TAYLOR' S UNIVERSITY
Wisdom • Integrity • Excellence

Bachelor of Computer Science (Hons)

Module Code: *ITS66004 (March 2025)*

Module Name: *Introduction to Mobile Computing*

Assignment No./Title	**Project (Group Project)** **30% Weightage**
Course Tutor/Lecturer	Mr. Subit Timalsina
Submission Date	31st May 2025
Student Name, ID and Signature 1. 2. 3. 4. 5.	

Declaration *(need to be signed by students. Otherwise, the assessment will not be evaluated)*

Certify that this assignment is entirely our own work, except where we have given fully documented references to the work of others, and that the material contained in this assignment has not previously been submitted for assessment in any other formal course of study.

Marks/Grade:	**Evaluated by:**
Evaluator's Comments:	

* Please include this cover page for your project submission

Objective

Design a 5G-Advanced network architecture addressing latency reduction, scalability, and security in urban environments (e.g., smart cities, autonomous vehicles). Your solution must incorporate mmWave, Massive MIMO, and network slicing, validated through industrial case studies and architectural diagrams. The project will emphasize real-world implementation challenges and opportunities. **You are required to complete all three phases.**

Phase 1: Research & Planning

Tasks:

1. **Literature Review**:
    - **Study mmWave** (Ch. 5, *The Future of Mobile Computing*):
        - Analyze frequency bands (24–100 GHz), propagation challenges, and beamforming techniques.
        - Examine mmWave penetration loss and mitigation strategies (e.g., relays, small cells, RIS technology).
    - **Explore Massive MIMO**:
        - Compare antenna configurations (e.g., 64x64 arrays) and their impact on throughput.
        - Evaluate beamforming algorithms and their role in improving spectral efficiency.
    - **Investigate Network Slicing**:
        - Define use cases (e.g., IoT, emergency services) and QoS requirements.
        - Investigate orchestration techniques using AI/ML.
2. **5G vs. 5G-Advanced Comparison**:
    - Create a **table** contrasting:
        - **Speed**: 5G (1–10 Gbps) vs. 5G-Advanced (10–100 Gbps).
        - **Latency**: 1 ms (5G) vs. 0.5 ms (5G-Advanced).
        - **Use Cases**: Enhanced mobile broadband (5G) vs. holographic communications (5G-Advanced).
3. **Deliverables**:
    - **Literature Review Report** (for item 1).
    - **Table of Comparison** (for item 2).
    - **Annotated Bibliography** (5 sources total, covering topics from both items 1 and 2):
        - Format: APA, with 100-word summaries per source.
        - Include industrial whitepapers (e.g., Ericsson's *5G-Advanced for Smart Cities*).
    - **Signed Meeting Minutes**
        - Roles: Assign Research Lead and Design Lead.

Phase 2: Architectural Design & Analysis

Tasks:

1. **Architecture Design**:
    - Create detailed diagrams (using Lucidchart or Visio) showing:
        - mmWave deployment in urban canyons (e.g., small cells on lampposts).
        - Massive MIMO antenna arrays for high-density areas (e.g., stadiums).
        - Network slicing for IoT, emergency services, and autonomous vehicles.
2. **Latency Reduction**:
    - Propose edge computing integration (e.g., AWS Wavelength) to reduce backhaul dependency.
    - Analyze real-world latency metrics from Ericsson/Nokia case studies.
    - Investigate RAN optimization techniques (e.g., dynamic scheduling, AI-driven load balancing).
3. **Security Implementation**:
    - Design a threat model for urban 5G-Advanced networks.
    - Propose AI-driven security measures (e.g., ML-based anomaly detection for DDoS).
    - Examine attack vectors such as jamming, spoofing, and unauthorized network slicing access.
4. **Deliverables**:
    - **Design Document**:
        - Must include diagrams, threat models, and latency reduction strategies.
    - **Updated Meeting Minutes**:
        - Document research findings, technical challenges, and proposed solutions.

