**Internship Plan: Survey on AI for Mobile Networks**

**Internship Period: 25 June – 24 August, 2025**

**Phase 1: Analysis of Development Trends**

*(Timeline: Mid May – June 24, 2025)*

* **Objectives:**
* Analyze the current landscape, key standards (3GPP, O-RAN, AI-RAN), and research trends to build foundational knowledge.
* **Task:**
* Review technical reports from standards bodies like 3GPP and O-RAN.
* Survey industry white papers to identify key use cases and strategies.
* Analyze academic research on AI-native concepts and federated learning.
* Categorize AI application models (automation, optimization, services).
* **Deliverables:**
* Written study notes summary of AI development trends and standards evolution.
* Organized reference list.

**Phase 2: Toolkit Evaluation and Application Potential**

*(Timeline: June 25 – July 13, 2025 / Weeks 1-3)*

* **Objectives:**
* Gain hands-on experience with AI toolkits to assess their features, feasibility, and constraints for network applications.
* **Task:**
* Install and test key AI development toolkits (e.g., NVIDIA Aerial SDK, Sionna) within mobile network scenarios.
* Complete tutorials and run a sample use case to assess workflows.
* Document the capabilities, limitations, and system requirements for each platform.
* Propose suitable application concepts and integration approaches based on toolkit capabilities.
* **Deliverables:**
* A technical memo summarizing the features and evaluation of the toolkits.
* Working code or scripts from experiments and simulations.

**Phase 3: Modeling Deployment and Computational Requirements**

*(Timeline: July 14 – August 3, 2025 / Weeks 4-6)*

* **Objectives:**
* Analyze the trade-offs of deploying AI models at different points in the mobile network (e.g., RAN, Edge, Core).
* Model the resource demands associated with these deployment scenarios.
* **Task:**
* Model and evaluate latency tolerance, bandwidth constraints, data collection types, and inference cycles for AI models in the RAN vs. Edge vs. Core.
* Analyze trade-offs in latency, bandwidth, and data availability for each model.
* Model the computational resource demands (CPU/GPU cycles, memory) for different deployment scenarios to illustrate key differences.
* **Deliverables:**
* An analysis report detailing different AI deployment models.
* Comparative tables and graphs illustrating resource demands for each model.
* Recommendations for model deployment conditions and resource allocation.

**Phase 4: System Integration Recommendations and Future Directions**

*(Timeline: August 4 – August 17, 2025 / Weeks 7-8)*

* **Objectives:**
* Synthesize previous findings into a coherent system integration proposal.
* Identify key challenges, mitigation strategies, and future research directions.
* **Task:**
* Design a high-level architecture diagram for integrating AI into a mobile network, showing data flows and control loops.
* Identify potential deployment challenges such as model management, interoperability, and scalability.
* Propose practical mitigation strategies for the identified challenges and outline future research directions.
* **Deliverables:**
* An integration plan featuring a proposed demonstration architecture.
* A document detailing potential deployment challenges and their mitigation strategies.

**Phase 5: Final Report Drafting and Presentation**

*(Timeline: August 18 – August 24, 2025 / Week 9)*

* **Objectives:**
* Consolidate all analyses and recommendations into a comprehensive survey report to serve as a key reference for future planning.
* **Task:**
* Combine all previous deliverables (memos, reports, architecture documents) into a single, structured internship report.
* Prepare a final presentation that summarizes the key findings and recommendations from the survey.
* **Deliverables:**
* A final, comprehensive internship report.
* A final presentation deck.

**Reference List:**

**Phase 1: Analyis of Development Trends**

1. 3GPP, "Study on Artificial Intelligence (AI) / Machine Learning (ML) for NR Air Interface," TR 38.843 V18.0.0, Mar. 2025. [Online]. Available: <https://www.3gpp.org/ftp/Specs/archive/38_series/38.843/>
2. AI-RAN Alliance, "AI-RAN Alliance Whitepaper: Revolutionizing Radio Access Networks with AI," Dec. 2024. [Online]. Available: https://ai-ran.org/wp-content/uploads/2024/12/AI-RAN\_Alliance\_Whitepaper.pdf
3. J. Montojo et al., "Overview of AI in 3GPP's RAN Release 18," IEEE ComSoc Tech News, 2024. [Online]. Available: <https://www.comsoc.org/publications/ctn/2024/june/overview-ai-3gpps-ran-release-18>
4. Ericsson, "AI in RAN - Enhancing Network Performance of CSPs," White Paper, 2024. [Online]. Available: <https://www.ericsson.com/en/reports-and-papers/white-papers/ai-in-ran>
5. O-RAN Alliance, "Principles and Methodologies for AI/ML Testing in Next-Gen Networks," Research Report, 2024. [Online]. Available: <https://mediastorage.o-ran.org/specifications/o-ran-public/O-RAN.WG1.Principles-and-Methodologies-for-AI-ML-Testing-v01.00>
6. 5G Americas, "Artificial Intelligence and Cellular Networks," White Paper, Dec. 2024. [Online]. Available: <https://www.5gamericas.org/wp-content/uploads/2022/12/5G-Americas-AI-in-Cellular-Networks-WP-final.pdf>

