



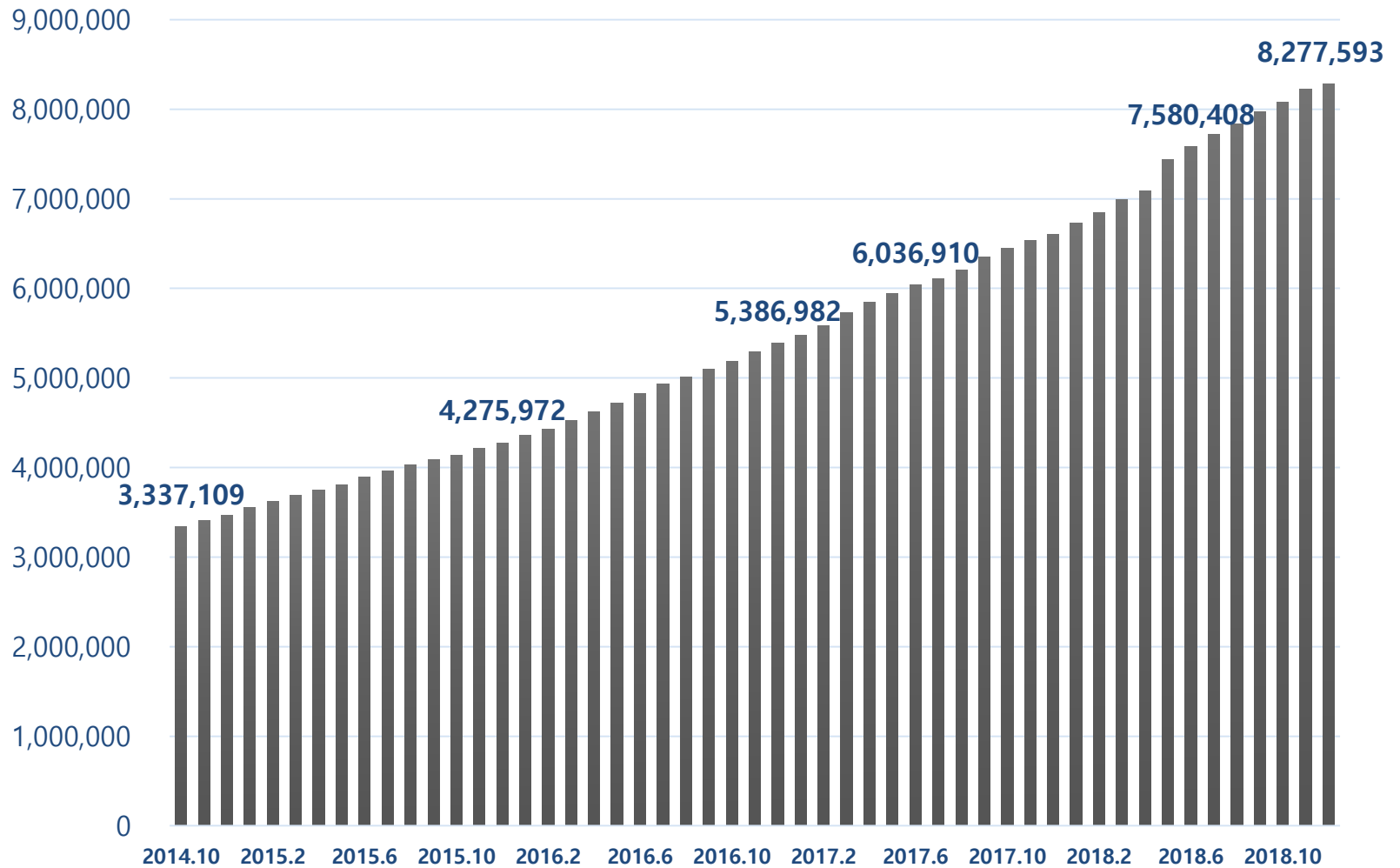
IoT·M2M Numbering Plan in Korea

2019. 03. 26.

Min S. LEE, Ph.D.



