A Major Project Synopsis on

**Flowsight-Smart Testing Insights/Validations**

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8. **Introduction**

During my internship at Nokia, I had the opportunity to work on various projects, including FlowSight – Smart Testing Insights (PCAP Automation) and Config (XML) comparison tools. These projects deepened my understanding of network protocols, packet analysis, and troubleshooting methodologies. For my major project, I chose to focus on FlowSight, leveraging my experience in analyzation and visualization of packet data to create an advanced Call Flow Analysis Tool.

The Session Initiation Protocol (SIP) is essential to the establishment, control, and termination of voice and video calls via IP-based systems in contemporary communication networks. It might be time-consuming and difficult to manually analyze SIP call flows from packet capture (PCAP) files. The goal of this project is to create an automated SIP Call Flow Analysis Tool that will improve network performance analysis and troubleshooting by streamlining the extraction, classification, and visualization of SIP call data. The program categorizes issues, produces visual representations of call flows, and generates structured insights into call success and failure scenarios by automating SIP message processing. Telecom professionals may now effectively manage SIP-based communication infrastructures, improve network reliability, and greatly improve the debugging process.

1. **Motivation**

With the increasing reliance on VoIP and SIP-based telecommunication, network engineers often struggle with manually analyzing SIP traces, identifying faults, and resolving call quality issues. The traditional approach of manually reviewing PCAP files is **time-consuming, error-prone, and lacks standardization.** A structured and automated tool can improve efficiency, ensuring accurate analysis and reducing operational workload.

The key motivations for developing this tool include:

* **Reduces manual effort** in analyzing SIP call flows.
* **Enhances accuracy and speed** in detecting and troubleshooting SIP-related issues.
* **Providing a structured and visual representation** of SIP interactions.
* **Improving VoIP network performance** by offering real-time diagnostics and categorization of SIP messages.

1. **Problem Statement**

SIP call flow analysis from PCAP files presents several challenges:

1. **Complexity:** SIP traces contain multiple messages and headers, making manual interpretation difficult.
2. **Time-Intensiveness:** Identifying and categorizing call details and failures requires significant effort.
3. **Lack of Visual Representation:** Without proper visualization, understanding SIP sequences is challenging.
4. **Inconsistencies in Analysis:** Different engineers use varied debugging techniques, leading to non-standardized interpretations.
5. **Scalability Issues:** Analyzing multiple PCAP files manually is impractical and quite hectic for large-scale telecom operations.

This project addresses these challenges by -- **automating data extraction, classification, and visualization** of SIP call flows, thereby improving debugging efficiency and accuracy

1. **Methodology/ Planning of work:**

The development of the **Flowsight-Smart Testing Insights/Validations** follows a structured approach to ensure efficient way of implementation, accuracy, and scalability. The methodology is consists of multiple phases, each focusing on specific aspects of the tool's functionality.

**Phase 1: Requirement Analysis & Design**

* Identify key requirements for SIP message extraction, call flow analysis, and error categorization.
* Define the data structure for storing extracted SIP messages.
* Plan the integration of multiple protocol support for future scalability.
* Design the architecture, including core components such as packet processing, data extraction, visualization, and reporting.

**Phase 2: Data Processing & Extraction**

* Implement a packet capture parser to extract SIP messages from PCAP files.
* Develop logic to identify and categorize SIP messages based on Call-ID, Method, Status, and other parameters.
* Implement error code detection and mapping for failure analysis.
* Structure extracted data into a tabular format for ease of processing and reporting.

**Phase 3: Call Flow Visualization & Reporting**

* Develop an algorithm to generate visual SIP call flow diagrams.
* Implement horizontal IP positioning and vertical message representation for clarity.
* Generate structured Excel reports with categorized insights, including call flow details, error trends, and statistical summaries.

**Phase 4: Configuration & Customization**

* Implement a configuration management system (config.json) for user-defined settings.
* Enable custom mapping for IP addresses, cause codes, and other parameters.
* Provide options for enabling/disabling SIP message filtering and IP anonymization.

