



Korean Successes for Nationwide Smart Transition: E-Government to Smart City Service Initiatives

2019.6



Dr. Sang-Baek “Chris” Kang
Director of External Cooperation, KLID

Agenda

1. National Identification Policy and System Development

- 1.1 Resident Registration in Korea
- 1.2 Resident Registration Information System Deployment

2. E-Government to Smart City

- 2.1 Designing Data Centric Smarty City
- 2.2 E-Government and Smart City Services: Similarities and Differences

3. Smart City Application for Transportation

- 3.1 Multi-Modal Transportation with T-Money Card
- 3.2 Night Bus based on a Big-Data Analysis
- 3.3 Open Transportation Data and Application

4. IoT Platform and Future

- 4.1 LoRa IoT Network and Eco-system
- 4.2 Busan Case

5. Discussion

- 5.1 Smart Nation Perspective
- 5.2 Implications and a Way Forward

1. National Identification Policy and System Development

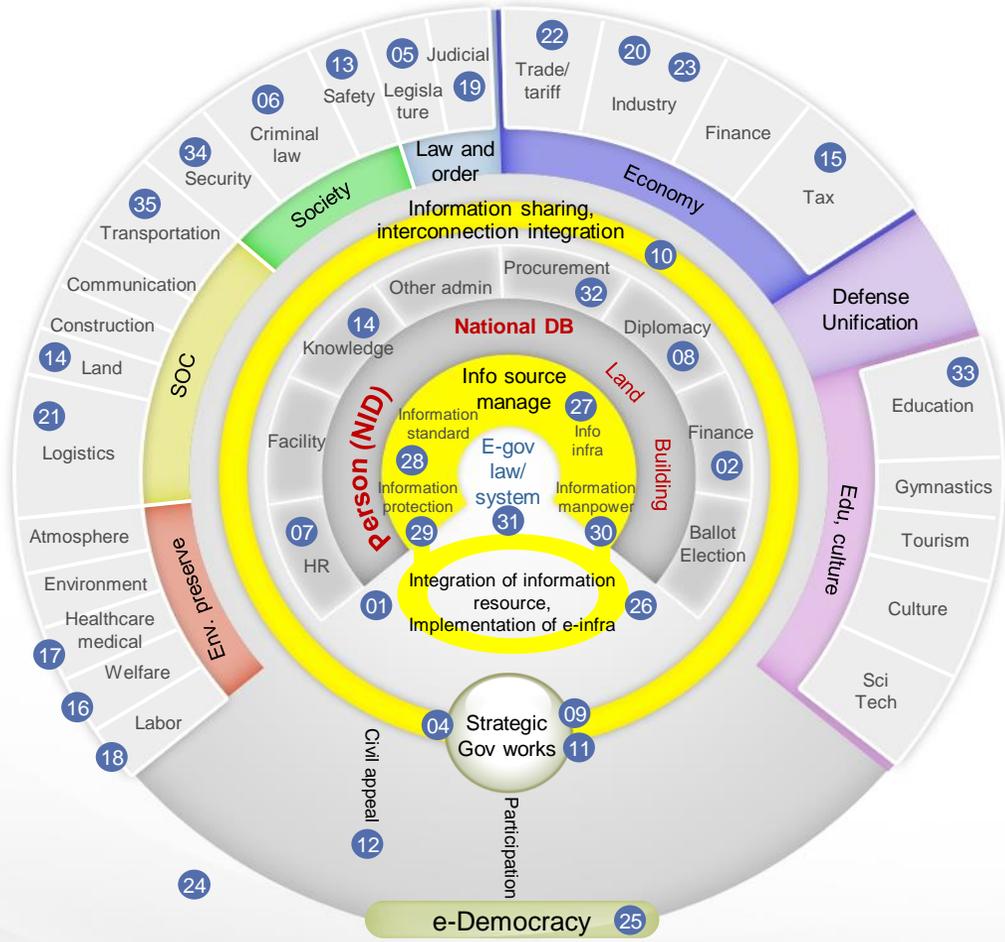
1.1 Resident Registration in Korea

1.2 Resident Registration Information System Deployment



1.1 Resident Registration in Korea

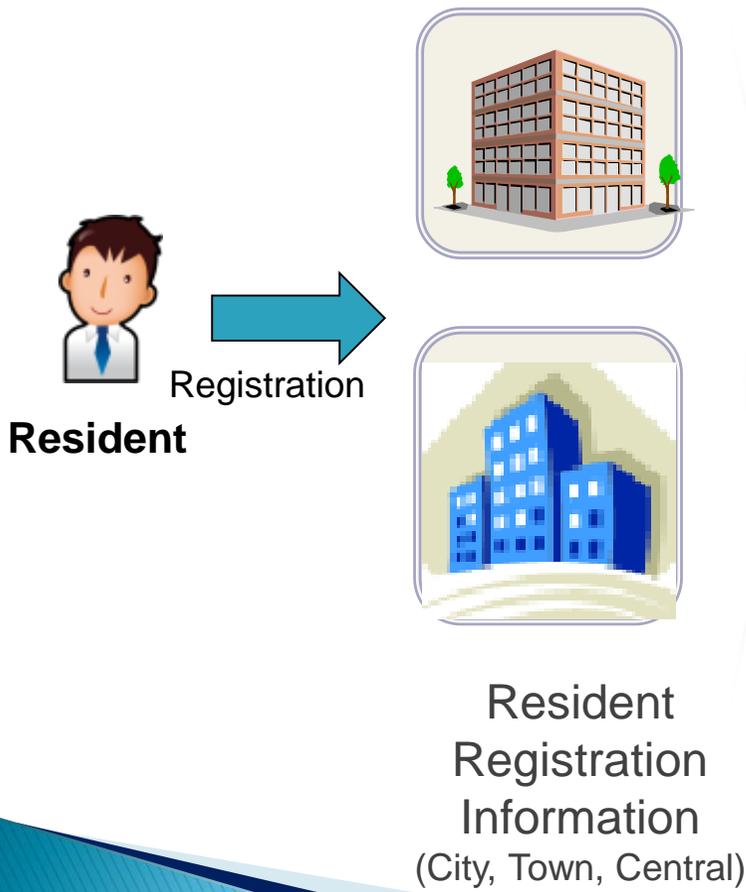
□ National ID as a core of e-government



1. All electronic document handling processes
2. Comprehensive informatization of central and local finance
3. Implementation of local e-government
4. Implementation of an electronic audit system
5. Implementation of e-congress
6. Implementation of a comprehensive criminal law system
7. Comprehensive informatization of HR and administration
8. informatization of diplomacy and trading
9. Real time management of national tasks
10. Expanded sharing of admin information
11. Development of a government function interconnection model
12. Implementation of internet civil appeal service
13. Comprehensive national safety management
14. Implementation and interconnection of architecture/land/registration
15. Comprehensive national tax service
16. Comprehensive national welfare information service
17. Comprehensive food/drug information service
18. Comprehensive hiring/job information service
19. Admin court internet service
20. Unified company application account service
21. Comprehensive logistic information service
22. e-trading/tariff service
23. Comprehensive foreigner support service
24. Support for e-government's oversea exploration
25. Expanded online citizen participation
26. Implementation of the integrated government computer system
27. Advancement of the e-government communication network
28. Application of the government's IT architecture
29. Implementation of an information protection system
30. IT manpower and operation organization strengthened and repaired
31. Implementation of e-government and reinforcement of the reliability related laws
32. e-procurement
33. (NEIS) National Education Information System
34. Police IT System
35. ITS, BIS

1.1 Resident Registration in Korea

□ National ID usage



A central box lists the following agencies receiving information:

- Ministry of Health and Welfare
- h·well NHIS National Health Insurance Service
- Ministry of Education
- REPUBLIC OF KOREA NATIONAL ELECTION COMMISSION
- National Tax Service
- Military Manpower Administration
- KNPA (KOREAN NATIONAL POLICE AGENCY)

Provision of Information to 32 organizations for 70 tasks

- Welfare
- Education
- Election
- Taxation
- Military Service
- Security
- Bank 새마을금고 Banking

1.1 Resident Registration in Korea

□ National ID for lifecycle care for citizens



- Issuance of Resident Registration Number
- Payment of subsidies for birth

- Support for childcare charges
- Notification of vaccination for infants

- Notification for education
- Issuance of National ID Card (over 17-year-old)

- Permission of eligibility for election (over 19-year-old)
- Support of National Scholarship

- Notification for health screening
- Notification for taxation
- Lease for housing

