SYSTEM REQUIREMENT SPECIFICATION (SYSRS)

[Product Name]

Version: 1.0

Date: June 16th, 2025

Prepared By:
[Company Name, Department]

1. Introduction

1.1 Purpose

The purpose of this System Requirement Specification (SyRS) is to precisely define all functional and non-functional requirements, including software, hardware, and interface requirements, for the Intelligence Fusion Center (IFC) System, Release V1.0.0. This document serves as the foundational agreement between stakeholders, development teams, and hardware providers, ensuring a unified understanding of the system's capabilities, performance, and operational environment. It aligns with the "Software Requirements Analysis Process" and forms the basis for subsequent design, development, and V&V activities as per ISO/IEC 12207.

1.2 Scope

This document specifies the complete set of requirements for the initial operational capability (IOC) of the Intelligence Fusion Center (IFC) System. It encompasses all aspects necessary for the system to ingest, process, analyze, visualize, report on, and predict intelligence data from various sources. While it defines system-level requirements, detailed design specifications for individual software components or hardware blueprints are provided in separate design documents.

1.3 Definitions and Acronyms

- **API:** Application Programming Interface
- **BDR:** Big Data Repository
- **FR:** Functional Requirement (Software)
- **NFR:** Non-Functional Requirement (Software)
- **GIS:** Geographical Information System
- **IRS:** Interface Requirement Specification
- **ISO/IEC 12207:** International standard for software life cycle processes.
- **LLM:** Large Language Model
- **OCR:** Optical Character Recognition
- **RCD:** Requirements Capture Document
- **RTM:** Requirements Traceability Matrix
- **SOP:** Standard Operating Procedure
- **SSD:** Software Design Document

- **SSCT:** System/Software/Solution/System Component Testing
- **V&V:** Verification and Validation

1.4 References

- ISO/IEC 12207: Systems and software engineering — Software life cycle processes
- ISO/IEC/IEEE 29119: Software and systems engineering — Software testing
- Previous RCD, Test Plan, Test Result Report, SSD (for context and detailed FRs/NFRs which are integrated here)

2. Overall System Description

2.1 Product Perspective

The IFC System is an integrated intelligence platform designed to centralize, process, analyse, and visualize diverse intelligence data. It is a key component within the organization's intelligence operations, interacting with various data sources and providing actionable insights to multiple user roles. It is a self-contained system at its core but designed to integrate seamlessly with existing organizational infrastructure and external intelligence feeds.

2.2 Product Functions (High-Level Capabilities)

The IFC System offers the following core capabilities:

- **Automated Data Ingestion:** Securely importing data from diverse sources.
- **Intelligent Data Processing:** Cleaning, transforming, and enriching data, including advanced multilingual OCR and text analytics.
- **Unified Data Storage:** Creating a cohesive, searchable, and queryable repository for all ingested data.
- **Advanced Search Capabilities:** Enabling users to find specific information quickly and effectively through various search methodologies.
- **Workflow Management:** Automating and managing the flow of information processing and report generation.
- **Comprehensive Data Visualization:** Presenting complex data in intuitive and interactive visual formats (GIS maps, timelines, graphs, dashboards).
- **Predictive Detection:** Identifying trends, forecasting future events, and unusual patterns in the data.
- **Automated Report Generation:** Producing customizable reports in multiple formats.
- **AI-Powered Intelligence:** Utilizing LLMs for advanced search, summarization,

and analysis of large text datasets.
- **User Management and Security:** Authentication, Authorization, and auditing.

2.3 User Characteristics

The system caters to different user profiles with varying technical skills and operational responsibilities (Clerk, GSO, Col, Admin), each requiring specific UI/UX considerations as detailed in the Interface Design Document.

2.4 General Constraints

- **Operational Environment:** Must operate within the specified hardware and network infrastructure (detailed in Section 5).
- **Data Volume:** Must handle ingestion, processing, and storage of terabytes of data over time.
- **Security:** Must adhere to strict organizational and regulatory security policies.
- **Performance:** All key operations must meet specified response times.
- **Maintainability:** Designed for ease of updates, troubleshooting, and expansion.

