



*GDPC Forum*



# **Master Plan for Arterial Road Network Development in Myanmar**

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# 1. Needs for a Master Plan

## ▣ Poor Road Infrastructure

- Lack of road infra structure → Excessive cost for logistics
- Most of roads have got 1-lane or 2-lanes
  - Yangon-Mandalay Expressway is the only road with 4-lanes
  - Most of Union Highways and Region/State Roads shows narrowed width, bad alignment and poor pavement.
- Poor Road Network
  - Regional economic growth is limited due to pure road networks.
  - Limit on economic and social participation of local residents
  - Lack of road network connecting regional growth center
  - Lack of road network for smooth economic activities with neighboring countries

## ○ Road Construction on Short-term Needs

- Priority is given to international connectivity with neighboring countries
- Investment is given to road development for short-term demand and remote area connection

## ▣ Need for Road Network Development

- Regional transport shares : 76.1%(passenger), 80.7% (cargo)  
(Source : National Transport Development Plan, JICA, 2014)
  - Roads play major roles in regional passenger and cargo transport
- Support for social & regional integration and poverty reduction
- Balanced regional development through efficient connection between Regions
- Basic infrastructure development for economic development

**▣ A master plan for arterial road network development**  
(getting comprehensive, systematic, and long-term)  
**is essential for supporting economic development**

**Comprehensive  
Approach**



- **Multimodal Consideration**
- **Regional & Industrial Development**

**Systematic  
Approach**



- **Functional Road Networks**
- **Integration of Road Networks**

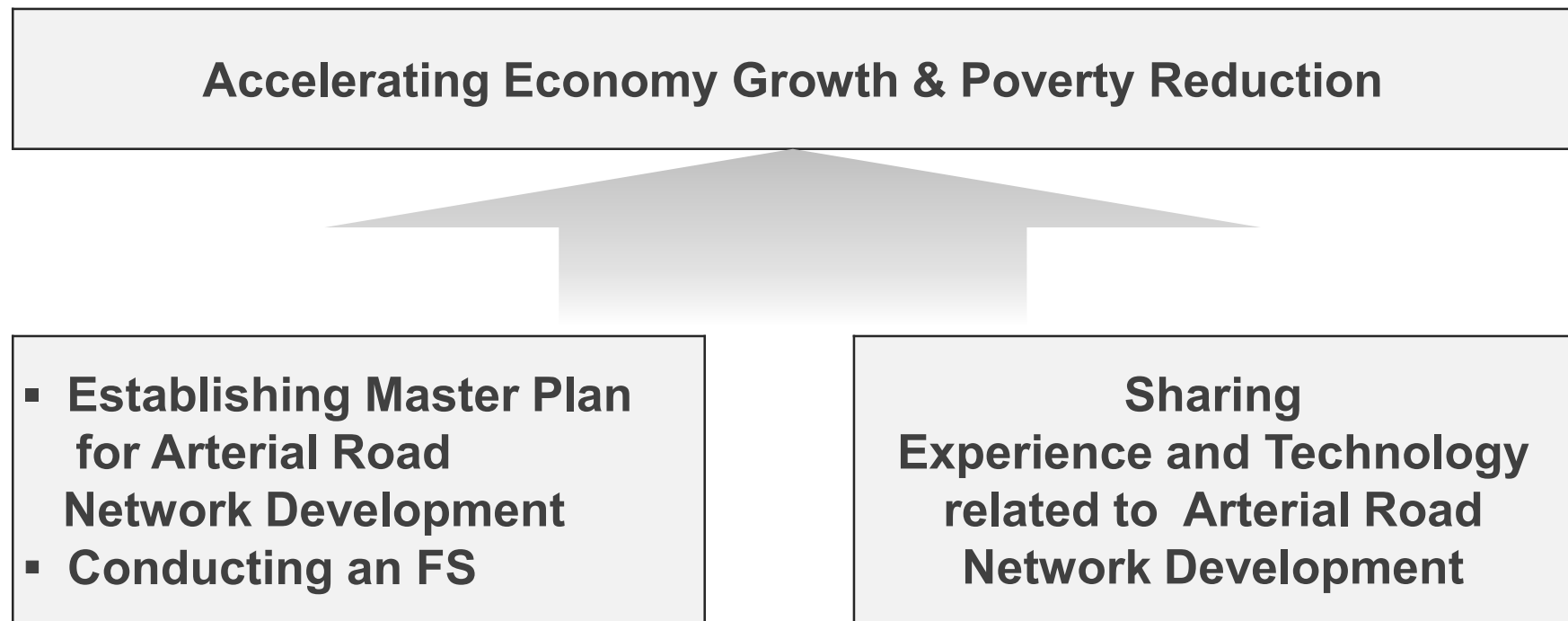
**Long-term  
Approach**



- **Long-term View with Short-term Demand**
- **Phased Road Network Development**

## 2. Objectives of the Project

- **Establishing a master plan** for arterial road network development
- **Conducting a feasibility study** on the road improvement project between Monywa and Gangaw of Myanmar



### 3. Scope of Works

## ○ Master Plan

- Area : 676,577km<sup>2</sup> • Population : 61 million
- Administrative System : 7 States & 7 Regions,  
68 Districts, 333 Townships
- Road Network in Myanmar (148,689 km)

Road Type		Length
MOC (39,082)	Union Highways	19,503km
	Regional/State Roads	19,579km
Ministry of Border Areas		93,373km
Others (YCDC, NCDC, MCDC)		16,235km

## ○ Feasibility Study

- Monywa – Gangaw Road Section (180km)

## ○ Technology Transfer



## ▣ Time Frame

### ○ Base Year

- 1) Data Collection : 2012~2014
- 2) Field Survey Data : 2013~2014

### ○ Time Frame for Planning

- 1) Phase 1 : 2016~2020(Target Year:2020)  
→Implementation Plan by Year
- 2) Phase 2 : 2021~2025(Target Year:2025)  
→Implementation Plan for 5 Years
- 3) Phase 3 : 2026~2035(Target Year:2035)  
→ Implementation Plan for 10 Years