- Payment of national pension
- Medical care service

1.1 Resident Registration in Korea

□ National ID card



820701

- 2

3456

7

8

Date of Birth

Gender

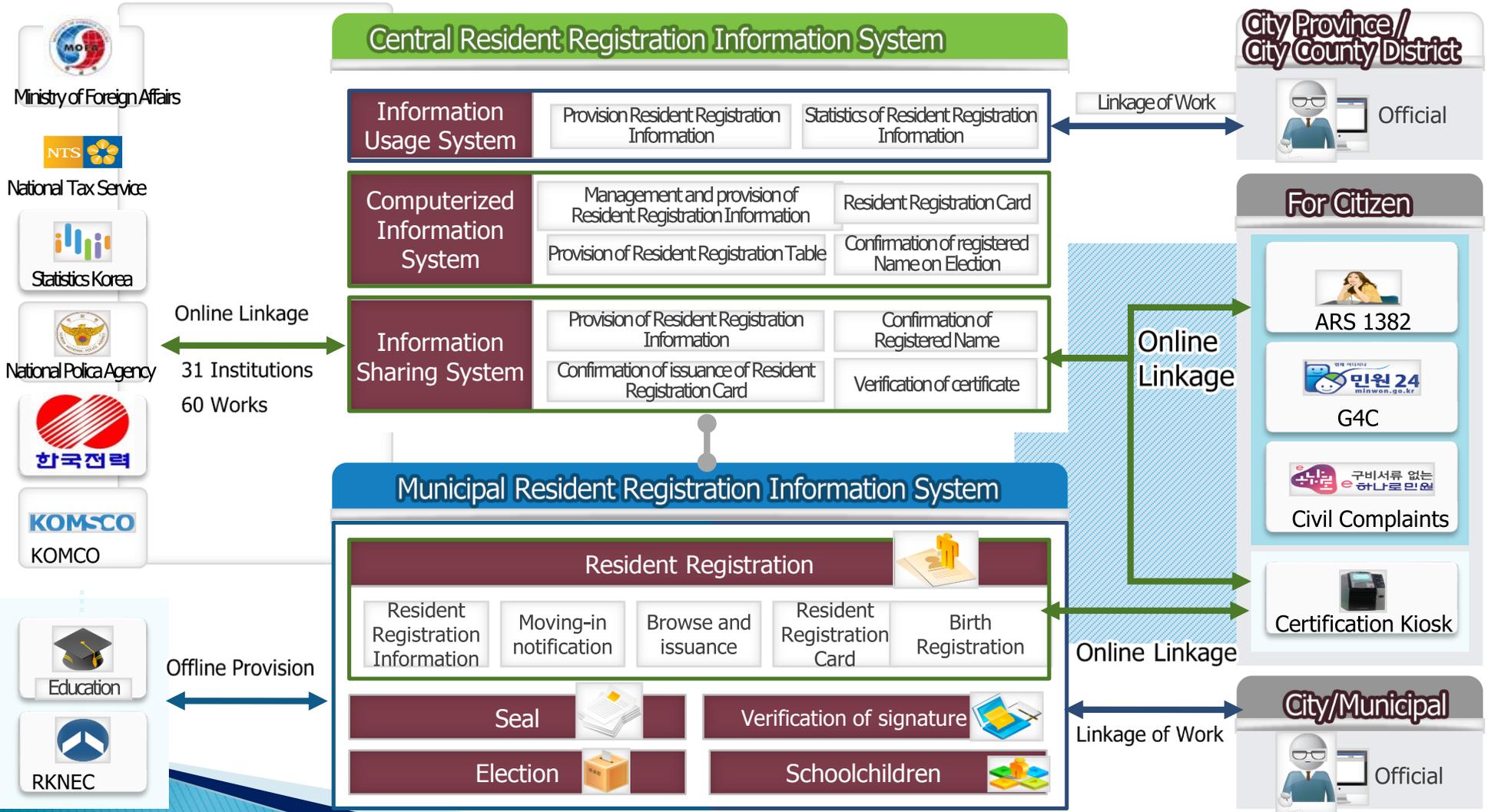
Area Code

Resident
Registration
Order

Verification
Number