Phase 3: Presentation & Report

Tasks:

1. **Stakeholder Pitch**:
    - Create a **15-slide** deck for city planners:
        - Highlight cost-benefit analysis (e.g., infrastructure vs. performance gains).
        - Include 3 industrial references (e.g., Nokia's 5G-Advanced case studies).
        - Explain regulatory and policy considerations (e.g., spectrum allocation, deployment constraints).
2. **Technical Report**:
    - **Structure**:
        1. **Introduction** (urban challenges, 5G-Advanced relevance).
        2. **Architecture Design** (diagrams, mmWave/Massive MIMO integration).
        3. **Case Study Analysis** (latency, security, scalability in real deployments).
        4. **Security & Scalability Considerations** (threat models, future-proofing).
        5. **Conclusion** (recommendations for real-world deployment).
3. **Deliverables**:
    - **Live Presentation**:
        - 20-minute presentation + 10-minute Q&A.
    - **Final Report**: Deliver an integrated technical report (minimum of 10 pages, single-spaced) that includes all materials from Phases 1, 2, and 3. Ensure that this report includes:
        - All research findings (from the literature review, comparative table, and annotated bibliography).
        - Detailed architectural diagrams and analysis (including threat models and latency/security strategies).
        - A synthesis of the stakeholder pitch content with case study references and regulatory considerations.
    - **Assessment Approach**: Although each phase has its own deliverables, the evaluation of the project will consider the comprehensive final report as the key submission. It should reflect a cohesive integration of the planning, design, and presentation phases, demonstrating how each stage contributes to a robust 5G-Advanced network architecture solution.

Weekly Meeting & Minute Requirements

Frequency: **Every Week**

Week: ___ | Date: [DD/MM/YYYY]
Group Name: _____
Member Names:

1.
2.
3.
4.
5.

Progress:

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Challenges:

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Next Steps:

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Roles and Responsibilities:

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Signatures:
Group Leader: _____
Module Leader: _____

Penalties:

- Late/unsigned minutes: -2% per week (max -10%).

Marking Rubrics

Criteria	10–9	8–7	6–5	4–3	2–1	0
Phase 1: Research & Planning (20 marks)	All deliverables (literature review, comparison table, bibliography, signed minutes) are comprehensive, well-structured, and submitted on time.	Most deliverables complete with minor formatting or content gaps; slight delays in submission.	Key elements present but some content lacks clarity or depth; notable delays.	Limited effort with incomplete or low-quality submissions.	Poor submission quality or missing major components.	Not submitted.
Phase 2: Architecture Design (30 marks)	Architecture diagrams are detailed, relevant technologies are well-integrated; strong industrial case study support.	Good diagrams and moderate innovation; some industrial relevance shown.	Adequate design but lacking clarity or weaker technical justification.	Basic or incomplete design work; limited link to real-world implementations.	Very weak architecture or irrelevant case examples.	Not submitted.
Introduction & Background (10 marks)	Clearly explains purpose, scope, context, and theory with excellent structure and clarity.	Mostly clear explanation; minor issues in theory linkage.	Some clarity issues; weaker integration of theoretical framework.	Lacks clear purpose and theoretical alignment.	Minimal theory, poorly structured.	Not attempted.
Latency & Security Strategies (10 marks)	Highly relevant and well-researched mitigation strategies using edge computing, AI/ML, encryption.	Good strategies, minor gaps in justification or scope.	Some valid approaches but lacks depth or technical detail.	Limited strategies; vague implementation ideas.	Minimal research with no technical depth.	Not attempted.
Final Report Quality & References (10 marks)	Well-organized, all APA citations correct, professional formatting, integrates all content from both phases.	Mostly correct format, small APA or structure issues.	Some APA errors or poor flow between sections.	Lacks cohesion; frequent citation and formatting issues.	Poorly referenced or disorganized.	Not submitted.
Presentation (10 marks)	Engaging, clear visuals, time-managed, team coordination evident.	Clear slides and presentation, minor timing or clarity issues.	Acceptable clarity but less engaging, some confusion.	Poor visuals, unclear message, minimal preparation.	Disorganized or confusing presentation.	No presentation.
Teamwork & Meeting Minutes (10 marks)	Team roles clearly defined (Research Lead, Design Lead); all minutes signed and submitted on time.	Minor delays or missing signatures; roles mostly respected.	Weak coordination, few signed records, unclear role allocation.	Team disorganization, missing minutes or role confusion.	Minimal collaboration.	No participation.