Cellular M2M Trend in Korea



Cellular M2M Trend in Korea

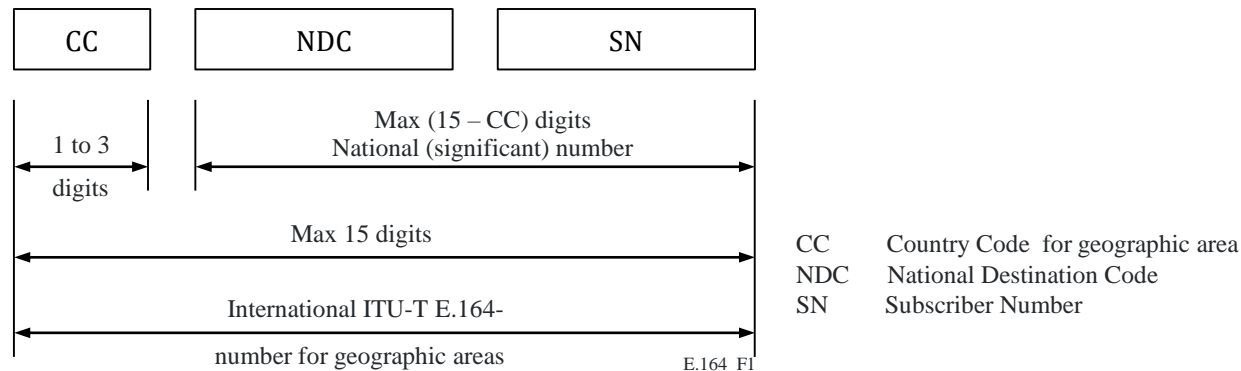
- As of Sep. 2018, cellular M2M records less than 8million lines
 - Machina Research estimation: 30million by 2023 (connections)
 - OVUM estimation: 10.16 million by 2022 (connections)
- No number issues for M2M devices connected via fixed-line network
 - IPv4 or IPv6 should be used as identifier
- M2M devices via mobile network demand numbers
 - LoRA device uses its own identification (Dev EUI by IEEE, LTID)
 - LTE-M & LTE NB-IoT devices use USIM ► **IMSI (E.212)**

Recalling the Recommendation of ECC

- Revisiting the recommendations of ECC in 2010 & 2011:
 - In the long-term, IPv6 should become an alternative numbering resource for M2M applications
 - In the short to medium term, a combination of the following could be an option:
 1. Use existing mobile number ranges
 2. Use a new number range
 3. Use an international numbering solution; or
 4. Use network internal numbers

M2M numbering plan in Korea

- Options 1 & 2 were mainly considered to secure M2M number resource
- Option 1 : use mobile number range
 - Mobile number follows E.164 numbering system
 - Possibility of exhaustion of number range (around 90% was used)
 - Extension of mobile number range was not a feasible option
 - Extension of IMSI was not feasible although MSISDN might be feasible (but costly)