1.2 Resident Registration Information System Deployment

□ National ID system overview



2. E-Government to Smart City

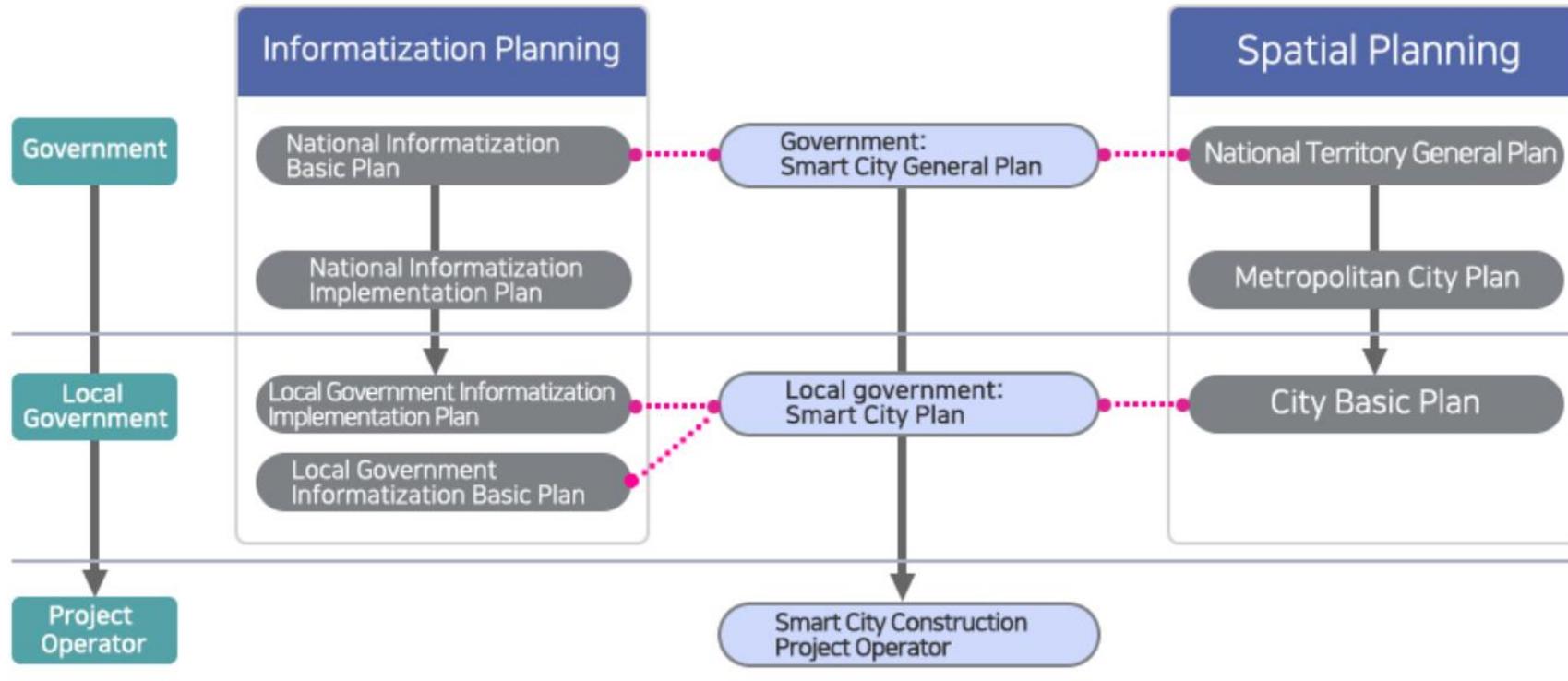
2.1 Designing Data Centric Smart City

2.2 E-Government and Smart City Services: Similarities and Differences