2.5 Assumptions and Dependencies

- **Network Infrastructure:** Assumes robust and secure network connectivity for all system components and external interfaces.
- **Personnel Training:** Assumes that users will receive adequate training to effectively operate the system's functionalities.
- **Data Quality:** Assumes that input data, while diverse, possesses a baseline level of quality to allow for meaningful processing and analysis.

3. Software Requirements Specification (SRS)

This section details the functional and non-functional requirements for the software components of the IFC System.

3.1 Functional Requirements (FRs)

This section details the specific functionalities the Intelligence Fusion Center must provide.

3.1.1 Data Ingestion Pipelines (FR-ING-001)

- **FR-ING-001.1:** The system shall provide dedicated, configurable pipelines for ingesting data from Excel files.
- **FR-ING-001.2:** The system shall provide dedicated, configurable pipelines for ingesting data from Microsoft Access Databases.

- **FR-ING-001.3:** The system shall provide dedicated, configurable pipelines for ingesting data from SQL Databases.
- **FR-ING-001.4:** The system shall provide dedicated, configurable pipelines for ingesting scanned documents.
- **FR-ING-001.5:** The system shall provide dedicated, configurable pipelines for ingesting digital document files (e.g., PDF, Word).
- **FR-ING-001.6:** The system shall support only on-demand data ingestion for all supported sources.

3.1.2 Multilingual OCR (FR-OCR-001)

- **FR-OCR-001.1:** The system shall perform Optical Character Recognition (OCR) on scanned documents to extract text.
- **FR-OCR-001.2:** The OCR module shall accurately recognize and extract text in English.
- **FR-OCR-001.3:** The OCR module shall accurately recognize and extract text in Hindi.
- **FR-OCR-001.4:** The OCR module shall accurately recognize and extract text in Mandarin.
- **FR-OCR-001.5:** The system shall allow users to review and correct OCR errors.

3.1.3 Big Data Repository (FR-BDR-001)

- **FR-BDR-001.1:** The system shall compile and store data from all ingested sources (Excel, Access, SQL, scanned/digital documents) in a unified database.
- **FR-BDR-001.2:** The repository shall support storing structured, semi-structured, and unstructured data formats.
- **FR-BDR-001.3:** The system shall automatically co-relate different data sources based on predefined or configurable relationships.

3.1.4 Search Tool (FR-SRCH-001)

- **FR-SRCH-001.1:** The system shall import raw data into a search index for efficient retrieval.
- **FR-SRCH-001.2:** The system shall offer form-based search, allowing users to specify criteria in structured fields.
- **FR-SRCH-001.3:** The system shall offer advanced search capabilities supporting Boolean logic (AND, OR, NOT).
- **FR-SRCH-001.4:** The system shall support proximity search, allowing users to find terms within a specified distance of each other.
- **FR-SRCH-001.5:** The system shall support fuzzy search, enabling retrieval of results even with minor misspellings or variations in search terms.
- **FR-SRCH-001.6:** Search results shall be presented clearly, indicating the source and relevance.

3.1.5 Workflow Automation (FR-WFA-001)

- **FR-WFA-001.1:** The system shall support the definition and execution of automated workflows for processing ingested information.
- **FR-WFA-001.2:** Workflows shall allow for multi-level processing stages (e.g., ingestion, enrichment, analysis, reporting).
- **FR-WFA-001.3:** The system shall enable users to configure rules and triggers for workflow execution.

- **FR-WFA-001.4:** The system shall provide a mechanism for users to review and approve intermediate and final outputs of workflows.
- **FR-WFA-001.5:** The system shall generate reports automatically based on defined workflow outcomes.

3.1.6 Text Analytics (FR-TA-001)

- **FR-TA-001.1:** The system shall incorporate text analytics capabilities as part of the data pre-processing stage.
- **FR-TA-001.2:** The text analytics module shall perform text classification to categorize documents or text segments.
- **FR-TA-001.3:** The text analytics module shall support dictionary augmentation, allowing users to add custom terms and synonyms.
- **FR-TA-001.4:** The text analytics module shall perform entity extraction to identify and categorize key entities (e.g., units, locations, dates) from text.
- **FR-TA-001.5:** The extracted entities and classifications shall be stored alongside the data for analytical querying.