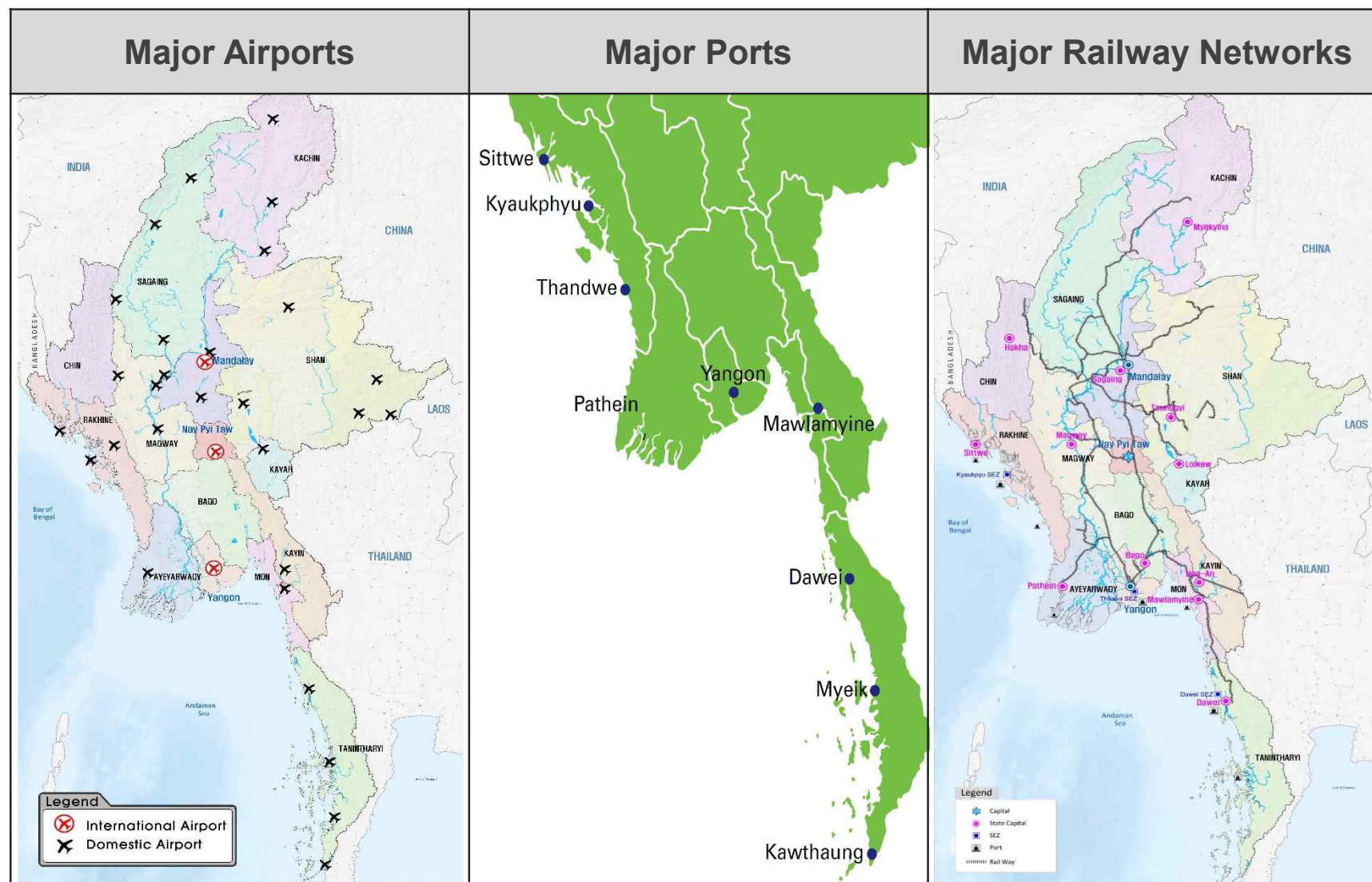
### ○ Time Frame for Analysis

- 1) Base Year : 2014
- 2) Forecast Year : 2020, 2030, 2040 *Note)*

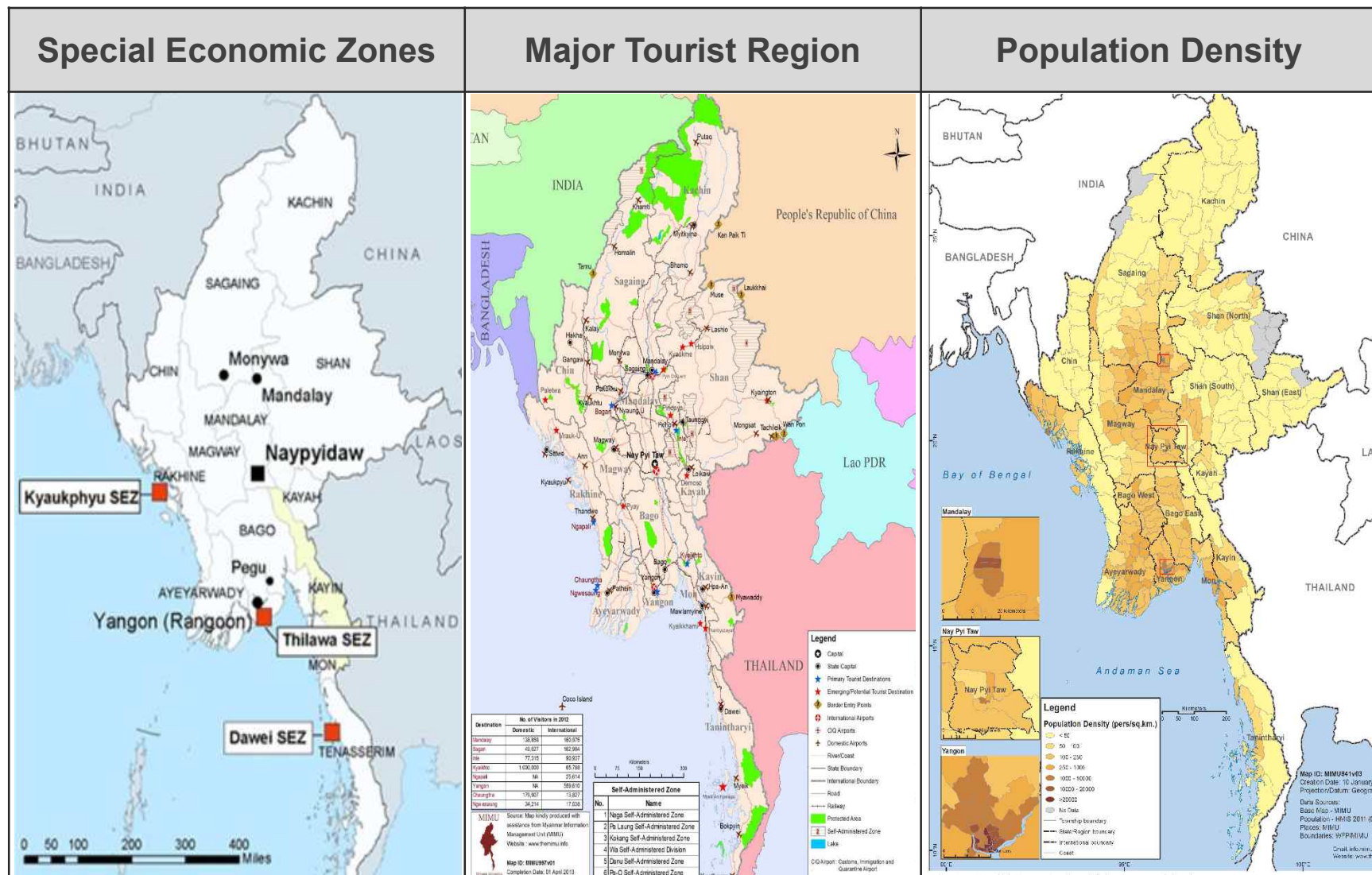
(Note : Same as the forecast year in *National Transport Development Master Plan*, JICA, 2014)