2.1 Designing Data Centric Smarty City (1)

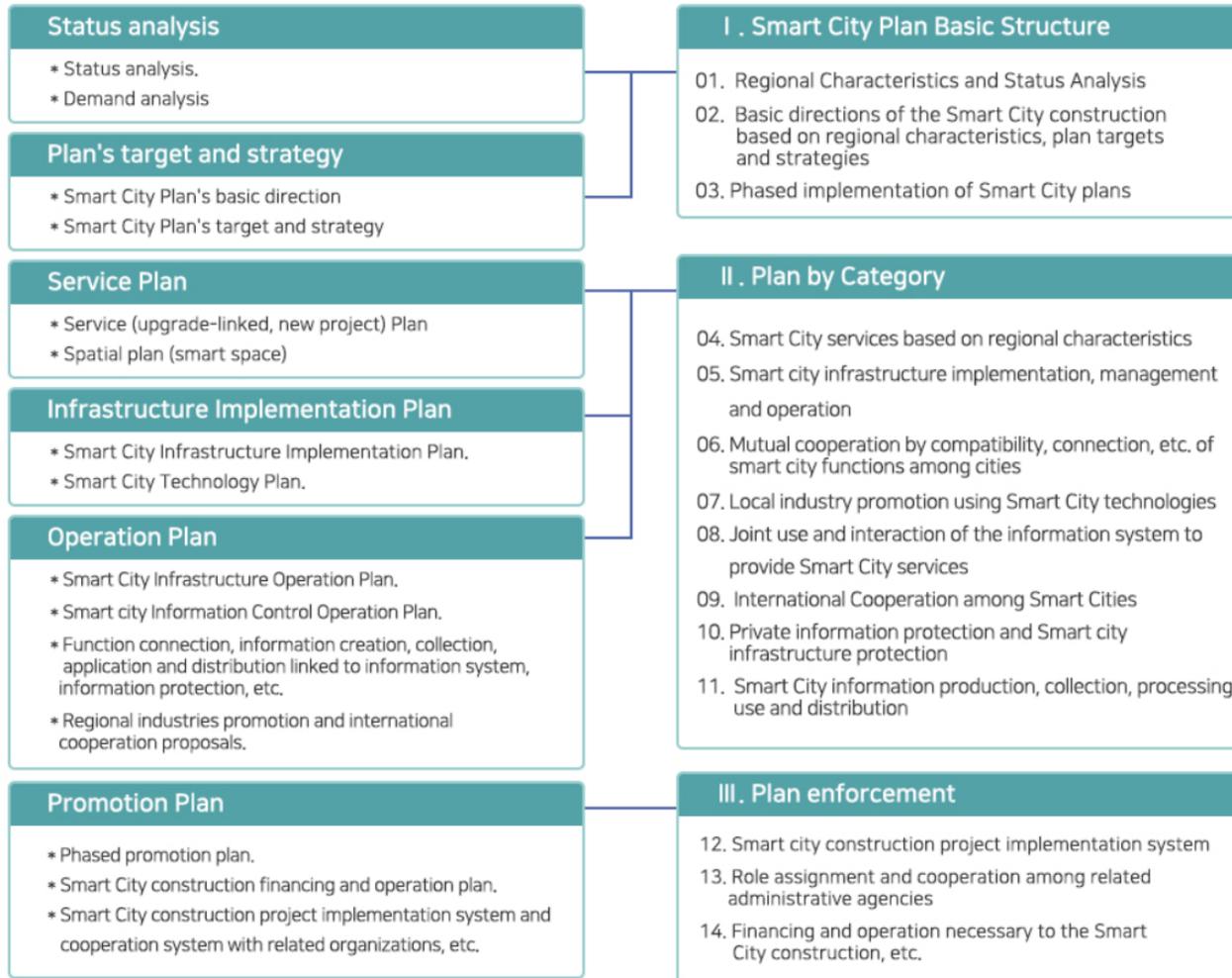
- Development Governance Structure



Source: Incheon Smart City

2.1 Designing Data Centric Smarty City (2)

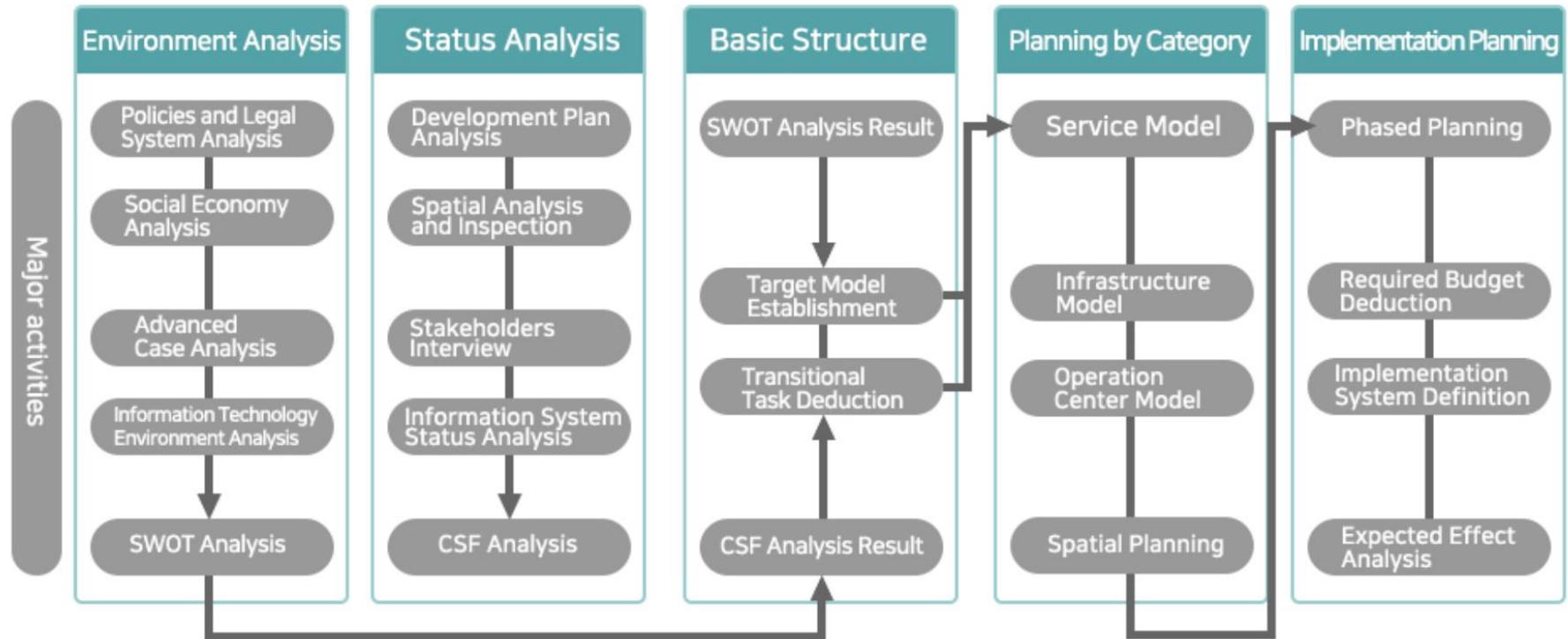
Development Governance: Local Government vs. Central Ministries