**Phase 5: Testing & Optimization**

* Conduct unit testing to validate data extraction, categorization, and visualization accuracy.
* Perform batch processing tests with multiple PCAP files to assess efficiency.
* Optimize performance by refining parsing algorithms and memory management.

**Phase 6: Future Enhancements & Protocol Expansion**

* Extend support for additional protocols such as **GTPv2, S1AP, DNS, and Diameter** for a more comprehensive analysis.
* Enhance filtering options to allow deeper customization based on user requirements.
* Improve automation and scalability to support large-scale VoIP network analysis.

This structured methodology ensures a systematic approach to developing a robust and scalable tool for SIP call flow analysis while allowing for future enhancements and protocol expansions.

**Deployment and User Interface** - The tool has been deployed on a **CentOS** server, utilizing **HTML and JavaScript** for the front-end. The web-based interface allows users to upload PCAP files, process them, and visualize the analyzed call flow data efficiently. The back-end processes SIP messages using Python-based packet analysis libraries, ensuring seamless execution in a server environment.

1. **Requirements for proposed work:**

To successfully design and implement the **Automated SIP Call Flow Analysis Tool**, the following hardware, software, and functional requirements have been identified.

**1. Hardware Requirements**

* **Processor:** Minimum Intel Core i5 or AMD Ryzen 5 (higher specifications recommended for improved performance)
* **RAM:** At least 8GB (16GB preferred for handling large PCAP files efficiently)
* **Storage:** Minimum 50GB of free disk space (SSD recommended for faster processing)

**2. Software Requirements**

* **Operating System:** CentOS (for deployment) but compatible with other OS.
* **Front-end Technologies:** HTML, JavaScript (for UI)
* **Back-end Processing:** Python (for SIP packet analysis and report generation)
* **Libraries Used:** PyShark, OpenPyXL, Pandas, etc.
* **Any Browser** like Chrome, brave, etc.

1. **Future Scope**

The **Automated SIP Call Flow Analysis Tool** is designed to streamline SIP call analysis, but there is significant potential for further enhancements in the tool. Future updates will mainly focus on expanding protocol support, improving data visualization, enhancing automation, and integrating AI-driven analytics.

**1. Multi-Protocol Support**

To provide a more comprehensive network analysis, the tool will be upgraded to include support for additional telecom signaling protocols beyond SIP, enabling correlation across different network layers:

* **GTPv2 (GPRS Tunneling Protocol):** For tracking user data sessions and mobility management in LTE networks.
* **S1AP (S1 Application Protocol):** To analyze signaling between eNodeB and MME in LTE networks.
* **DNS (Domain Name System):** To resolve domain names to IP addresses and facilitate SIP server identification.
* **Diameter Protocol:** For authentication, authorization, and accounting (AAA) in VoIP and IMS networks.

**2. Enhanced Visualization & Reporting**

* Integration of **interactive call flow diagrams** using web-based visualization.
* **Dynamic filtering and searching** within call flow reports to allow users to pinpoint specific calls, errors, or trends.
* **Enhanced statistical insights** using advanced data visualization techniques to identify patterns in call failures and performance trends.

**3. AI & Machine Learning Integration**

* **Anomaly detection**: Implementing ML models to detect irregular SIP behavior and predict potential service disruptions.
* **Automated root cause analysis**: Using AI to correlate SIP errors with network conditions and suggest resolutions.
* **Call quality assessment**: Predicting call quality based on SIP parameters, jitter, latency, and packet loss analysis

1. **Bibliography/References**

* *Wireshark User Guide for Analyzing SIP and VoIP Traffic*. <https://www.wireshark.org/>
* *Python Documentation – Libraries for Network Analysis*. <https://docs.python.org/>
* Nokia Internal Training - [Nokia Learning & Development Hub](https://nokialearn.csod.com/client/nokialearn/default.aspx?ReturnUrl=https%3a%2f%2fnokialearn.csod.com%2fui%2flms-learner-home%2fhome%3ftab_page_id%3d-200300006%26tab_id%3d221000375)