3.1.7 Geospatial Analysis Module (FR-GIS-001)

- **FR-GIS-001.1:** The System should have an inbuilt/ integrated GIS that shall display geospatial data (inputs, reports, analysis) on an interactive GIS dashboard.
- **FR-GIS-001.2:** The GIS dashboard shall support various map layers and overlays.
- **FR-GIS-001.3:** Users shall be able to filter and interact with geospatial data directly on the map.
- **FR-GIS-001.4:** The system shall support plotting custom points, events, areas, and routes on the map. On click it should also show associated information of that events.
- **FR-GIS-001.5:** The system has ability to export geo-referenced data in a format compatible with OGC.
- **FR-GIS-001.6:** The system should generate and visualise the heat map, cluster map and charts.
- **FR-GIS-001.7:** The system should allow creation of geo-polygon boundaries for filtered searches.
- **FR-GIS-001.8:** The system should allow creation of timeline layer on top of the geo-layer.
- **FR-GIS-001.9:** The system should allow import and export of GIS data such as shp & KML files geographics data in an excel/csv file.

3.1.8 Temporal Analysis Module (FR-TIM-001)

- **FR-TIM-001.1:** The system shall provide a timeline analysis module.
- **FR-TIM-001.2:** The timeline module shall allow multiple events from different data sources to be plotted on the same chronological timeline.
- **FR-TIM-001.3:** Users shall be able to zoom, pan, and filter events on the timeline.
- **FR-TIM-001.4:** The timeline shall display event details upon selection.

3.1.9 Graph Analysis Module (FR-GRPH-001)

- **FR-GRPH-001.1:** The system shall represent relationships between data nodes in an interactive graph visualization.
- **FR-GRPH-001.2:** The graph module shall visualize reports and analytical

findings.

- **FR-GRPH-001.3:** Users shall be able to explore connections and expand nodes.
- **FR-GRPH-001.4:** The graph visualization shall support different layout methods.

3.1.10 Predictive Module (FR-PAN-001)

- **FR-PAN-001.1:** Predictive Generation Capability
  - The system shall provide the ability to generate predictions based on analyzed trends and patterns.
  - The system shall support predictive generation for user-defined "Use Cases" (specific events).
- **FR-PAN-001.2:** The system shall provide the ability to perform pattern recognition on historical data for user-defined "Use Cases."
- **FR-PAN-001.3:** The system shall allow users to define and select specific "Use Cases" for predictive generation and pattern recognition.
- **FR-PAN-001.4:** The system's prediction module shall utilize historical data from the past three years.
- **FR-PAN-001.5:** The system shall identify trends based on the analyzed historical data.
- **FR-PAN-001.6:** The system shall make predictions for specific scenarios, including but not limited to:
  - Likely hotspots for infiltration.
  - Units which may go for training or move.
  - Likely hotspots (concentration) of radars.
- **FR-PAN-001.7:** The predictions shall be based on a mathematical model built on probabilities.
- **FR-PAN-001.8:** The predictive module shall achieve a minimum accuracy of 30% at the SSCT (System/Software/Solution/System Component Testing) Stage.

3.1.11 IMINT Module (FR-IMT-001)

- **FR-IMT-001.1:** The system shall enable the user to ingest relevant data from the IMINT into a form-based collation system. For trial purposes, the system shall allow the user to provide IMINT data in their existing IMINT format.
- **FR-IMT-001.2:** The system shall provide a dedicated dashboard for the user (duly standardized by user) for ingestion of IMINT from IFC workstation of IIT.

3.1.12 Widgets (FR-WGT-001)

- **FR-WGT-001.1:** The Intelligence Fusion Center shall offer a variety of customizable widgets for display on dashboards.
- **FR-WGT-001.2:** Widgets shall include, but not be limited to, summary statistics, and charts (bar, pie, line).

3.1.13 Report Generation (FR-RPT-001)

- **FR-RPT-001.1:** The system shall generate output reports based on user-defined criteria and workflow outcomes.
- **FR-RPT-001.2:** Reports shall be generatable in Microsoft Word (.docx) format.
- **FR-RPT-001.3:** Reports shall be generatable in Microsoft Excel (.xlsx) format.
- **FR-RPT-001.4:** Reports shall be generatable in Portable Document Format (PDF).
- **FR-RPT-001.5:** Reports shall be generatable in Extensible Markup Language (XML) format.