- The Article 8 of the Smart City Act of Korea is the key juridical and designing policy guidelines in Korea
- Major activities when designing a smart city are stipulated at the next slide

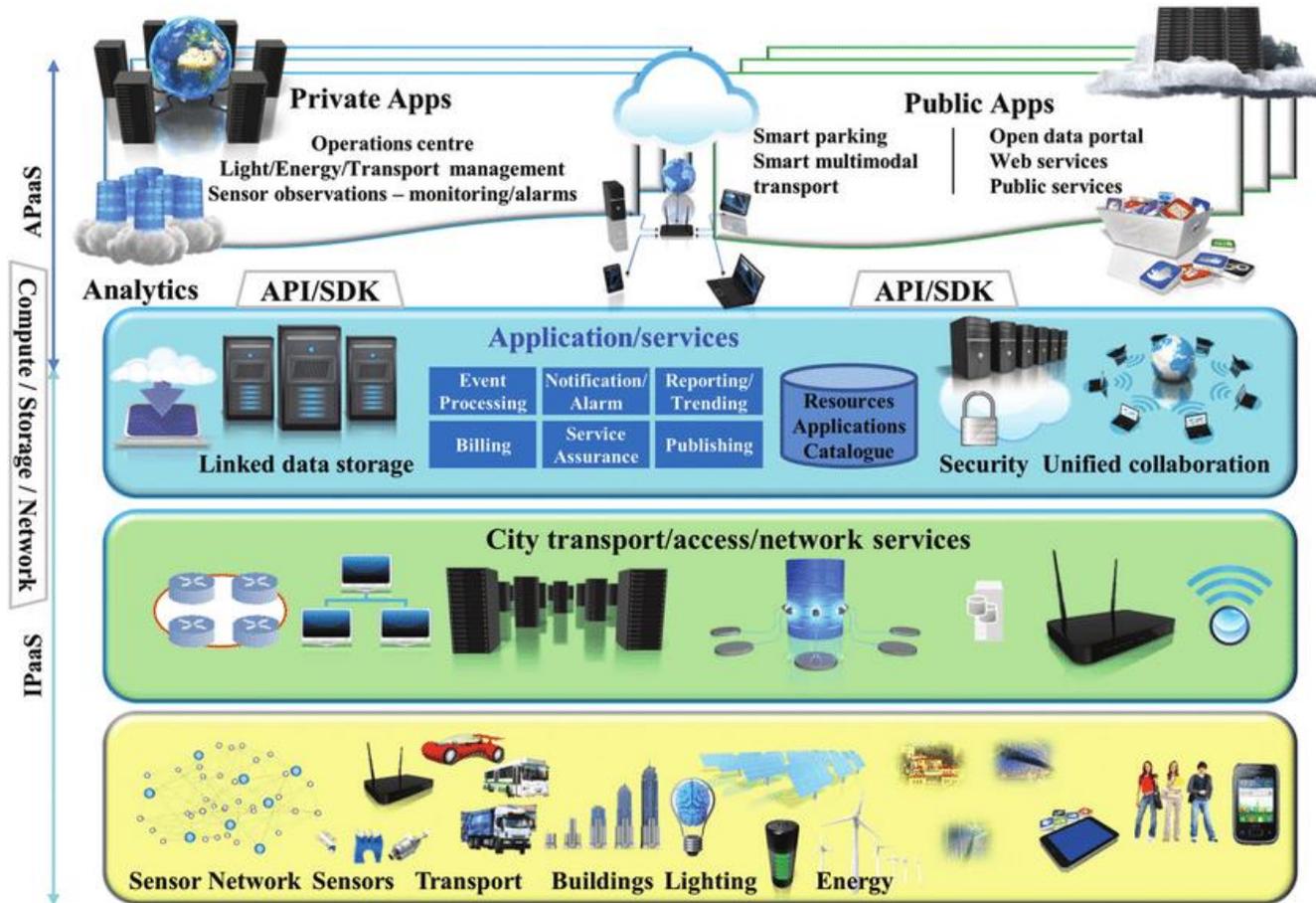
2.1 Designing Data Centric Smarty City (3)

