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Comparative Analysis of MORAN, RF Sharing, and Neutral Host Platform Architectures for Indoor 5G Distributed Antenna Systems

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Abstract - **The increasing demand for high-capacity indoor 5G services has accelerated the adoption of infrastructure sharing techniques to reduce deployment costs while maintaining reliable network performance. Indoor Distributed Antenna Sys-tems (DAS) are widely deployed in environments such as airports, hospitals, stadiums, shopping malls, and commercial buildings, where multiple mobile network operators require seamless cov-erage and capacity. This paper presents a comparative analysis of three indoor 5G DAS sharing architectures: Multi-Operator Radio Access Network (MORAN), RF Sharing, and Neutral Host Platform (NHP). The comparison is based on practical engineering design data using key deployment metrics, including power consumption, equipment room requirements, hardware utilization, operational complexity, and network scalability. The analysis demonstrates that the MORAN architecture achieves the lowest power consumption, minimum equipment footprint, simplified network architecture, and reduced operational com-plexity compared with RF Sharing and Neutral Host Platform deployments. These characteristics contribute to lower capital and operational expenditures while supporting efficient multi-operator service delivery. The findings indicate that MORAN provides the most practical and cost-effective architecture for future indoor 5G DAS deployments. Future work will focus on validating the design-stage analysis through live network measurements and additional performance indicators, including throughput, latency, and Quality of Experience (QoE).**

Index Terms - **5G New Radio (NR), Distributed Antenna Sys-tem (DAS), Multi-Operator Radio Access Network (MORAN), RF Sharing, Neutral Host Platform (NHP), Radio Access Net-work (RAN) Sharing, Indoor Coverage, Infrastructure Sharing.**

I. INTRODUCTION

The rapid evolution of fifth-generation (5G) mobile net-works has significantly increased the demand for high-capacity, low-latency, and reliable wireless connectivity. Whileoutdoor macro base stations provide wide-area coverage, theyoften experience considerable signal degradation within largeindoor environments due to penetration losses caused by building materials and complex indoor layouts. As a result, Indoor Distributed Antenna Systems (DAS) have become an essential solution for extending 5G coverage and delivering consistent network performance in high-density venues such as airports, hospitals, shopping malls, stadiums, commercial buildings, and smart campuses.

Traditionally, each Mobile Network Operator (MNO) de-ployed and maintained its own indoor infrastructure to provide coverage within shared facilities. Although this approach en-sures complete operational independence, it leads to significant duplication of network equipment, increased equipment room requirements, higher power consumption, and elevated capital and operational expenditures. To address these challenges, infrastructure sharing has become a widely adopted strategy that enables multiple operators to utilize common network resources while maintaining independent service delivery. Be-sides reducing deployment costs, infrastructure sharing also improves resource utilization, simplifies site deployment, and supports more sustainable network expansion.

Several Radio Access Network (RAN) sharing architectures have been introduced to support multi-operator indoor de-ployments, including Multi-Operator Radio Access Network (MORAN), RF Sharing, and Neutral Host Platform (NHP). Each architecture differs in terms of equipment ownership, in-frastructure sharing, operational complexity, network manage-ment, scalability, and deployment cost. Consequently, selecting an appropriate sharing model requires careful evaluation of both technical performance and implementation efficiency to satisfy the coverage and capacity requirements of modern indoor 5G networks.

This paper presents a comparative analysis of MORAN, RF Sharing, and Neutral Host Platform architectures for indoor 5G Distributed Antenna Systems using practical engineering design data. The comparison evaluates key deployment met-rics, including power consumption, equipment room space, hardware utilization, operational complexity, and infrastructure requirements. Based on the comparative results, the study identifies the relative advantages and limitations of each ar-chitecture and provides practical guidance for selecting an efficient and cost-effective indoor 5G deployment strategy.