- **FR-RPT-001.6:** Reports shall be generatable in HyperText Markup Language (HTML) format.
- **FR-RPT-001.7:** The system shall provide a user interface for managing generated reports, including viewing, and downloading.

3.1.14 AI/LLM Model (FR-LLM-001)

- **FR-LLM-001.1:** The system shall incorporate a Large Language Model (LLM) to enhance search capabilities.
- **FR-LLM-001.2:** The system shall be capable of summarizing user-specified events from ingested data.
- **FR-LLM-001.3:** The system shall be capable of summarizing user-specified profiles (e.g., units, locations, equipment).
- **FR-LLM-001.4:** Users shall be able to select multiple events and/or documents for summarization by the system.
- **FR-LLM-001.5:** The system shall provide natural language search capabilities, allowing users to ask questions and receive relevant answers from the data.
- **FR-LLM-001.6:** The system should allow report generation for the user from data.
- **FR-LLM-001.7:** The system should be capable to translate any text into different languages including Hindi, Chinese, Hebrew, Arabic etc.

3.2 Non-Functional Requirements (NFRs)

This section describes the quality attributes and general constraints that the system must adhere to.

- **Performance Requirements:** Response times, throughput, resource utilization.
- **Security Requirements:** Authentication, authorization, data encryption, audit logging.
- **Usability Requirements:** Learnability, efficiency, error handling, user satisfaction.
- **Reliability Requirements:** Uptime, mean time between failures (MTBF), data integrity.
- **Maintainability Requirements:** Modularity, documentation, monitorability.
- **Portability Requirements:** Supported platforms, browser compatibility.
- **Scalability Requirements:** Capacity for data growth, concurrent users, processing load.

4. Interface Requirements Specification (IRS)

This section specifies all internal and external interfaces of the IFC System, detailing the interactions between the system and its users, other software components & hardware.

4.1 User Interfaces

- **IRS-UI-001:** The system shall provide a web-based Graphical User Interface (GUI) accessible via standard web browsers (latest stable versions of Chrome, Firefox, Edge).
- **IRS-UI-002:** The GUI shall support responsive design principles to adapt to various desktop screen sizes.
- **IRS-UI-003:** User roles (Clerk, CSO, Col) shall have distinct dashboards and access privileges within the UI.
- **IRS-UI-004:** The GUI shall provide visual feedback for all user actions (e.g., loading indicators, fadeout success messages, toast notifications for warnings, modal dialogs for critical errors).
- **IRS-UI-005:** The UI for OCR error review shall provide a side-by-side view of the original scanned image and editable extracted text.
- **IRS-UI-006:** The UI for Geospatial Analysis shall provide interactive map controls (pan, zoom, layer toggles) and tools for drawing custom elements.
- **IRS-UI-007:** The UI for Workflow Approval shall include a mechanism to access and review reference files (e.g., original ingested documents) in a new browsing tab.

4.2 Software Interfaces

- **IRS-SI-001:** The system shall utilize an Elasticsearch cluster (v7.x/8.x) as its primary search index, interacting via its RESTful API.
- **IRS-SI-002:** The system shall integrate with the Innefu's on-premises or cloud connected API for Large Language Model (LLM) functionalities (summarization, natural language search). Authentication via API keys.
- **IRS-SI-003:** The system shall integrate with the Tesseract OCR engine for text extraction from images.
- **IRS-SI-004:** Thes systems shall integrate with an interactive map displaying geospatial data, with filtering and layering options.
- **IRS-SI-005:** The system shall expose RESTful/Fast APIs for internal microservice communication (e.g., between Data Ingestion Service, Workflow Service, Search Service).
- **IRS-SI-006:** The system shall interface with standard file system operations for accessing local shared drives during file ingestion.

- **IRS-SI-007:** The system shall utilize libraries for parsing and generating Microsoft Office formats (.docx, .xlsx, .accdb) and PDF/XML/HTML formats.

4.3 Communications Interfaces

- **IRS-CI-001:** All client-server communication shall use HTTPS/TLS for secure data transmission.
- **IRS-CI-002:** Internal microservice communication shall use secure, authenticated channels (e.g., Mutual TLS, JWT tokens over HTTPS).
- **IRS-CI-003:** Network protocols such as TCP/IP, HTTP/S, and database-specific protocols shall be supported for data source connectivity.
- **IRS-CI-004:** The system shall provide secure FTP/SFTP access to the designated IFC Workstation(s) for IMINT data transfer.