- Development Activities for Smart City Planning



2.1 Designing Data Centric Smarty City (4)

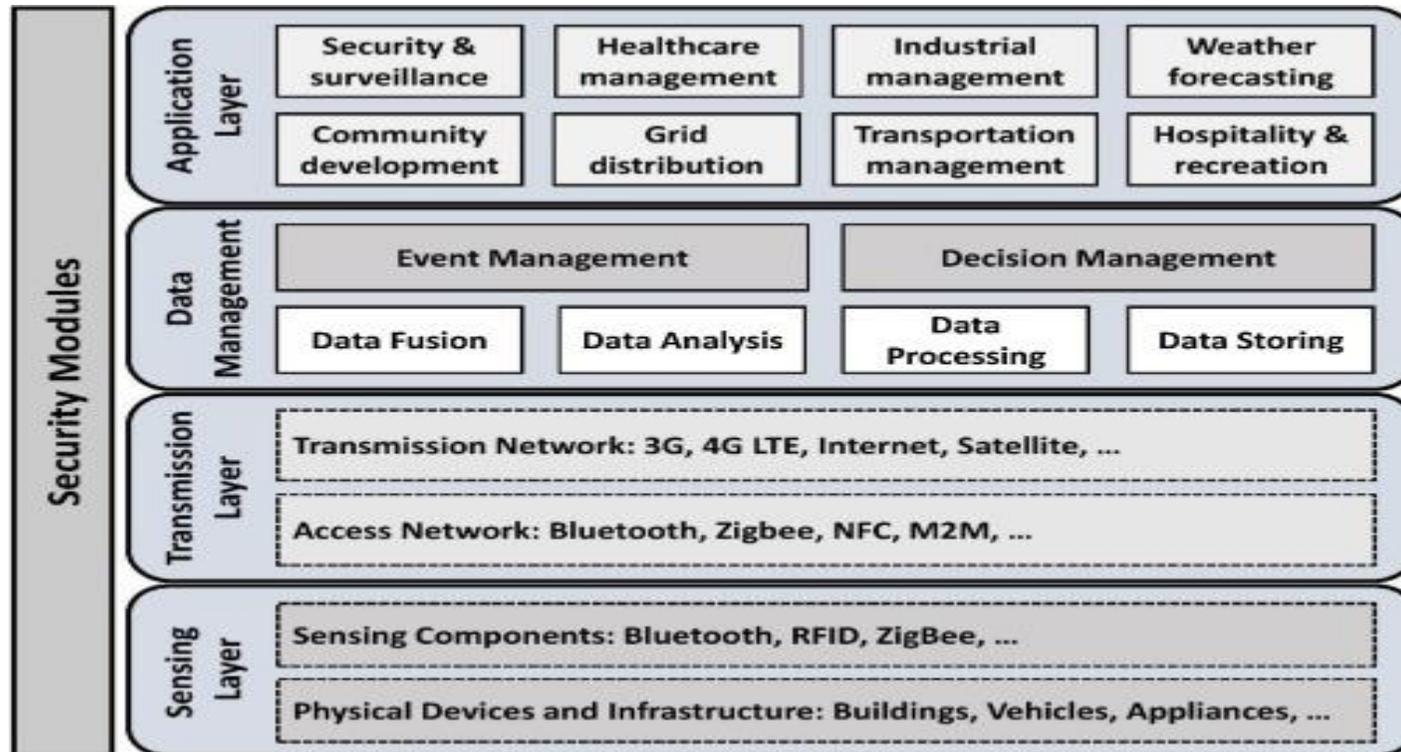
- Smart City Architecture



* Source: Barnaghi et. al, (2015) IoT Analytics for Public Safety

2.1 Designing Data Centric Smarty City (5)

- Smart City Layers

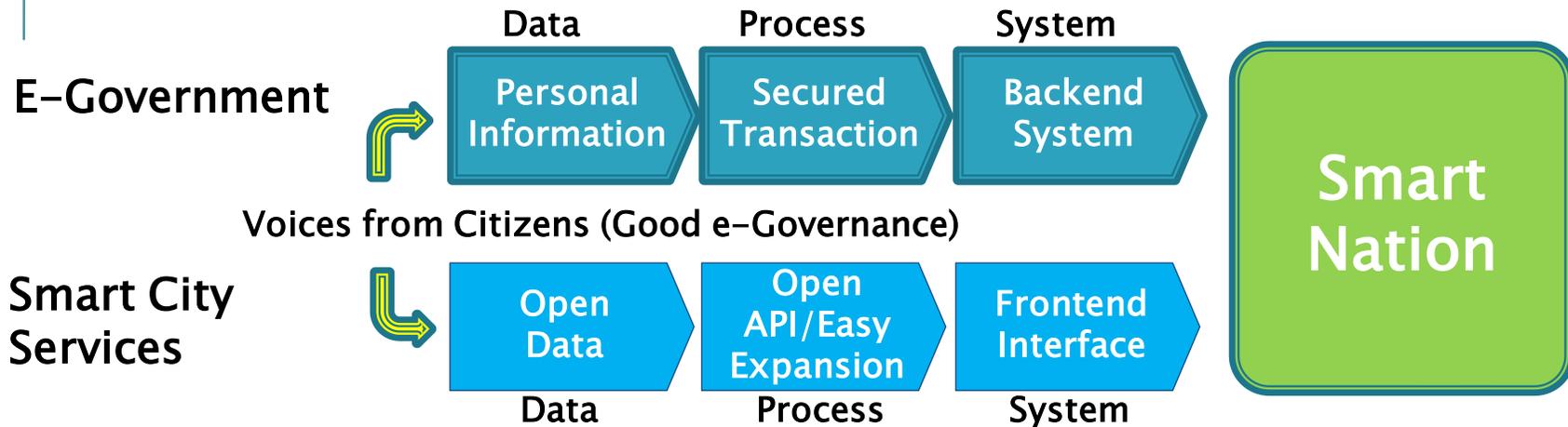


* Source: Silva et. al, (2018) Towards sustainable smart cities: A review of trends, architectu4res, components and open challenges in smart cities, Sustainable Cities and Society, Vol 38. pages 697-713.

2.2 E-Government and Smart City Service: Similarities and Differences

E-Government vs. Smart City Services

- Digitized online public services based on national citizen data - only government has the data under highly secured system
- Data regarding National ID, Passport, Tax, Finance, Pension, Insurance, etc.



- Try to solve problems in city life by unanimous SOC data with open architecture and API - easily expanded to another city
- Traffic data, transportation payment, air quality, water quality, CCTV videos, etc.

3. Smart City Application for Transportation

3.1 Multi-Modal Transportation with T-Money Card

3.2 Night Bus based on a Big-Data Analysis

3.3 Open Public Transportation Data and Application



3.1 Multi-Modal Transportation with T-Money Card

□ T-Money Card for multi-modal transportation in Korea



3.1 Multi-Modal Transportation with T-Money Card

T-Money Card charge at the subway station kiosk