## 4. Major Consideration for the Master Plan

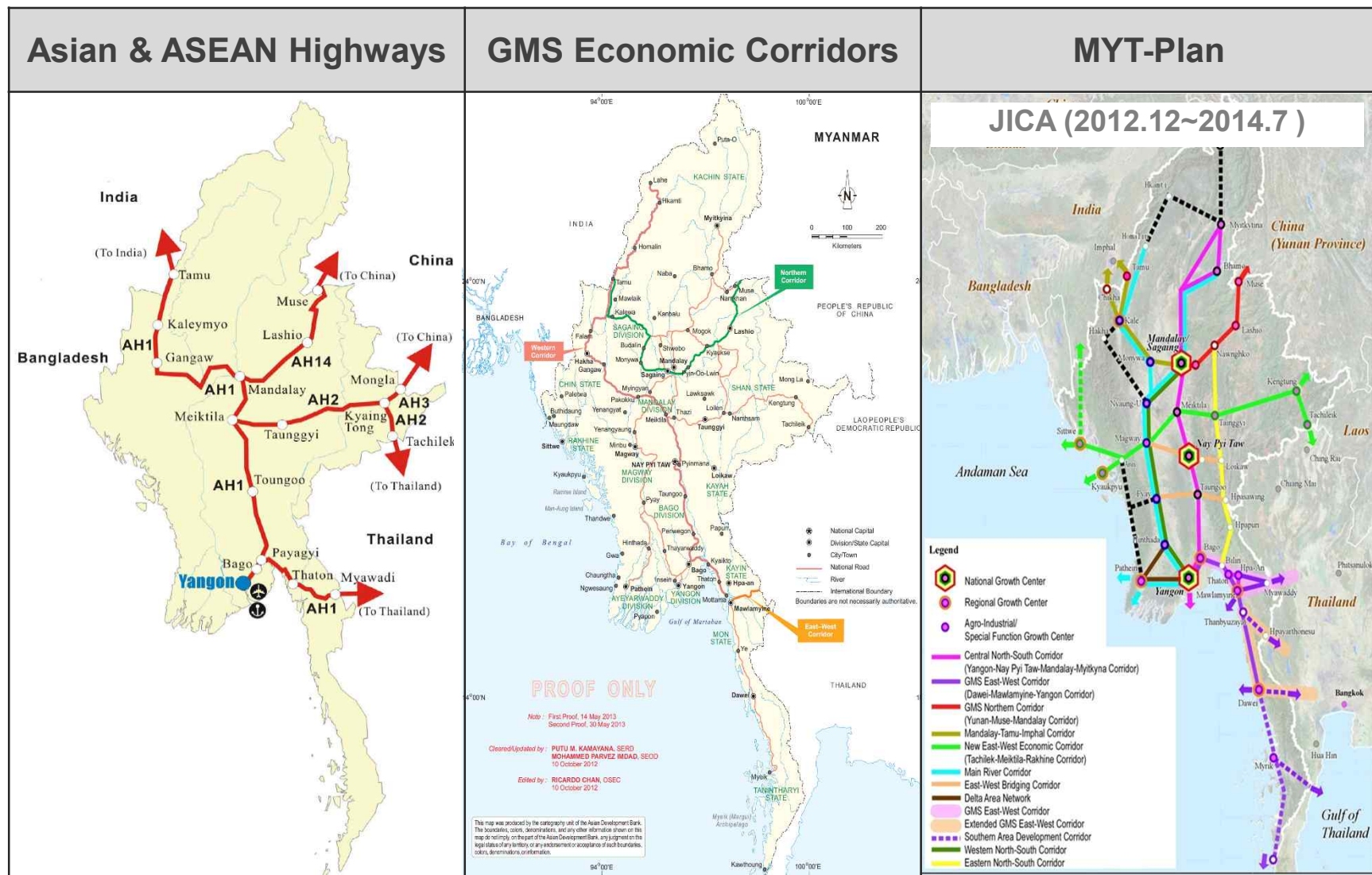


## 4. Major Consideration for the Master Plan







## 4. Major Consideration for the Master Plan



## 4. Major Consideration for the Master Plan

National Growth Poles	Union Highway & State/Regional Road	Others
 <p> <span style="color: red;">●</span> Capital City  <span style="color: red; border: 2px dashed red; border-radius: 50%; padding: 2px;">●</span> National Economic Growth Center  <span style="color: orange;">●</span> Secondary Regional Growth Center  <span style="color: blue;">●</span> Other Growth Center         </p>	 <p> <b>Legend</b>  <span style="color: blue;">★</span> Capital  <span style="color: pink;">●</span> State Capital  <span style="color: blue;">■</span> SEZ  <span style="color: black;">🚢</span> Port  <span style="color: orange;">—</span> Union Highway  <span style="color: black;">—</span> State &amp; Regional Roads         </p>	<ul style="list-style-type: none"> <li>• Center to Center Connection</li> <li>• Multimodal Transport Connection</li> <li>• International Linkage</li> <li>• Hierarchical Road Network Development</li> <li>• Topographical Consideration</li> </ul>

## 5. Arterial Road Development Strategies

- Center to Center Connection
  - Accessibility improvement to capital city of Region/State
- Multimodal Transport Connection
  - Connectivity with other transport modes such as Railway, Airport, Port, and Inland waterway
- International Linkage
  - Improvement of international road network (Asian/ASEAN Highway, GMS, etc.)
- Hierarchical Road Network Development
  - Road classification by its function and road network development (Strengthening efficiency and functionality )
- Topographical Consideration
  - Minimizing negative environmental impacts



## ▨ Arterial Road Network Development



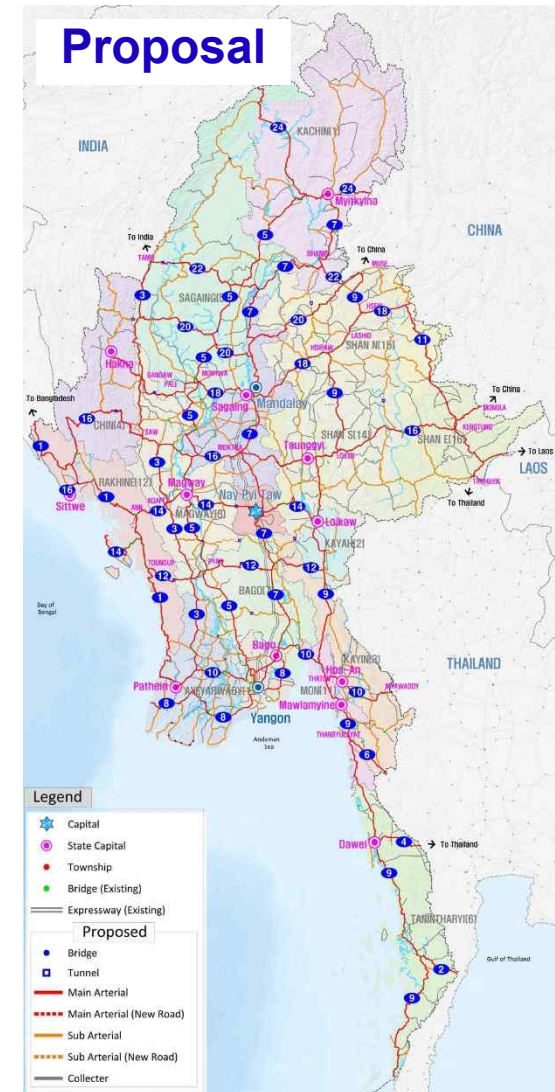
Center to Center  
Connection

Multimodal Transport  
Connectivity

International Linkage

Hierarchical Road  
Network Development

Topographical  
Consideration



## ▣ Expressway Network Development

- Establishment of High-speed Arterial Road ⇒ Support Economy growth

- Current Expressway in Myanmar

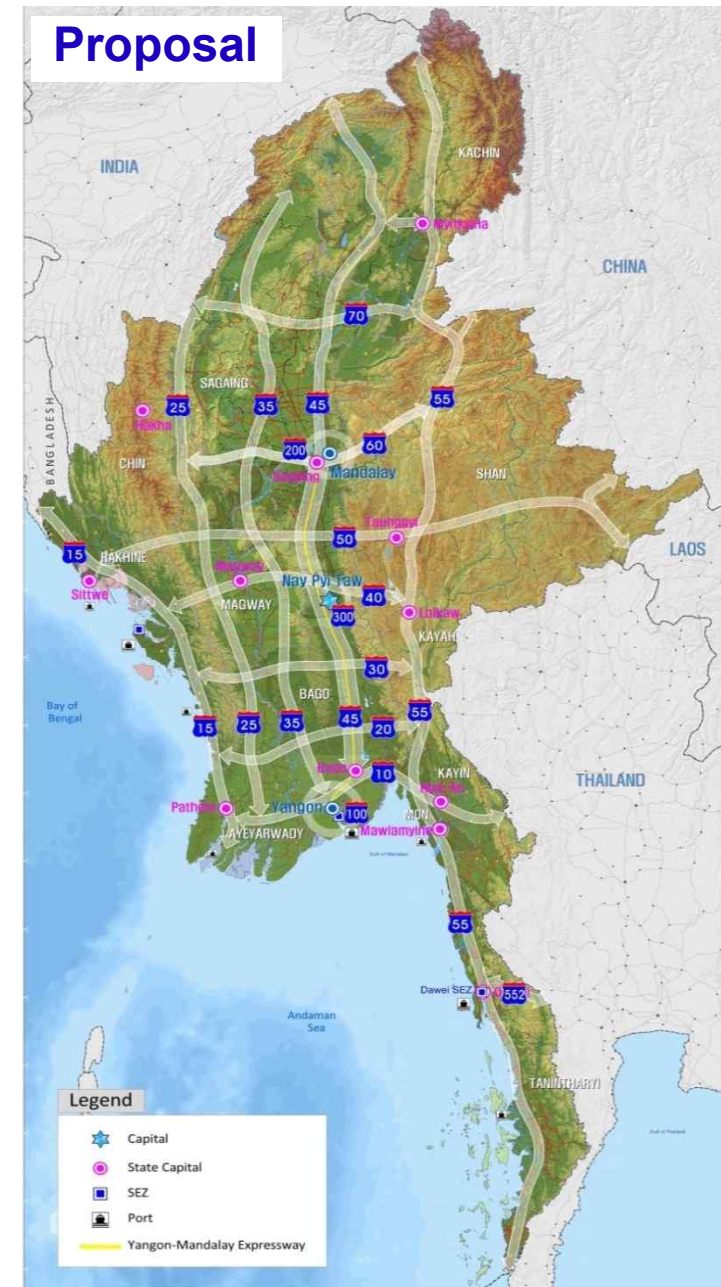
: Yangon ~ Mandalay Expressway  
- 586km, 4 Lanes (Future: 8 Lanes)