II. BACKGROUND AND RELATED WORK

The continuous growth of mobile data traffic and the widespread adoption of 5G services have significantly in-creased the demand for reliable indoor wireless coverage. Industry studies indicate that a large proportion of mobile data traffic is generated within buildings, where signal penetration from outdoor macro base stations is often insufficient due to structural attenuation and complex indoor propagation envi-ronments. Consequently, Indoor Distributed Antenna Systems (DAS) have become a preferred solution for extending radio coverage and providing uniform capacity in high-density en-vironments such as airports, hospitals, commercial buildings, shopping malls, and stadiums.

A Distributed Antenna System consists of multiple antennas connected to centralized radio equipment through optical fiber

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or coaxial infrastructure. Unlike conventional indoor repeaters, DAS enables controlled signal distribution throughout a building while supporting multiple frequency bands and wireless technologies. Modern 5G DAS deployments are designed to improve coverage, increase network capacity, and enhance user experience by reducing signal dead zones and improving spectral efficiency. As indoor deployments continue to expand, minimizing infrastructure cost and improving resource utilization have become major design objectives.

To address these challenges, Radio Access Network (RAN) sharing has emerged as an effective approach for reducing both capital expenditure (CAPEX) and operational expenditure (OPEX). Among the commonly adopted sharing architectures, Multi-Operator Radio Access Network (MORAN) allows multiple operators to share active RAN infrastructure while maintaining independent spectrum resources and core networks. RF Sharing enables operators to share the antenna distribution network while deploying separate radio equipment, whereas the Neutral Host Platform (NHP) introduces an independent infrastructure provider that builds and manages the shared DAS for multiple operators. Each architecture offers different trade-offs in terms of equipment utilization, operational flexibility, deployment complexity, power consumption, and scalability.

Previous studies have extensively investigated RAN sharing strategies, focusing primarily on spectrum utilization, net-work performance, and infrastructure cost reduction. However, comparatively limited research has evaluated indoor 5G DAS sharing architectures using practical engineering deployment metrics such as power consumption, equipment footprint, hardware requirements, and operational complexity. This paper addresses this gap by providing a comparative analysis of MORAN, RF Sharing, and Neutral Host Platform architectures using a representative indoor 5G DAS deployment scenario, offering practical guidance for selecting efficient and cost-effective multi-operator deployment solutions.

III. SHARING NETWORK ARCHITECTURES

Indoor 5G Distributed Antenna Systems (DAS) support multiple Radio Access Network (RAN) sharing architectures, each offering different levels of infrastructure sharing, deployment complexity, and operational flexibility. The selection of an appropriate sharing model directly influences capital expenditure (CAPEX), operational expenditure (OPEX), power consumption, equipment room requirements, and long-term network scalability. This section presents the three architectures evaluated in this study: Multi-Operator Radio Access Network (MORAN), RF Sharing, and Neutral Host Platform (NHP). Their operational principles and key characteristics are discussed to provide the technical foundation for the comparative analysis presented in the subsequent sections.

A. Multi-Operator Radio Access Network (MORAN)

Multi-Operator Radio Access Network (MORAN) is an active Radio Access Network (RAN) sharing architecture in which multiple Mobile Network Operators (MNOs) share the

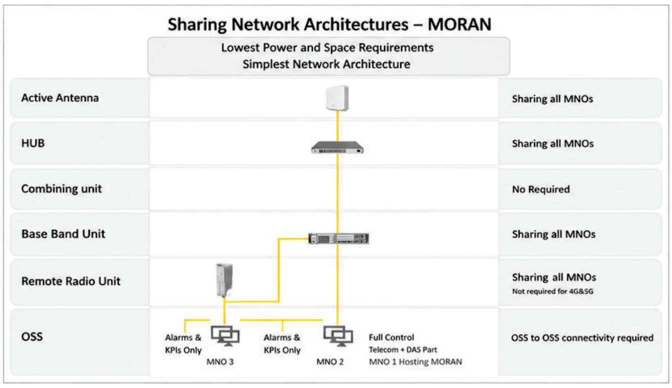

Fig. 1: Conceptual architecture of the Multi-Operator Radio Access Network (MORAN) for indoor 5G Distributed Antenna Systems.

same radio access infrastructure while maintaining independent spectrum resources and core networks. In an indoor 5G DAS deployment, the active antenna system, centralized hub, Remote Radio Units (RRUs), and Baseband Units (BBUs) are shared among participating operators, significantly reducing hardware duplication and infrastructure requirements.

