

Remote Firmware Update (RFU) – the capability to upload new software versions to IFEC devices while the aircraft is on the ground or in flight.
Related terms: OTA, Patch Management
Explanation: RFU uses secure channels to deliver updates, reducing the need for physical access and minimizing turnaround time.
Example: A security patch is pushed to all seat-back modules overnight via the ground network.
Practical application: Keeps the system up-to-date with the latest features and security fixes.
Challenges: Ensuring update integrity, preventing bricking, and complying with certification requirements for software changes.

Satellite Rain-Fade Mitigation – techniques to counteract signal loss caused by precipitation.
Related terms: Adaptive Coding, Power Boost
Explanation: The system may increase transmit power, switch to a lower-order modulation, or fallback to a different frequency band during rain events.
Example: During a heavy rainstorm, the Ka-band link automatically reduces from 64-QAM to 16-QAM to maintain connectivity.
Practical application: Preserves passenger Wi-Fi service during adverse weather.
Challenges: Power constraints and the need for rapid detection of rain-fade conditions.

Secure Boot Process – a hardware-enabled verification that only authenticated firmware can run on IFEC devices.

Related terms: TPM, Code Signing
Explanation: During power-on, the bootloader checks cryptographic signatures of each software component, preventing malicious code execution.
Example: The OBS's BIOS validates the kernel image against a stored RSA hash before loading.
Practical application: Protects against supply-chain attacks and unauthorized modifications.
Challenges: Managing key revocation and updating certificates without compromising flight safety.

Seat-Back Display Resolution – the pixel density and aspect ratio of the screen installed on each passenger seat.
Related terms: 1080p, 4K
Explanation: Higher resolutions provide sharper images but increase bandwidth and processing requirements.
Example: A 737 MAX features 12-inch 1080p LCDs, while a premium cabin on a 777 offers 4K OLED panels.
Practical application: Aligns visual quality with service class and pricing strategy.
Challenges: Balancing cost, power consumption, and the ability of the network to sustain the needed bitrate.

Streaming Protocols (HLS/DASH) – standards for delivering media over HTTP in adaptive bitrate formats.
Related terms: HLS, MPEG-DASH
Explanation: These protocols segment video into small chunks, allowing the client to switch quality levels based on real-time bandwidth.
Example: A passenger's device requests a 5 Mbps segment; when bandwidth drops, the player selects a 2 Mbps segment.
Practical application: Provides smooth playback across fluctuating satellite links.
Challenges: Implementing low-latency variants for live content and ensuring compatibility with a wide range of passenger devices.

Telemetry Data Compression – reducing the size of aircraft performance and health data before transmission to ground stations.
Related terms: Huffman, LZ77
Explanation: Compression algorithms encode sensor readings efficiently, conserving bandwidth for IFEC services.
Example: Engine parameters are compressed using a custom lossless scheme before being sent via ACARS.
Practical application: Frees up bandwidth for passenger connectivity without sacrificing diagnostic fidelity.
Challenges: Maintaining real-time delivery and ensuring decompression does not introduce errors.

Unified Passenger Interface (UPI) – a single touchscreen or remote that allows passengers to control entertainment, lighting, and connectivity settings.
Related terms: HMI, UI
Explanation: The UPI consolidates multiple functions, reducing hardware complexity and enhancing user

experience.
Example: A touchpad mounted on the armrest lets a passenger adjust the personal screen brightness, request Wi-Fi access, and order a meal.
Practical application: Streamlines cabin design and lowers manufacturing costs.
Challenges: Designing an intuitive layout that meets accessibility standards for all passengers.

Virtualization of IFEC Services – running multiple logical instances of entertainment and connectivity applications on shared hardware.
Related terms: Hypervisor, Container
Explanation: Virtual machines or containers isolate passenger services from crew-critical functions, improving security and resource utilization.
Example: The OBS hosts a VM for passenger Wi-Fi and another for the crew's operational data, each with separate network interfaces.
Practical application: Enables flexible scaling and easier maintenance.
Challenges: Ensuring real-time performance and meeting aviation certification for virtualized environments.

Wi-Fi Roaming Management – handling passenger device transitions between cabin Wi-Fi zones without dropping connections.
Related terms: 802.11r, Fast BSS Transition
Explanation: Roaming protocols allow seamless handoff by pre-authenticating devices to neighboring access points.
Example: As a passenger walks from the front to the rear of the aircraft, their tablet automatically switches to the stronger signal zone.
Practical application: Maintains stable internet sessions throughout the flight.
Challenges: Synchronizing multiple APs, avoiding channel overlap, and managing authentication latency.

Zero-Latency Gaming (ZLG)</b