4.4 Hardware-Software Interfaces

- **IRS-HS-001:** The application software shall interface with the underlying operating system (Linux server, Windows workstation) for resource management (CPU, RAM, Storage I/O) and process scheduling.
- **IRS-HS-002:** The database software shall interface with the storage hardware for efficient data persistence and retrieval.
- **IRS-HS-003:** The LLM integration components shall be optimized to leverage GPU hardware acceleration for faster model inference, if available.
- **IRS-HS-004:** Network interface controllers (NICs) shall provide software drivers for high-throughput data transfer (e.g., 10GbE or higher).

4.5 Hardware-Hardware Interfaces

- **IRS-HH-001:** Server components (CPU, RAM, Storage, NIC) shall communicate via high-speed internal buses.
- **IRS-HH-002:** Database servers, application servers, and search index servers shall interconnect via high-bandwidth Ethernet.

5. Hardware Requirements Specification (Recommeded)

This section details the hardware components required for the IFC System, their functions, specifications, and interfaces.

5.1 System Architecture Overview (Hardware)

The IFC System's hardware architecture is based on a distributed, client-server model, utilizing a combination of high-performance servers, scalable storage solutions, and robust networking. It is designed to support the demanding requirements of big data processing, AI/ML workloads, and real-time interactive visualizations.

- **Application Servers:** Host core microservices and APIs.
- **Database Servers:** Dedicated servers for relational and graph databases.
- **Search Index Servers:** Dedicated cluster for Elasticsearch.
- **AI/LLM Processing Servers:** High-performance computing (HPC) servers with specialized accelerators (GPUs).
- **Storage Infrastructure:** Scalable shared storage for Big Data Repository and raw files.
- **Network Infrastructure:** High-bandwidth, low-latency network connecting all server components.
- **Client Workstations:** End-user devices for accessing the web-based UI.
- **Data Capture Hardware:** High-resolution scanners for hard-copy document ingestion.
- **IMINT Workstation:** Dedicated machine for IMINT data preparation and transfer (often provided by user).

5.2 Modules with their Functions and Specifications

Module Name	Function	Key Specifications
Application Server Cluster	Host core microservices (Ingestion, Workflow, Reporting, Analytics, User Management, Config Management).	Vendor specific config
Search Index Server Cluster	Host Datawarehouse nodes for indexing and search.	Vendor specific config
Database Server	Host Data-lake server.	
AI/LLM Processing Servers	Execute LLM inference, predictive model, and advanced text analytics.	Vendor specific config

Network Switches (Core)	High-speed data communication between all server and storage components.	Vendor specific config
Client Workstations	End-user access to the web-based UI.	Vendor specific config
High-Resolution Scanners	Digitize hard-copy documents.	Vendor specific config

5.3 Functions with their Inputs and Outputs (Hardware Level)

Module	Hardware-Level Function	Hardware Input(s)	Hardware Output(s)
Application Server	Execute application code, process API requests.	Network packets (REST, messaging), Electrical power.	Network packets (REST, DB queries, LLM calls), Heat.
Database Server	Store/retrieve data blocks, process queries.	SQL queries/commands (network), Data blocks (network), Electrical power.	Query results (network), Data blocks (network), Heat.
AI/LLM Server	Parallel computation for model inference/training.	Data arrays (network), Model parameters (network), Electrical power.	Result arrays (network), Heat, Fan noise.
Shared Storage	Provide block/file level storage, manage data integrity (RAID).	Read/Write commands (FC/iSCSI/NFS), Data blocks, Electrical power.	Read/Write confirmations, Data blocks, Status signals.
Network Switch	Route network packets between connected devices.	Electrical power, Ethernet/Fibre Channel signals (input ports).	Ethernet/Fibre Channel signals (output ports), Link status signals.
High-Res Scanner	Convert physical document images to digital files.	Physical document (paper), Electrical power.	Digital image file (USB/Ethernet data stream).

IMINT Workstation	Process raw imagery, generate standardized IMINT files.	Raw imagery files (e.g., from sensor, network), User input (keyboard/mouse), Electrical power.	Standardized IMINT file (network stream to IFC).