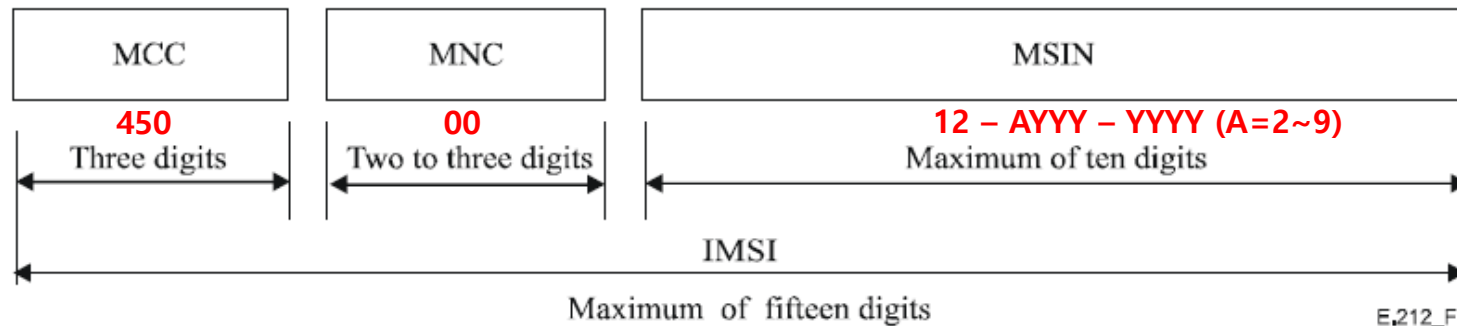
M2M numbering plan in Korea

- Option 2 : use new number range
 - Number range used for pager was available for new assignment
 - Number portability was not a significant concern
 - Devices supporting voice call & SMS
 - use mobile phone number range
 - Some services had already been using mobile numbers
 - e.g., Telematics, Wireless Router, etc.
 - Mobile number unification policy shall bring more freedom for future use of numbers (01X numbers → 010)

Numbering for Cellular M2M in Korea

- In 2013 Feb., MSIP(MSIT) of Korea decided to introduce a new number range for M2M devices

	0	1	2	3	4	5	6	7	8	9
01Y	3G/4G	2G	M2M				2G	2G	2G	



MCC Mobile Country Code
MNC Mobile Network Code
MSIN Mobile Subscription Identification Number
IMSI International Mobile Subscription Identity

- MSIT may allocate up to 10^5 numbers (or less) for each application

Numbering for Cellular M2M in Korea

- Introducing new number range secured 80 million numbers for M2M use
- Devices supporting voice calls (e.g., smart watch or tablets) may be assigned with existing mobile phone number
- As of Dec. '17, 13.8% of total numbers was allotted to Telcos, and only 6.3% has been actually used
- In the short-run, we do not expect a shortage of numbers for M2M and expect to collect the numbers used for 2G
- However, forecasting for M2M number demand is still important for decision of policy direction

Forecasting for IoT M2M number demand

- The number of M2M devices are monthly reported with 6 classifications and this produces 6 possibly correlated time series
- Thus various time series analysis can be used for forecasting
- For a short-run, VAR model and for long-run, VECM can be used

VAR(p):
$$X_t = C + \theta_1 X_{t-1} + \dots + \theta_p X_{t-p} + \varepsilon_t = C + \sum_{i=1}^p \theta_i X_{t-i} + \varepsilon_t$$