T-Money Card tagging when taking buses



Mobile T-Money Card tagging with a Smartphone



Mobile T-Money Card payment with a wearable device



3.1 Multi-Modal Transportation with T-Money Card

- T-Money Card for taxi fare payment



3.1 Multi-Modal Transportation with T-Money Card

□ T-Money Card can be used in various service outlets

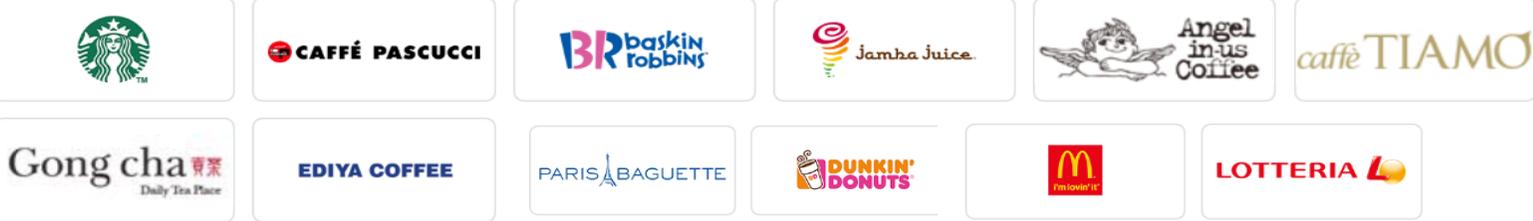
Convenient Stores



Mega Stores



Coffee-shops and food stores



3.1 Multi-Modal Transportation with T-Money Card

□ Seoul Transportation Fare Information (Transportation Card vs. Cash)

| Seoul Transportation Fare Information | | | |
|--|-----------|-----------|-----------|
| Transportation | Age group | T-money | Cash |
| Subway | Adults | 1,250 won | 1,350 won |
| | Youth | 720 won | 1,350 won |
| | Children | 450 won | 450 won |
| Blue Bus / Green Bus (4-digit number) | Adults | 1,200 won | 1,300 won |
| | Youth | 720 won | 1,000 won |
| | Children | 450 won | 450 won |
| Green Village Bus (2-digit number) | Adults | 900 won | 1,000 won |
| | Youth | 480 won | 550 won |
| | Children | 300 won | 300 won |
| Yellow Bus (circul ar route bus) | Adults | 1,100 won | 1,200 won |
| | Youth | 560 won | 800 won |
| | Children | 350 won | 350 won |
| Red Bus (express bus) | Adults | 2,300 won | 2,400 won |
| | Youth | 1,360 won | 1,800 won |
| | Children | 1,200 won | 1,200 won |
| Night Bus | Adults | 2,150 won | 2,250 won |
| | Youth | 1,360 won | 1,800 won |
| | Children | 1,200 won | 1,200 won |