- Considerations

- National Development Corridors
- International Linkages
- Strategic Development Corridors
- Multimodal Transport
- Topography
- Arterial Road Network

- 7 X 5 Expressway Network (10,000km)

- East-West : 7 Corridors → 3,400km
- North-South : 5 Corridors → 6,000km
- Ring-Road (Major Cities) → 600km



## 6. Definition of Arterial Roads

Local Road	Collector Road	Arterial Road		
		Sub Arterial	Main Arterial	Expressway
run within a Township	run within a District	run within a Region/State	Across Regions/States	High speed with access control

← accessibility

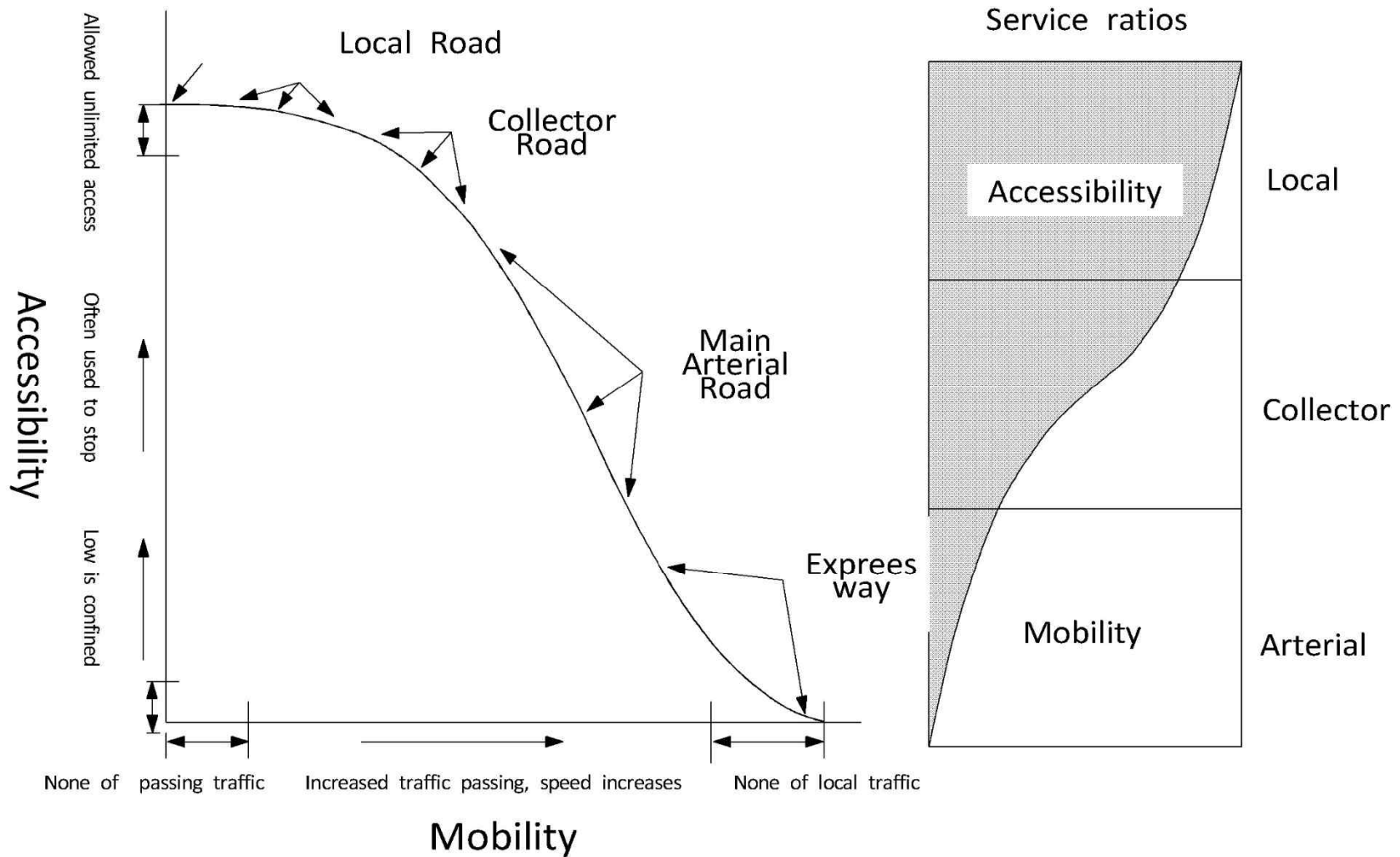
(a major consideration)

mobility →

Road Class	Basic Principles
Main Arterial Road	<ul style="list-style-type: none"> <li>• Roads that connect two or more states</li> <li>⇒ Operation in all weathers; Securing sufficient Capacity; Asphalt Pavement; Design standards of International Road Networks</li> </ul>
Sub Arterial Road	<ul style="list-style-type: none"> <li>• Roads that connect two or more <i>Main Arterial Roads</i></li> <li>⇒ Securing the Connectivity of <i>Main Arterial Roads</i>, Operation regardless of weather and Road applied Asphalt Pavement</li> </ul>