**Phase 2: Toolkit Evaluation and Application Potential**

1. NVIDIA, "Aerial Omniverse Digital Twin Boosts Development of AI-Native Wireless," *NVIDIA Technical Blog*, Mar. 2025. [Online]. Available: [https://developer.nvidia.com/blog/aerial-omniverse-digital-twin-boosts-development-of-ai-native-wireless/](https://www.google.com/search?q=https://developer.nvidia.com/blog/aerial-omniverse-digital-twin-boosts-development-of-ai-native-wireless/&authuser=1)
2. NVIDIA, "Sionna - An Open-Source Library for 6G Research," *NVIDIA Developer Portal*, 2025. [Online]. Available: <https://developer.nvidia.com/sionna>
3. NVIDIA, "NVIDIA Aerial cuPHY Documentation: Overview," *docs.nvidia.com*. [Online]. Available: <https://docs.nvidia.com/aerial/aerial-cuphy/current/text/overview.html>
4. Intel, "FlexRAN™ Reference Architecture for Wireless Access," 2024. [Online]. Available: [https://www.intel.com/content/www/us/en/products/platforms/details/flexran.html](https://www.google.com/search?q=https://www.intel.com/content/www/us/en/products/platforms/details/flexran.html&authuser=1)
5. OpenAirInterface, "OAI 5G RAN Roadmap - Sept 2024," 2024. [Online]. Available: [https://openairinterface.org/oai-5g-ran-project-group/](https://www.google.com/search?q=https://openairinterface.org/oai-5g-ran-project-group/&authuser=1)

**Phase 3: Modeling Deployment and Computational Requirements**

1. ETSI, "Network Data Analytics Services (NWDAF); Stage 3," *TS 29.520 V17.9.0*, Jan. 2023. [Online]. Available: <https://www.etsi.org/deliver/etsi_ts/129500_129599/129520/17.09.00_60/ts_129520v170900p.pdf>
2. Y. Zhang *et al*., "6G EdgeAI: Performance Evaluation and Analysis," *arXiv:2504.16529*, 2025. [Online]. Available: <https://arxiv.org/abs/2504.16529>
3. M. Varela *et al*., "Latency-Aware and Proactive Service Placement for Edge Computing," *IEEE Access*, 2024. [Online]. Available: <https://ieeexplore.ieee.org/document/8687355>
4. Rohde & Schwarz, "On the Verge of 6G - Will AI/ML Revolutionize Wireless Communication?," White Paper, May 2024. [Online]. Available: [https://www.rohde-schwarz.com/us/knowledge-center/white-papers/on-the-verge-of-6g---will-ai/ml-revolutionize-wireless-communication--white-paper\_254972.html](https://www.google.com/search?q=https://www.rohde-schwarz.com/us/knowledge-center/white-papers/on-the-verge-of-6g---will-ai/ml-revolutionize-wireless-communication--white-paper_254972.html&authuser=1)

**Phase 4: System Integration Recommendations and Future Directions**

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2. O-RAN Alliance, "O-RAN Service-Based RAN for 6G," Research Report, Nov. 2024. [Online]. Available: [https://static1.squarespace.com/static/5ad774cce74940d71151f8d4/t/63863773173a195438883701/1669740405101/O-RAN.WG1.Research-Report-on-Service-Based-RAN-for-6G-v01.00.pdf](https://www.google.com/search?q=https://static1.squarespace.com/static/5ad774cce74940d71151f8d4/t/63863773173a195438883701/1669740405101/O-RAN.WG1.Research-Report-on-Service-Based-RAN-for-6G-v01.00.pdf&authuser=1)
3. Ericsson, "Intelligent RAN Automation - Managing 5G Complexity," 2024. [Online]. Available: [https://www.ericsson.com/en/reports-and-papers/white-papers/intelligent-ran-automation](https://www.google.com/search?q=https://www.ericsson.com/en/reports-and-papers/white-papers/intelligent-ran-automation&authuser=1)
4. 3GPP, "Study on AI/ML Management Enhancements (SA5)," *S5-252558r3*, May 2025. [Online]. Available: [https://www.3gpp.org/ftp/tsg\_sa/WG5\_TM/TSGS5\_150e/Docs/S5-234677.zip](https://www.google.com/search?q=https://www.3gpp.org/ftp/tsg_sa/WG5_TM/TSGS5_150e/Docs/S5-234677.zip&authuser=1)