i) $E(X_t) = \mu < \infty$

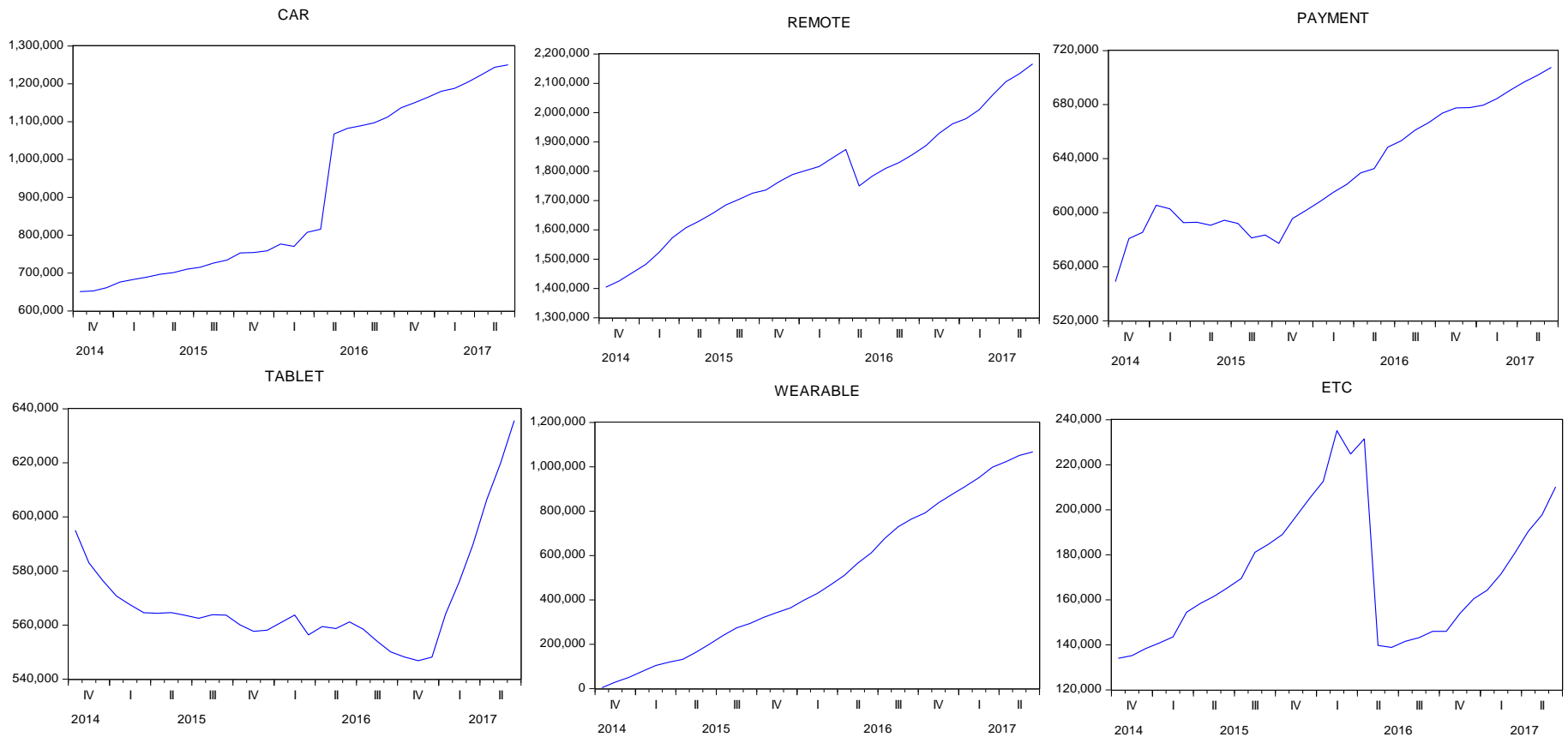
ii) $Var(X_t) = E[(X_t - \mu)(X_t - \mu)'] = \Sigma_X < \infty$