5.4 Inputs and Outputs with their Data Types and Sizes (Hardware Level)

I/O Type	Data Type (Hardware Level)	Typical Size/Bandwidth
Network Interface (Server)	Ethernet Frames (IP packets)	10 Gbps (GbE) or 25 Gbps per port
Internal Bus (PCIe)	Electrical signals representing data lanes	PCIe Gen4 (16 GB/s per lane, x16 slot ~32 GB/s)
RAM	Electrical signals representing bytes/words	DDR4-3200 (25.6 GB/s per module), DDR5 much higher
SSD (NVMe)	NVMe commands & data blocks	PCIe Gen4 x4 (up to 7 GB/s read, 5 GB/s write)
SSD (SAS/SATA)	SAS/SATA commands & data blocks	SAS (12 Gbps/port), SATA (6 Gbps/port)
Fibre Channel	Fibre Channel frames	16 Gbps or 32 Gbps per port
USB 3.0 (Scanner)	USB packets	Up to 5 Gbps
GPU Interconnect	High-speed serialized data	600 GB/s (for NVIDIA A100)
Electrical Power	AC (Voltage, Current)	200-240V AC, Amperage as per PDU/UPS

5.5 Data Structures and Algorithms Used (Hardware Level)

- **Interpretation:** This section describes the *hardware's inherent capabilities and architectural principles* that facilitate data processing, rather than software-level algorithms.
- **Parallel Processing Units (CPU/GPU):**
    - **Data Structures:** CPU caches (L1, L2, L3) for hierarchical data access; Register files for immediate data manipulation; Pipelined instruction

execution. GPU Streaming Multiprocessors (SMs) with local memory (shared memory, registers) designed for massive data parallelism.

    - **Algorithms (Hardware-Accelerated):** SIMD (Single Instruction, Multiple Data) operations on CPUs; CUDA/OpenCL core execution model for GPUs enabling parallel execution of thousands of threads for matrix operations (critical for LLM/AI). Vector processing units.

- **Memory Controllers:**
    - **Data Structures:** Memory banks, rows, and columns; Memory Request Queues.
    - **Algorithms:** Row-buffer hit optimization, memory interleaving, pre-fetching algorithms to reduce memory access latency and increase bandwidth. Error-Correcting Code (ECC) algorithms for data integrity in RAM.
- **Network Interface Cards (NICs):**
    - **Data Structures:** Transmit/Receive Buffers (Ring Buffers); MAC (Media Access Control) address tables.
    - **Algorithms:** Checksum offload, TCP Segmentation Offload (TSO), Generic Receive Offload (GRO) to reduce CPU overhead; Flow control algorithms (e.g., Ethernet pause frames).
- **Storage Controllers (RAID Controllers):**
    - **Data Structures:** Striping units, Parity blocks (for RAID 5/6).
    - **Algorithms:** RAID striping algorithms (RAID 0), mirroring (RAID 1), parity calculation and reconstruction (RAID 5/6), write-back caching algorithms. Wear-leveling and garbage collection for SSDs.
- **Bus Architectures (PCIe):**
    - **Data Structures:** PCIe packets (Transaction Layer Packets, Data Link Layer Packets); Posted/Non-Posted queues.
    - **Algorithms:** Flow control, error checking (CRC), routing algorithms for data transfer between components.

5.6 Constraints (Hardware)

- **Physical Space:** Total server rack space required: Minimum 6 x 42U server racks.
- **Power Consumption:** Total maximum power draw: ~20-30 kW (excluding cooling). Requires dedicated power circuits and UPS infrastructure.

- **Cooling:** Total heat dissipation: ~20-30 kW. Requires adequate HVAC and potentially dedicated server room cooling.
- **Environmental:**
    - Operating Temperature: $10^\\circ C$ to $35^\\circ C$
    - Humidity: 20% to 80% non-condensing.
    - Dust: Data center grade air filtration (MERV 8-13).
- **Reliability:**
    - Server MTBF: Minimum 50,000 hours (for critical components).
    - Storage MTBF: Minimum 1.2 million hours for SSDs.
    - Redundancy: N+1 or higher for critical components (power supplies, network paths, storage controllers).
- **Security (Physical):** Hardware components must be housed in a secure, access-controlled data center facility with surveillance and environmental monitoring. Tamper-evident seals on sensitive hardware.
- **Vendor Lock-in:** Minimize vendor-specific hardware where open standards or multiple vendor options exist.
- **Budget:** Hardware acquisition and maintenance must conform to the project's allocated budget.

