

CONTENTS

APPROVAL PAGE

SELF DECLARATION AGAINST PLAGIARISM

ABSTRACT iv

ACKNOWLEDGEMENTS v

PREFACE vi

CONTENTS vii

LIST OF FIGURES x

LIST OF TABLES xi

LIST OF ABBREVIATION xiii

1 INTRODUCTION 1

- 1.1 Background 1
- 1.2 Research Problem 3
- 1.3 Research Purpose 3
- 1.4 Scope of Work 3
- 1.5 Research Methodology 4
- 1.6 Hypothesis 5

LIST OF SYMBOL 1

ACHIEVEMENT 1

2 BASIC CONCEPT 7

- 2.1 5G Technology 7
 - 2.1.1 5G Architecture 8
 - 2.1.2 5G Standalone and Non-Standalone 10
 - 2.1.3 Capabilities and Requirements 5G NR 12
- 2.2 5G NR Spectrum Frequency 14

2.2.1	Frequency Spectrum of 700 MHz	16
2.3	Numerology in 5G NR	18
2.3.1	Subcarrier Spacing and Slot Duration	18
2.3.2	Frame Structure of 5G NR	18
2.4	Metropolitan Area	19
2.5	Techno-Economic Analysis	22
2.6	5G Technical Planning	22
2.6.1	Capacity Planning	22
2.6.2	Coverage Planning	24
2.7	5G Economic Planning	26
2.7.1	Capital Expenditure (CAPEX) and Operational Expenditure (OPEX)	26
2.7.2	Business Feasibility Analysis	27
2.7.3	Sensitivity Analysis	29
2.8	Regulation	30
2.8.1	Regulation of 700 MHz Spectrum in Indonesia	33
2.8.2	Regulation of 700 MHz Spectrum in Other Countries	34
2.9	5G Key Performance Indicator (KPI)	37
2.9.1	Secondary Synchronization-Signal Reference Signal Received	37
2.9.2	Secondary Synchronization Signal-to-Noise and Interference Ratio	38
3	RESEARCH METHODOLOGY	39
3.1	System Design	39
3.2	Data Collection	40
3.3	Data Analysis	41
3.4	Capacity Planning	41
3.5	Coverage Planning	42
3.6	Network Planning Simulation	44
3.7	Economic Planning	44
3.7.1	Capital Expenditure and Operating Expenditure Calculations	45
3.7.2	Business Feasibility	48
3.7.3	Sensitivity Analysis	49
4	RESULT AND ANALYSIS	51
4.1	5G Technical Analysis	51
4.1.1	Capacity Analysis	51

4.1.2	Coverage Analysis	54
4.2	Required Number of gNodeB	56
4.2.1	Based on Capacity Analysis	56
4.2.2	Based on Coverage Analysis	57
4.2.3	Final Number of gNodeB	58
4.3	Network Planning Simulation Analysis	59
4.3.1	Result of SS-RSRP	60
4.3.2	Result of SS-SINR	61
4.4	5G Economic Analysis	63
4.4.1	Capital Expenditure	63
4.4.2	Operational Expenditure	64
4.4.3	Revenue	65
4.5	Business Feasibility Analysis	66
4.5.1	Net Present Value (NPV)	66
4.5.2	Internal Rate of Return (IRR)	67
4.5.3	Payback Period (PBP)	68
4.5.4	Profitability Index (PI)	69
4.6	Sensitivity Analysis	69
4.6.1	Sensitivity Analysis Implications on Business Feasibility Metrics	70
4.6.2	Parameter Impact on Business in Sensitivity Analysis	77
4.7	Comparative Analysis of 700 MHz Frequency Spectrum	82
4.8	Policy Brief	82
5	CONCLUSION	86
5.1	Conclusions	86
5.2	Future Works	88
	REFERENCES	89