## ▨ Classification by Road Function



## 7. Problems of Existing Road and Improvements

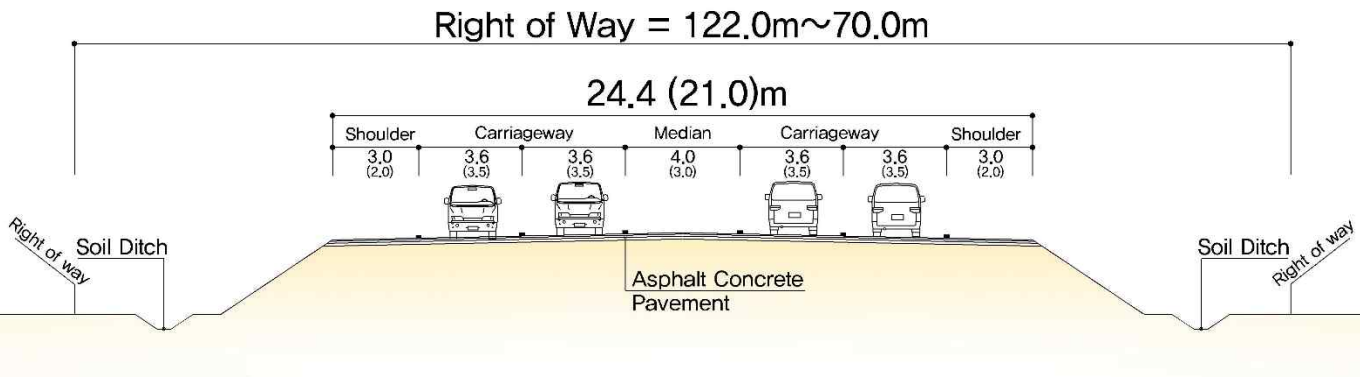
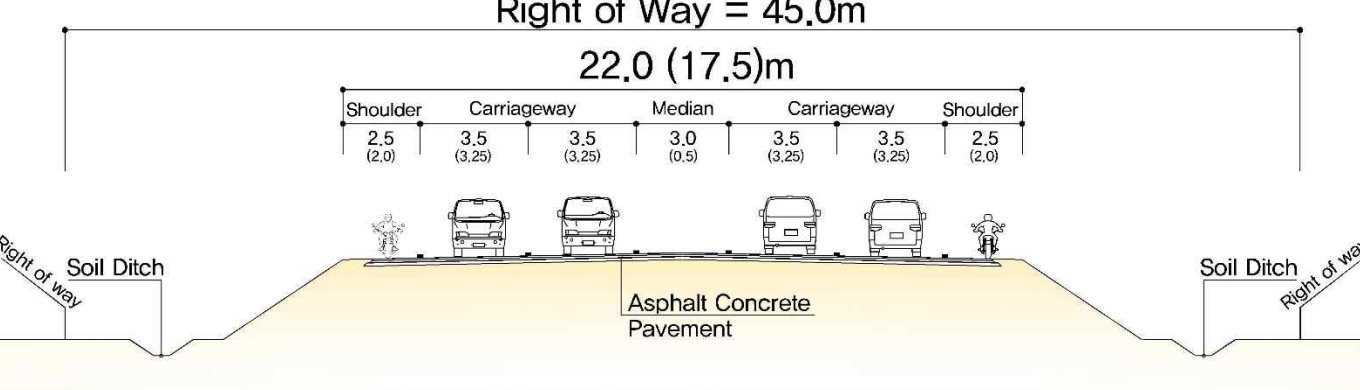
Items	Problem	Improvements
Road Condition	<ul style="list-style-type: none"> <li>- Poor pavement condition</li> <li>- Low rate of Pavement</li> <li>- Narrow width of Pavement</li> <li>- Lower than the standards of international road networks</li> <li>- Aged and poor bridge</li> </ul>	<ul style="list-style-type: none"> <li>- Repairing and re-pavement</li> <li>- New pavement</li> <li>- Road pavement widening</li> <li>- Road upgrade to meet standards</li> <li>- Building new bridges</li> </ul>
Road Network	<ul style="list-style-type: none"> <li>- Disconnected road networks</li> <li>- Disconnection at main rivers</li> </ul>	<ul style="list-style-type: none"> <li>- Road, bridge &amp; tunnel construction</li> <li>- Building new bridges</li> </ul>
Traffic	<ul style="list-style-type: none"> <li>- Traffic congestion in large cities</li> <li>- Mixed traffic flows</li> <li>- Poor transport management</li> </ul>	<ul style="list-style-type: none"> <li>- New road and bypass road</li> <li>- Control of traffic flows</li> <li>- Installing transport safety facilities (traffic lights, traffic signs, etc.)</li> </ul>

## 8. Cross Sections of Arterial Roads

### ▨ Cross Section by Road Class

Classification			Local Road	Collector Road	Arterial Road		
					Sub Arterial	Main Arterial	Expressway
Width		Rural	3.00	3.25	3.50	3.50	3.60
		Urban	3.00	3.00	3.25	3.25	3.50
Shoulder	Rural	Level	1.5	2.0	2.5	2.5	3.0
		Rolling	1.5	2.0	2.5	2.5	3.0
		Mountain	1.0	1.5	2.0	2.0	2.5
	Urban		1.5	1.5	2.0	2.0	2.0
Median	Rural	Level	-	-	2.0 (0.5)1)	3.0 (0.5)	4.0
		Rolling	-	-	2.0 (0.5)	3.0 (0.5)	4.0
		Mountain	-	-	2.0 (0.5)	2.5 (0.5)	3.0
	Urban		-	-	(0.5)	(0.5)	3.0
Right of way		Rural	30	45	45	45	70~122
		Urban	To decision width of Right of Way by urban planning				

## ▣ Typical Cross Sections

Classification	Typical Cross Section
<b>Expressway</b>  <b>(4 Lanes)</b>	 <p>Right of Way = 122.0m~70.0m</p> <p>24.4 (21.0)m</p> <p>Shoulder 3.0 (2.0) Carriageway 3.6 (3.5) Median 4.0 (3.0) Carriageway 3.6 (3.5) Shoulder 3.0 (2.0)</p> <p>Right of way Soil Ditch Asphalt Concrete Pavement Soil Ditch Right of way</p>
<b>Main Arterial Road</b>  <b>(4 Lanes)</b>	 <p>Right of Way = 45.0m</p> <p>22.0 (17.5)m</p> <p>Shoulder 2.5 (2.0) Carriageway 3.5 (3.25) Median 3.0 (0.5) Carriageway 3.5 (3.25) Shoulder 2.5 (2.0)</p> <p>Right of way Soil Ditch Asphalt Concrete Pavement Soil Ditch Right of way</p>

## ▨ Typical Cross Sections

Classification	Typical Cross Section
<b>Main Arterial Road</b>  <b>(2 Lanes)</b>	<p>Right of Way = 45.0m</p> <p>12.5 (11.0)m</p> <p>Shoulder Carriageway Carriageway Shoulder</p> <p>2.5 (2.0) 3.5 (3.25) Median 0.5 (3.25) 3.5 (3.25) 2.5 (2.0)</p> <p>Right of way Soil Ditch NMT Asphalt Concrete Pavement NMT Soil Ditch Right of way</p>
<b>Sub Arterial Road</b>  <b>(2 Lanes)</b>	<p>Right of Way = 45.0m</p> <p>12.5 (11.0)m</p> <p>Shoulder Carriageway Carriageway Shoulder</p> <p>2.5 (2.0) 3.5 (3.25) Median 0.5 (3.25) 3.5 (3.25) 2.5 (2.0)</p> <p>Right of way Soil Ditch NMT Asphalt Concrete Pavement NMT Soil Ditch Right of way</p>



# 9. Arterial Road Improvement Plan

## ▪ Main Arterial Network



## ▪ Sub Arterial Network



## ▪ Arterial Network(Main+Sub)



## ▣ Improvement Type (Main Arterial Road)

Classification	Type-1	Type-2	Type-3	Type-4	Type-5
Improvement Plan	New construction 4-Lane	New construction 2-Lane	expansion 4-Lane	Upgrade 2-Lane	Pavement

### Examples : Improvement Plan of Main Arterial Road

Road No.	Classification No.	Management No.	Condition of the existing Road							Improvement plan			
			Section		Topography	Length	Lane width	Number of Lanes	Pavement type	Improvement type	Lane width	Number of Lanes	Pavement type
			Start point	End point									
1	17140	MU0801000000	Ngayokekaungd aung	Ngayokekaung	Mount	29.6	4.3	1	Earth	Type-4	12.5	2	AC
	17149	MU0802000000	TaZinGwin	Ngayokekaungd aung	Mount	19.8	4.3	1	Bitumi nous	Type-4	12.5	2	AC
	17110	MU0804000000	KhweLeGyi	Ngapudaw	Rolling	14.9	4.3	1	Bitumi nous	Type-4	12.5	2	AC
	17020	MU0806000000	LanThaMaing	Kwelwe	Level	42.2	4.3	1	Bitumi nous	Type-4	12.5	2	AC
	17136	MU0808000000	ThaYoutMyaik	Mawlamyinegyu n	Level	7.8	4.3	1	Bitumi nous	Type-4	12.5	2	AC
	New	MN0810000000	Shewgyaung	PeikTar	Level	6.8	-	-	-	Type-2	12.5	2	AC
	.	.	.	.	.	.	.	.	.	.	.	.	.
2~24	.	.	.	.	.	.	.	.	.	.	.	.	.