Compared with conventional multi-operator deployments, MORAN minimizes equipment room space, lowers power consumption, and simplifies network architecture by eliminating redundant radio equipment. Since multiple operators utilize a common radio platform, installation, maintenance, and network expansion become more efficient while preserving independent network management and service delivery. These characteristics make MORAN a practical solution for large indoor environments where deployment cost, available space, and energy efficiency are critical design considerations.

Figure 1 illustrates the conceptual MORAN architecture used in this study.

B. RF Sharing

RF Sharing is a Radio Access Network (RAN) sharing architecture in which multiple Mobile Network Operators (MNOs) share the passive antenna distribution infrastructure while maintaining independent active radio equipment. In a typical indoor 5G DAS deployment, the antenna system, signal distribution network, and supporting passive components are shared, whereas each operator deploys dedicated Remote Radio Units (RRUs), Baseband Units (BBUs), and associated transmission equipment. This architecture enables infrastructure sharing while preserving full operational control over each operator's radio network.

Compared with MORAN, RF Sharing requires additional radio equipment because each operator maintains its own active network elements. Consequently, the architecture demands greater equipment room space, higher power consumption, and increased maintenance effort. However, the separation of active radio resources provides greater flexibility for independent network planning, software upgrades, capacity expansion, and performance optimization, making RF Sharing

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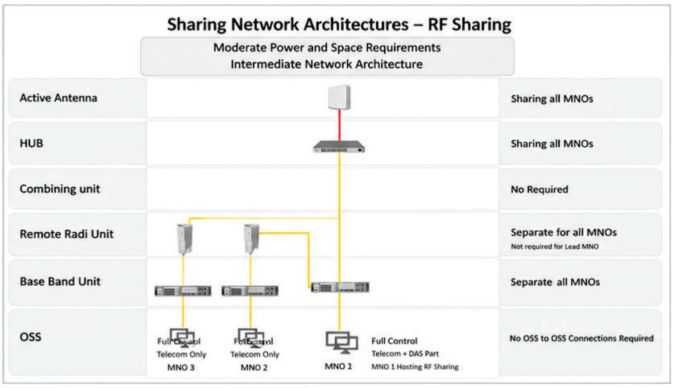

Fig. 2: Conceptual architecture of the RF Sharing deployment for indoor 5G Distributed Antenna Systems.

a suitable option when operators require greater control over their individual network configurations.

Figure 2 illustrates the conceptual RF Sharing architecture considered in this study.

C. *Neutral Host Platform (NHP)*

The Neutral Host Platform (NHP) is an infrastructure-sharing architecture in which an independent service provider designs, deploys, and manages the indoor Distributed Antenna System (DAS) on behalf of multiple Mobile Network Operators (MNOs). Unlike MORAN and RF Sharing, where participating operators own part of the radio access infrastructure, the Neutral Host provider is responsible for the shared DAS infrastructure, while each operator connects its own radio equipment to the platform. This model enables multiple operators to deliver services over a common indoor network without constructing separate antenna systems.

The Neutral Host architecture offers high deployment flexibility and simplifies the addition of new operators without requiring significant modifications to the existing antenna infrastructure. However, supporting multiple independent radio systems results in higher hardware requirements, increased equipment room space, greater power consumption, and a more complex network architecture. Furthermore, coordination between the infrastructure provider and participating operators introduces additional operational and management challenges compared with other sharing approaches.

Figure 3 illustrates the conceptual Neutral Host Platform architecture evaluated in this study.

IV. METHODOLOGY

This study adopts a comparative analytical methodology to evaluate the performance of three indoor 5G Distributed Antenna System (DAS) sharing architectures: Multi-Operator Radio Access Network (MORAN), RF Sharing, and Neutral Host Platform (NHP). The analysis is based on a representative indoor deployment scenario designed to support three Mobile Network Operators (MNOs) using a common Distributed Antenna System. The comparison focuses on infrastructure utilization and operational characteristics rather than radio performance measurements.