iii) $Cov(X_t, X_{t+k}) = E[(X_t - \mu)(X_{t+k} - \mu)'] = T_X(k)$

- Bass type models –esp. Bayesian Bass - can also be considered

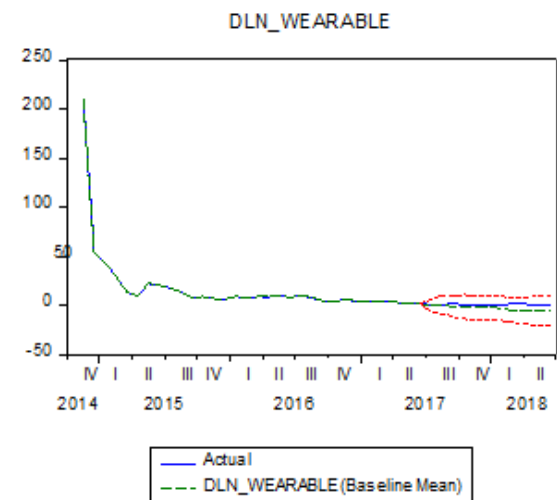
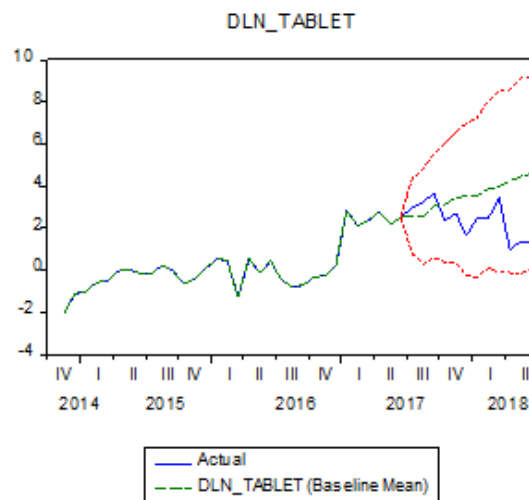
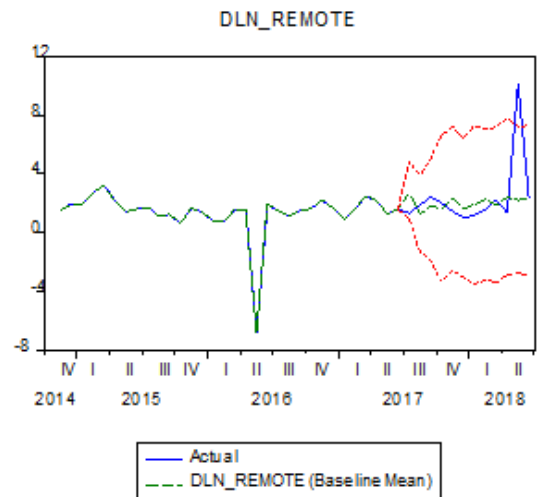
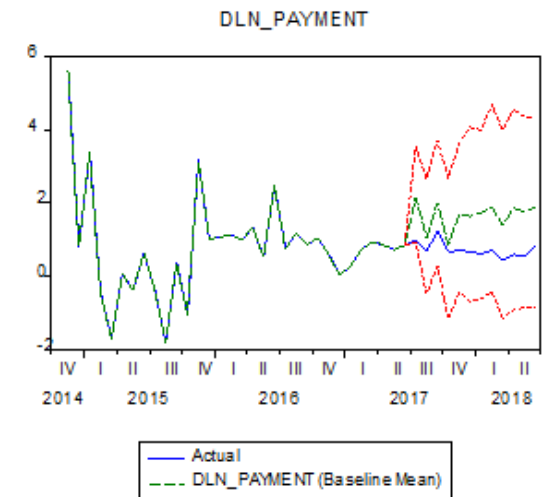
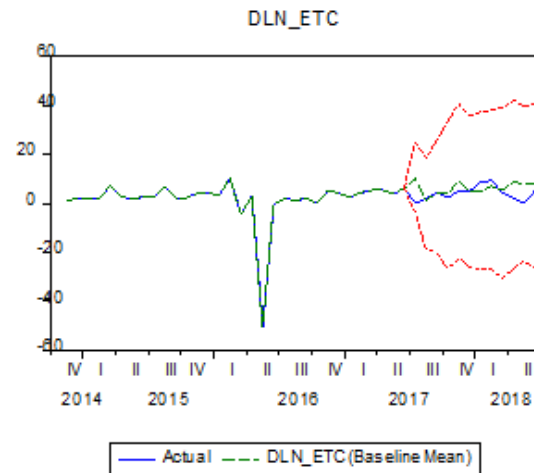
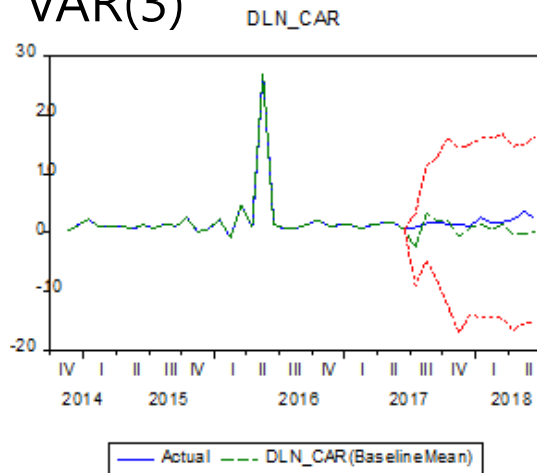
Forecasting for IoT M2M number demand

- All series need to satisfy technical assumptions (stationary cond.)



Forecasting for IoT M2M number demand

VAR(3)



Forecasting for IoT M2M number demand

- Appropriate VAR(3) model produced good in-sample forecasting results for 5 series while 1 (remote) exhibited high variation
- The study suggests that VAR model would be a good indication for short-term forecasting(a year-long); however, forecasting-error might become significantly large for highly volatile series
- MSIT closely monitors the available number resources for M2M and the forecasting exercises would be extended for more precision

Thank you