## ▨ Improvement Type (Sub Arterial Road)

Classification	Type-1	Type-2	Type-3
Improvement Plan	New construction 2-Lane	Upgrade 2-Lane	Pavement

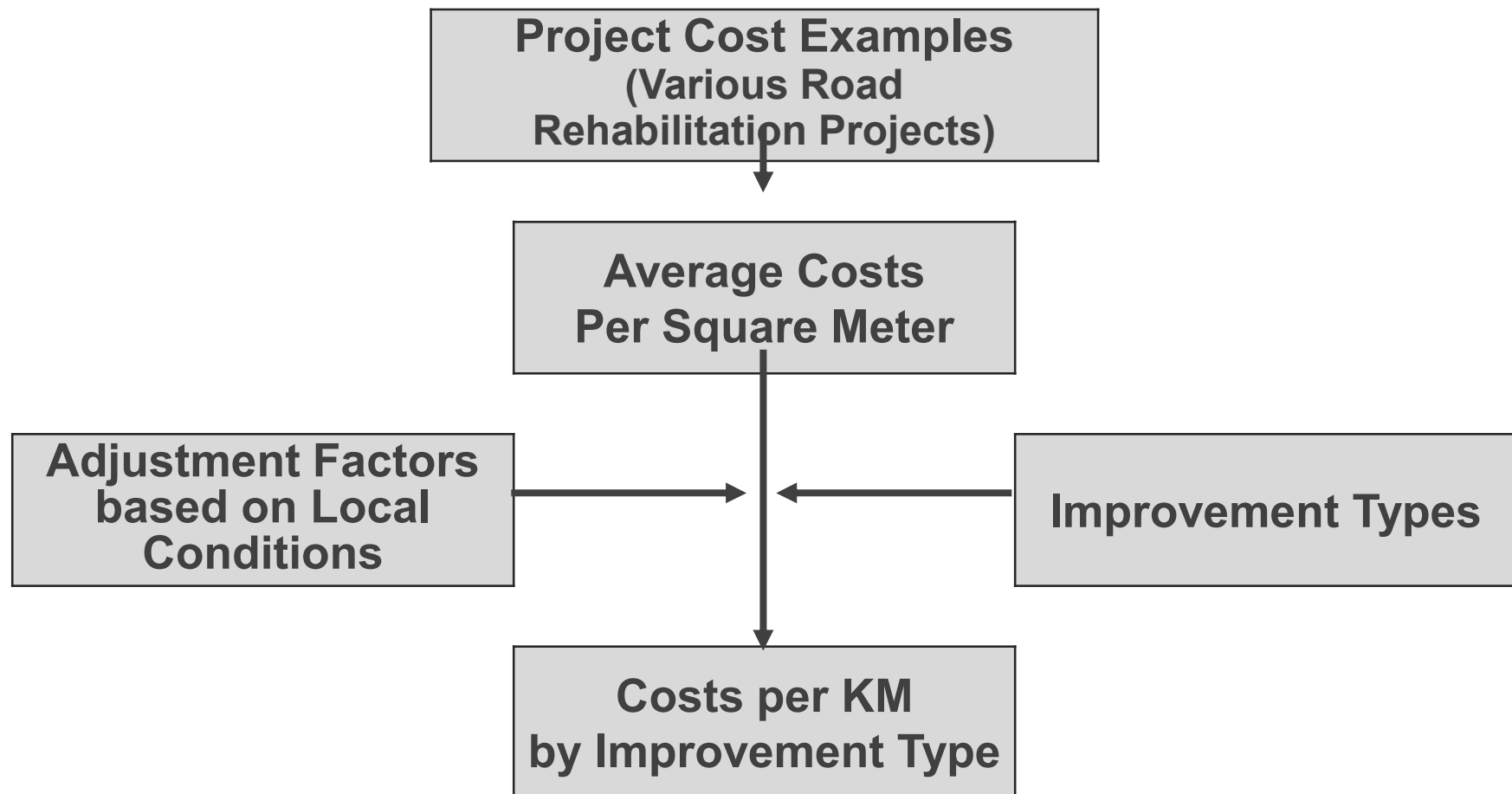
### Examples : Improvement Plan of Sub Arterial Road

Road No.	Classification No.	Management No.	Condition of the existing Road							Improvement plan			
			Section		Topography	Length	Lane width	Number of Lanes	Pavement type	Improvement type	Lane width	Number of Lanes	Pavement type
			Start point	End point									
101	01145	SU0000010101	Hopin	Nyaungpin	Mount	63.6	5.5	1	Gravel	Type-2	12.5	2	AC
103	01004	SU0000010301	Myitkyina	Putao	Mount	350.2	9.1	1	Macadam	Type-2	12.5	2	AC
104	01014	SU0000010401	Lawa	Hpakan	Mount	69.2	5.5	1	Macadam	Type-2	12.5	2	AC
	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.	.



## 10. Cost Estimation

### ▣ Calculation of Project Cost



## Unit construction Costs by Improvement Alternative by Road Class

Classification	Improvement type	Number of Lanes	Width	Pavement type	Unit construction Cost (width 10.0m) (US\$/KM) <sup>1)</sup>	Modification factor				Applied unit construction Cost (US\$/KM)
						Pavement width factor <sup>2)</sup>	New construction and upgrade factor <sup>3)</sup>	Topography factor <sup>4)</sup>	Road facility factor <sup>5)</sup>	
Main Arterial Road										

- Note :** 1) Unit construction Cost(w=10.0m) : ① including earth work, Pavement(A.C), drainage work, slope protection work and small bridge ② calculating on the basis of 10.0m standard cross section
- 2) Pavement width factor : Pavement width standard 10.0m(Lane width:7.0m, Shoulder width:3.0m)  
→ adjusting factor value according to the width change
- 3) New construction and upgrade factor : Calculating factor value by difficulty of new construction width and upgrade(new:1.5 ~ 2.0, upgrade:1.0)
- 4) Topographic factor : Increase of construction Cost by topographic condition. 20% of increase in rolling and 50% increase in mountainous in comparison with flat terrain
- 5) Road facility factor : Additional construction Cost factor according to Road function and reinforcement of Road facility caused by disaster(1.2time in coastal areas)

## ▣ Maintenance Unit Cost (Korean Example)

Unit : million us \$ / km

Classification \ Year	1	.....	5	....	10	.....	15	.....	20	.....	25	.....	30	Cycle
Operation Cost	0.2	.....	0.2	.....	0.2	.....	0.2	.....	0.2	.....	0.2	.....	0.2	1year
Routine repair	0.5	.....	0.5	.....	0.5	.....	0.6	.....	0.8	.....	1.3	.....	1.3	1year
Re-surfacing	-	-	-	-	2.0	-	-	-	2.0	-	-	-	2.0	10year
Bridge rehabilitation	-	-	-	-	32	-	-	-	32	-	-	-	32	10year
Total	0.7	.....	0.7	.....	34.7	.....	0.8	.....	35.0	.....	1.5	.....	35.5	

- Operation Cost : Cost of office operation
- Routine Repair : Cleaning Road surface, patching pot-holes, sealing cracks
- Re-surfacing : Patching and overlaying the defective Road surface that is requiring a medium/large scale repair
- Bridge rehabilitation : Shoe, Expansion Joint, Paint, etc.