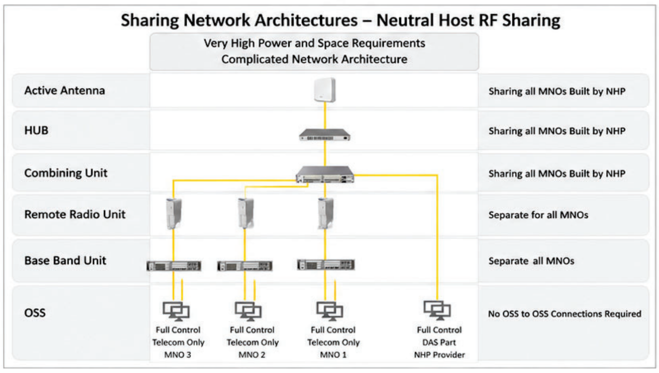

Fig. 3: Conceptual architecture of the Neutral Host Platform (NHP) for indoor 5G Distributed Antenna Systems.

TABLE I: Evaluation Metrics Used for Comparative Analysis

Evaluation Metric	Unit
Power Consumption	kW
Equipment Room Space	m^2
Remote Radio Units (RRUs)	Number
Baseband Units (BBUs)	Number
Power Cabinets	Number
Battery Strings	Number
Operational Complexity	Qualitative
Infrastructure Sharing	Qualitative
Deployment Scalability	Qualitative

A common deployment scenario consisting of twelve sectors supporting multi-technology services was selected to ensure a fair comparison among the three architectures. The network configuration, coverage requirements, and service demand were assumed to be identical for all deployment models. Only the infrastructure sharing architecture was varied, allowing the impact of each sharing approach on deployment efficiency and resource utilization to be evaluated under equivalent operating conditions.

The comparative analysis considers several engineering design metrics that directly influence deployment cost and operational efficiency. These include power consumption, equipment room space, number of Remote Radio Units (RRUs), number of Baseband Units (BBUs), power cabinets, battery strings, operational complexity, infrastructure sharing level, and deployment scalability. These parameters were selected because they represent the primary factors affecting both Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) in indoor 5G DAS deployments.

The engineering design data collected for each architecture were normalized and compared using identical evaluation criteria to ensure consistency throughout the analysis. The resulting comparison provides a quantitative assessment of the infrastructure requirements and operational characteristics of MORAN, RF Sharing, and Neutral Host Platform architectures, forming the basis for the results and discussion presented in the following section.

V. RESULTS AND DISCUSSION

The comparative analysis was performed using the engineering design data obtained for the three indoor 5G Distributed Antenna System (DAS) sharing architectures. The evaluation

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TABLE II: Comparative Analysis of Indoor 5G DAS Sharing Architectures

Parameter	MORAN	RF Sharing	NHP
Power Consumption (kW)	9.50	45.96	55.56
Equipment Room Space (m^2)	8.28	28.15	34.36
Combining Units	0	0	12
Remote Radio Units (RRUs)	4	39	54
Baseband Units (BBUs)	3	9	12
Power Cabinets	2	5	6
Battery Strings	4	13	16

focuses on the infrastructure and operational characteristics that directly influence deployment efficiency, including power consumption, equipment room space, hardware requirements, and overall network complexity. The comparison provides a practical assessment of the advantages and limitations of MORAN, RF Sharing, and Neutral Host Platform (NHP) under identical deployment conditions.

Table II summarizes the engineering comparison of the three indoor 5G DAS sharing architectures. Among the evaluated solutions, MORAN demonstrates the lowest infrastructure requirements, requiring only 9.50 kW of power and 8.28 m^2 of equipment room space. In comparison, RF Sharing and Neutral Host Platform require significantly higher power consumption and equipment footprint due to the deployment of dedicated radio equipment for each participating operator.