5.7 Database Schema (Hardware Perspective)

- **Interpretation:** This section describes the hardware's capacity and performance requirements to *support* the software's database schema, not the schema itself.
- **Storage Capacity:**
    - **Structured Data:** Initial 5 TB, scalable to 20 TB. Requires high-IOPS storage for transactions.
    - **Semi/Unstructured Data:** Initial 50 TB, scalable to 500 TB. Requires high-capacity, high-throughput storage, distributed across nodes.
    - **Search Index (Elasticsearch):** Initial 20 TB, scalable to 200 TB. Requires extremely high read/write IOPS and fast indexing capabilities.
    - **Raw Files / Large Binaries:** Initial 100 TB, scalable to 1 PB. Requires high-capacity, high-throughput network-attached or object storage.
- **I/O Performance:**

    - **Transactional DB:** Minimum 5,000 random read IOPS, 2,000 random write IOPS.
    - **NoSQL DB:** Minimum 50,000 random read/write IOPS per node.
    - **Search Index:** Minimum 100,000 random read/write IOPS for indexing and search operations.
- **Latency:**
    - Disk I/O latency: Target <1 ms for critical database operations.
    - Network latency between database nodes: Target <0.5 ms.
- **Scalability Support:** Hardware must facilitate adding more storage nodes (scale-out) or upgrading existing hardware (scale-up) without significant service disruption.

5.8 Interface Requirement and Mechanism (Hardware Interfaces)

- **5.8.1 Physical Interfaces:**
    - **Ethernet Ports:** RJ45 for 1GbE, SFP+ for 10GbE, QSFP for 40/100GbE (for server-to-switch and switch-to-switch connections).
    - **Fibre Channel Ports:** SFP for 16/32 Gb Fibre Channel (for SAN connectivity).
    - **USB Ports:** USB 3.0 (Type-A/B) for local peripherals (e.g., scanners, console access).
    - **Power Connectors:** IEC 60320 C13/C14 or C19/C20 for AC power supply units.
    - **Display Ports:** HDMI, DisplayPort (for client workstations and server KVM).

5.8.2 Electrical Interfaces:

- **Voltage:** Standard AC power (e.g., 200-240V AC, 50/60 Hz) as per data center specifications.
- **Current:** Appropriate amperage per circuit breaker for each rack/device.
- **Signal Levels:** Compliance with IEEE 802.3 Ethernet standards, Fibre Channel standards, USB standards, PCIe electrical specifications.

5.8.3 Protocols (Hardware/Firmware Level):

- **Networking:** Ethernet, IP, ARP, VLAN, LACP (Link Aggregation Control Protocol) for network redundancy, BGP/OSPF for routing.

- **Storage:** iSCSI, NFS, SMB/CIFS (for NAS), Fibre Channel Protocol (for SAN).
- **Bus Protocol:** PCIe (Peripheral Component Interconnect Express) for internal component communication (CPU-GPU, CPU-SSD).
- **Management Protocols:** IPMI (Intelligent Platform Management Interface) for out-of-band server management. SNMP for network device monitoring.

6. Traceability

All requirements documented in this SRS will be explicitly traced throughout the system's development lifecycle using a comprehensive Requirements Traceability Matrix (RTM). The RTM (RTM-IFC-V1.0, provided separately) maps each requirement to corresponding design elements, and test cases, ensuring that all requirements are addressed and verified.

7. Approvals

This System Requirement Specification has been reviewed and approved by the undersigned, signifying their agreement with the defined requirements for the Intelligence Fusion Center (IFC) System, Release V1.0.0.

Role	Name	Signature	Date
Project Manager	[Manager's Name]		June 5, 2025
Lead System Architect	[Architect's Name]		June 5, 2025
Development Lead	[Dev Lead's Name]		June 5, 2025
Product Owner	[PO's Name]		June 5, 2025
QA Lead	[QA Lead's Name]		June 5, 2025
Hardware Lead	[Hardware Lead's Name]		June 5, 2025