## ▣ Maintenance Unit Cost (Plan in Myanmar)

Unit : million us \$ / km

Classification		Cycle	Unit Cost
Main Arterial Road	Operation Cost	1 year	
	Routine repair	1 year	
	Re-surfacing	10 years	
	Bridge rehabilitation	10 years	
Sub Arterial Road	Operation Cost	1 year	
	Routine repair	1 year	
	Re-surfacing	10 years	
	Bridge rehabilitation	10 years	

## 11. Additional Proposal : Road Numbering

### Problems

- Arterial Roads in Myanmar is named by words (state/township/village names)
- Road users have difficulties in recognizing where they are and where to go in the road network

### Necessity

- It is Necessary for road users to figure out the whole road network in which they are
- Necessary for road authorities (MoC, etc) to maintain road networks with efficiency

### Improvement

- Introduction of road numbering systems

## ▣ Comparison of Road Numbering Systems

Classifi- cation	KOREA,USA	JAPAN	United Kingdom	Thailand
Express- way	Odd numbers → south to north	Road Name	Hub-and-zone system M (M1, M3, etc.)	None system → 8 expressway
	Even numbers → west to east			(Bangkok area and some nearby provinces)
National Road	Odd numbers → south to north	Northeast and increasing towards the southwest	Hub-and-spoke system  - Major Road : Axxxx → 1~4 digits - Local Road : Bxxxx → 3~4 digits	- Northern : 1xxx - Northeastern : 2xxx - Central : 3xxx - Southern : 4xxx - Primary Road : 2-digits - Secondary Road : 3-digits - Intra-province Highway : 4-digits
	Even numbers → west to east			
Naming	Network base	Zone base		Mixed (Network + Zone)

## ☐ Introduction of Road numbering systems













Road calss	Property	Plan	Type of Naming
Express / Arterial Road	Connecting Road between Regions	Recognition of Road users	Network base
Collect Road / Local Road	Access Road in Region	Road OEM by Local Government	Zone base

## ☐ Comparison of Road Symbols

Classifi-cation	KOREA	USA	JAPAN	United Kingdom	Thailand
Expressway					
National Road		 U.S. ROUTE MARKER (M1-4)			


## ☑ Road Numbering for Expressway Networks

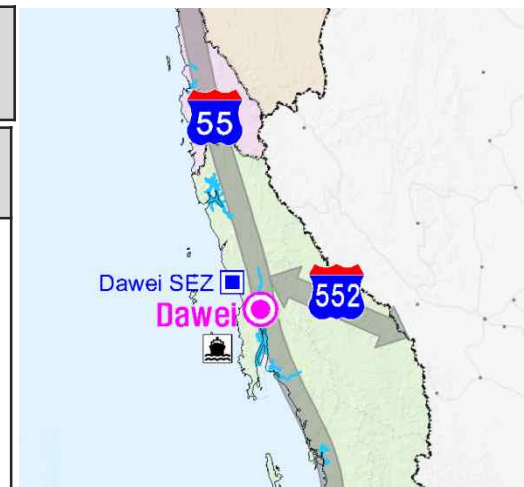
### 1) Main Expressway

- Main Axis Numbers (2 digits : AB)	
A	B
<ul style="list-style-type: none"> <li>· South-North Corridor ⇒ increasing to the east(1,2,3,4,...)</li> <li>· West-East Corridor ⇒ increasing to the north(1,2,3,4,...)</li> </ul>	<ul style="list-style-type: none"> <li>· south-north corridor : end in 5</li> <li>· west-east corridor : end in 0</li> </ul>
Symbol (e.g)	<ul style="list-style-type: none"> <li>· south-north corridor :      </li> </ul>
	<ul style="list-style-type: none"> <li>· west to east corridor :      </li> </ul>






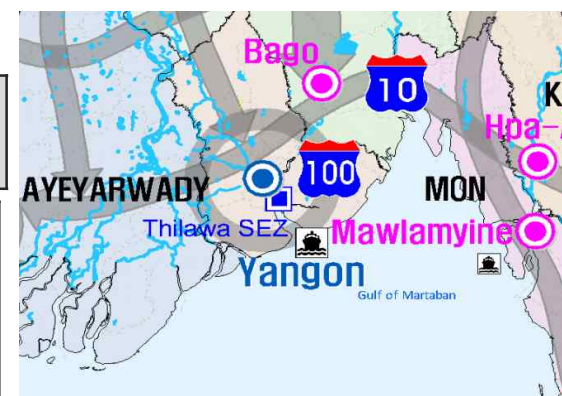
## 2) Branch Expressway

- Numbers (3 digits : ABX)	
AB	X
The main expressway numbers	<ul style="list-style-type: none"> <li>▪ South-North Corridor ⇒ end in 1,3,5,7,9 (Odd)</li> <li>▪ West-East Corridor ⇒ end in 2,4,6,8 (Even)</li> </ul>
Symbol(e.g)	<ul style="list-style-type: none"> <li>▪ west-east corridor :  (Dawei-Thai border)</li> </ul>



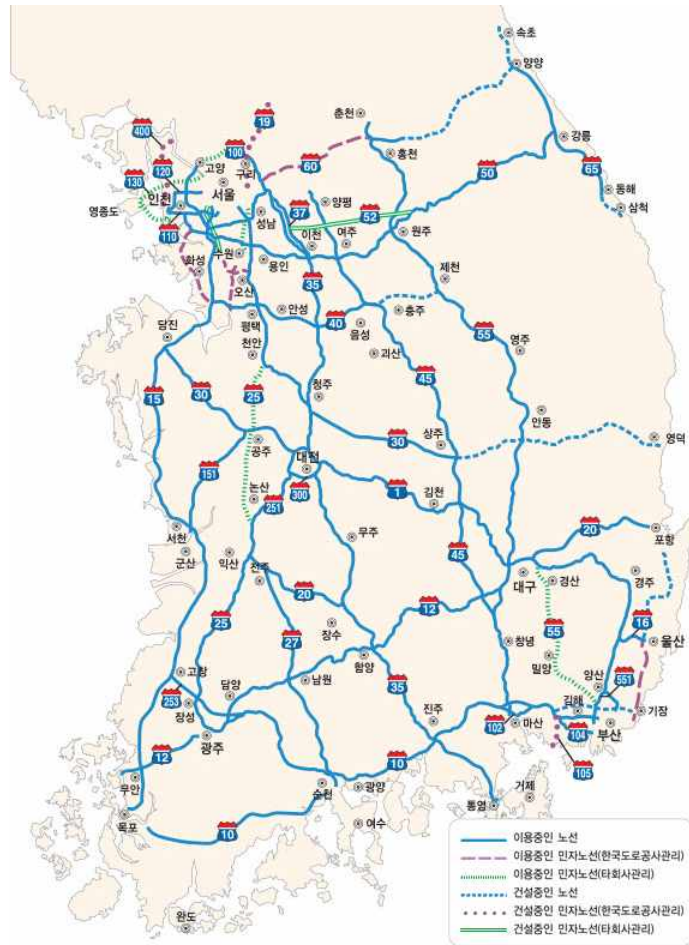
## 3) Ring-type Expressway(in Large Cities)

- Numbers (3 digits : Large Cities)	
Symbol (e.g)	<ul style="list-style-type: none"> <li>▪ YANGON  ▪ MANDALAY </li> <li>▪ NAY PYI TAW </li> </ul>