The hardware comparison further highlights the efficiency of the MORAN architecture. By sharing active radio access infrastructure, MORAN requires only four Remote Radio Units (RRUs) and three Baseband Units (BBUs), whereas RF Sharing requires 39 RRUs and 9 BBUs, and the Neutral Host Platform requires 54 RRUs and 12 BBUs. Similar trends are observed for power cabinets and battery strings, indicating that MORAN substantially reduces infrastructure complexity while lowering deployment and maintenance requirements.

Although RF Sharing and Neutral Host Platform provide greater flexibility in infrastructure ownership and operator independence, these benefits are accompanied by increased hardware deployment, higher power consumption, and additional equipment space. Therefore, from an engineering and deployment perspective, MORAN provides the most efficient balance between infrastructure utilization, operational simplicity, and resource optimization for indoor multi-operator 5G DAS deployments.

Table III presents a qualitative comparison of the three indoor 5G DAS sharing architectures based on key deployment and operational characteristics. MORAN demonstrates the highest overall deployment efficiency by combining active infrastructure sharing with reduced hardware requirements, lower power consumption, and simplified network management. These characteristics contribute to lower CAPEX and OPEX while maintaining efficient support for multiple mobile network operators.

RF Sharing provides a balanced approach by allowing operators to retain independent radio equipment while sharing the antenna distribution infrastructure. Although this architecture offers greater operational flexibility than MORAN, it requires additional hardware resources and higher infrastructure costs. In contrast, the Neutral Host Platform offers the greatest flexibility for supporting multiple operators through an independent infrastructure provider but introduces the highest deployment complexity, equipment requirements, and operational costs.

Overall, the comparative analysis indicates that the selec-tion of a sharing architecture depends on the deployment objectives and operational priorities. MORAN is well suited for cost-sensitive and space-constrained indoor environments, RF Sharing provides a compromise between infrastructure sharing and operator independence, while the Neutral Host Platform is appropriate for large venues where independent infrastructure management and multi-operator flexibility are primary requirements.

VI. CONCLUSION

This paper presented a comparative analysis of three infrastructure sharing architectures for indoor 5G Distributed Antenna Systems (DAS): Multi-Operator Radio Access Network (MORAN), RF Sharing, and Neutral Host Platform (NHP). The comparison was conducted using practical engineering design data and evaluated key deployment parameters, including power consumption, equipment room space, hardware requirements, and operational complexity. The results demonstrate that each architecture offers distinct advantages depending on deployment objectives and operational requirements.

Among the evaluated architectures, MORAN achieved the highest infrastructure efficiency by requiring the lowest power consumption, minimum equipment footprint, and reduced hardware resources while maintaining effective multi-operator support. RF Sharing provides a balanced solution by combining shared antenna infrastructure with independent radio resources, whereas the Neutral Host Platform offers greater deployment flexibility at the expense of increased infrastructure complexity and higher operational costs.

Overall, the findings indicate that MORAN is the most cost-effective and operationally efficient solution for multi-operator indoor 5G DAS deployments where minimizing CAPEX, OPEX, and equipment space is a primary objective. Future work will extend this study by validating the engineering design analysis through live network measurements and additional performance metrics such as throughput, latency, energy efficiency, and Quality of Experience (QoE).

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TABLE III: Qualitative Comparison of Indoor 5G DAS Sharing Architectures

Evaluation Criteria	MORAN	RF Sharing	Neutral Host Platform
Infrastructure Sharing Level	Active RAN Sharing	Passive RF Sharing	Shared DAS Infrastructure
Power Consumption	Low	Medium	High
Equipment Room Requirement	Low	Medium	High
Hardware Requirement	Low	Medium	High
Network Architecture Complexity	Low	Moderate	High
Operational Complexity	Low	Moderate	High
Deployment Scalability	High	Moderate	High
Operator Independence	Moderate	High	High
CAPEX	Low	Medium	High
OPEX	Low	Medium	High
Ease of Deployment	High	Moderate	Moderate
Overall Deployment Efficiency	High	Moderate	Moderate

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