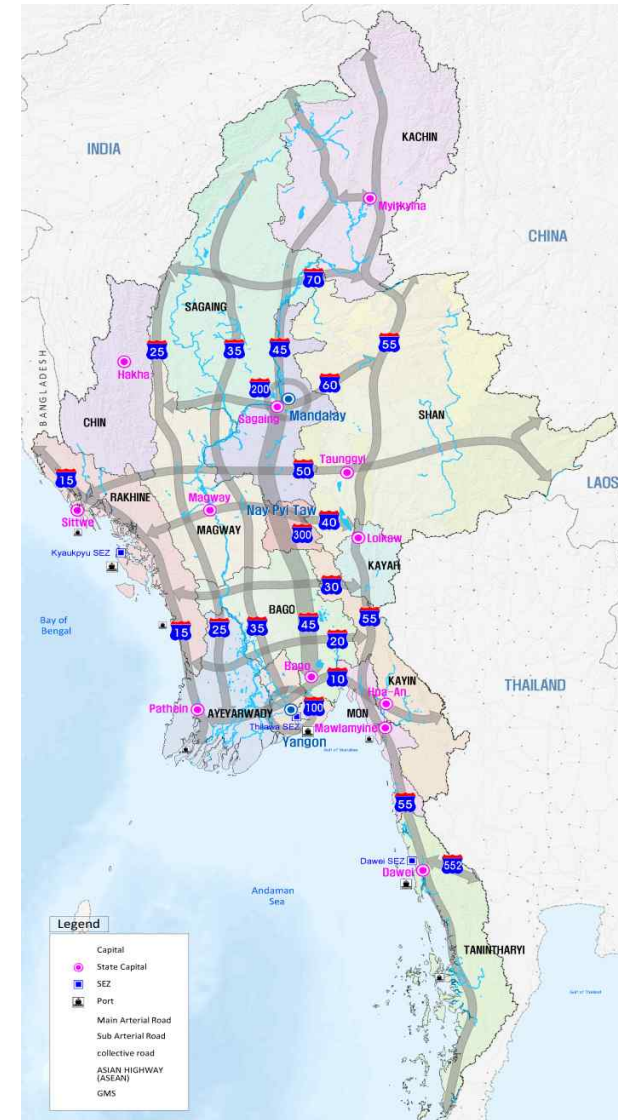


(Example)

○ Korea



○ Myanmar(Proposal)



## ▣ Road Numbering for Main Arterial Road Networks

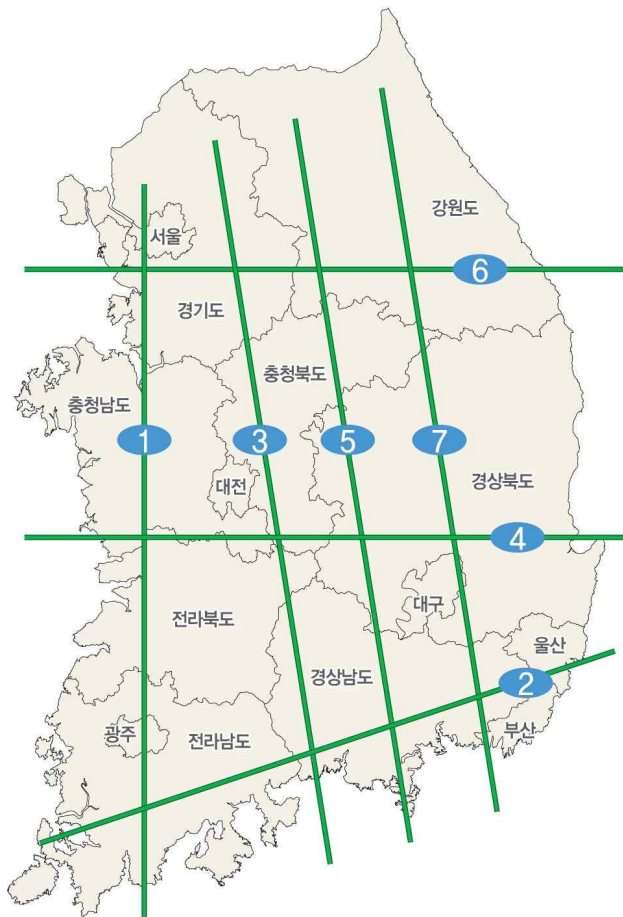
- National Highway Numbers (1 or 2 digits : A or AB)

South-North Corridor	West-East Corridor
<p>⇒ <b>Odd Numbers</b>            ⇒ <b>increasing to the east</b>  <b>(1,3,5,7,9,11,13...)</b></p>	<p>⇒ <b>Even Numbers</b>            ⇒ <b>increasing to the north</b>  <b>(2,4,6,8,10,12...)</b></p>

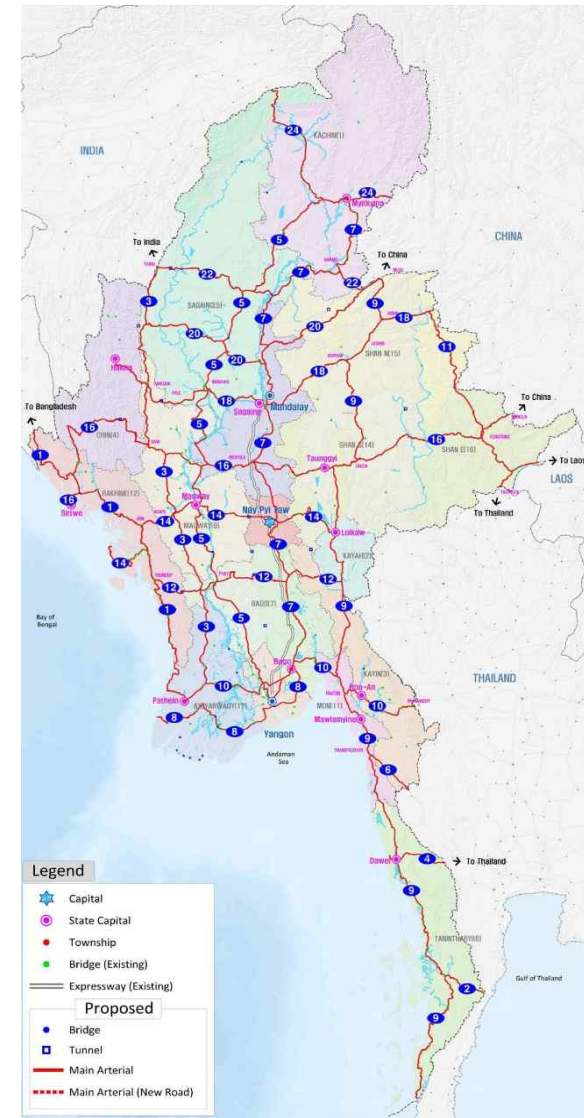
Symbol (e.g)	· south-north corridor : <b>1</b> <b>3</b> <b>5</b> <b>7</b> <b>9</b>
	· west to east corridor : <b>2</b> <b>4</b> <b>6</b> <b>8</b> <b>10</b>

(Example)

○ Korea



○ Myanmar(Proposal)



## ▣ Road Numbering for Sub Arterial Road Networks

- Regional & State Numbers (3 or 4 digits : AXY or ABXY)				
A or AB (Area Classification)				XY
Area	No	Area	No	<ul style="list-style-type: none"><li>· 1~50 : assignment in route which connect only inside of jurisdiction area</li><li>· 51~99 : assignment in route which connect with other area ⇒ Number of area where route length is long is followed.</li><li>· South-North Corridor ⇒ Odd Numbers ⇒ Increasing to the east (01,03,05,07,...,99)</li><li>· West-East Corridor ⇒ Even Numbers ⇒ Increasing to the north (02,04,06,08,...,98)</li></ul>
Kachin	1	Naypyitaw	10	
Kayah	2	Mon	11	
Kayin	3	Rakhine	12	
Chin	4	Yangon Region	13	
Sagaing	5	Shan(South)	14	
Tanintharyi	6	Shan(North)	15	
Bago	7	Shan(East)	16	
Magway	8	Ayeyarwady	17	
Mandalay	9			
Symbol(e.g)	101      1655      ➡			3 or 4 digits





**Thank you !**

Seong Yil BAE

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