1,000Won=1 USD

□ Transfer Discount Policy for T-Money Card usage (cont'd)

- Transfer discounts are applicable for up to 4 times a day, within a transfer time limit of 30 minutes (up to 1 hour from 9pm to 7am next day).
- However, if a customer does not tap the card on the sensors as he/she gets off the bus or exit the subway, he/she will not benefit from the transfer discounts and may be charged double the base fare at the next time.
- Therefore, it is important to ensure to tap the card at all times when getting off the bus or exiting the subway.

3.2 Night Bus based on a Big-Data Analysis

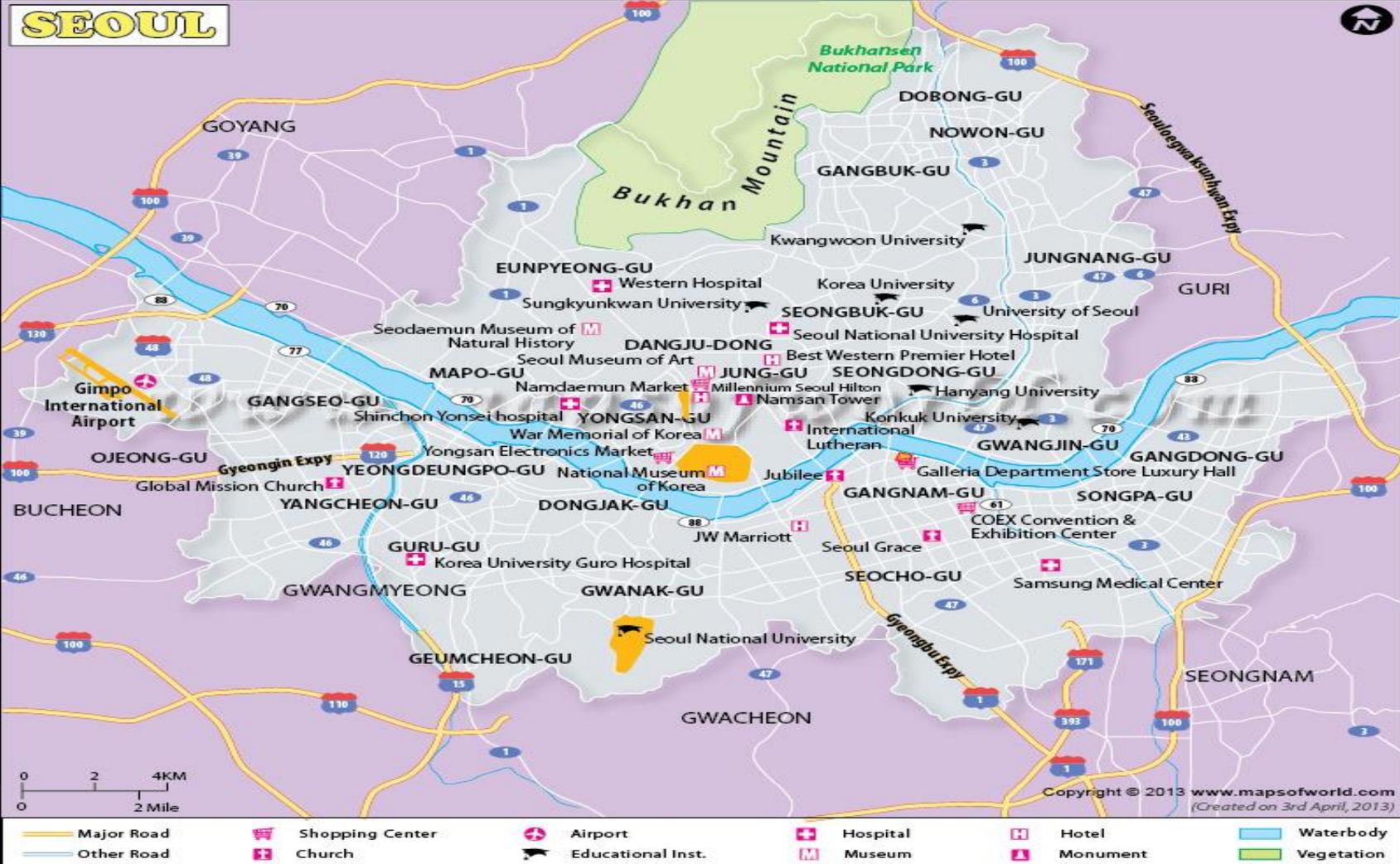
□ Night Bus in Seoul



올빼미버스

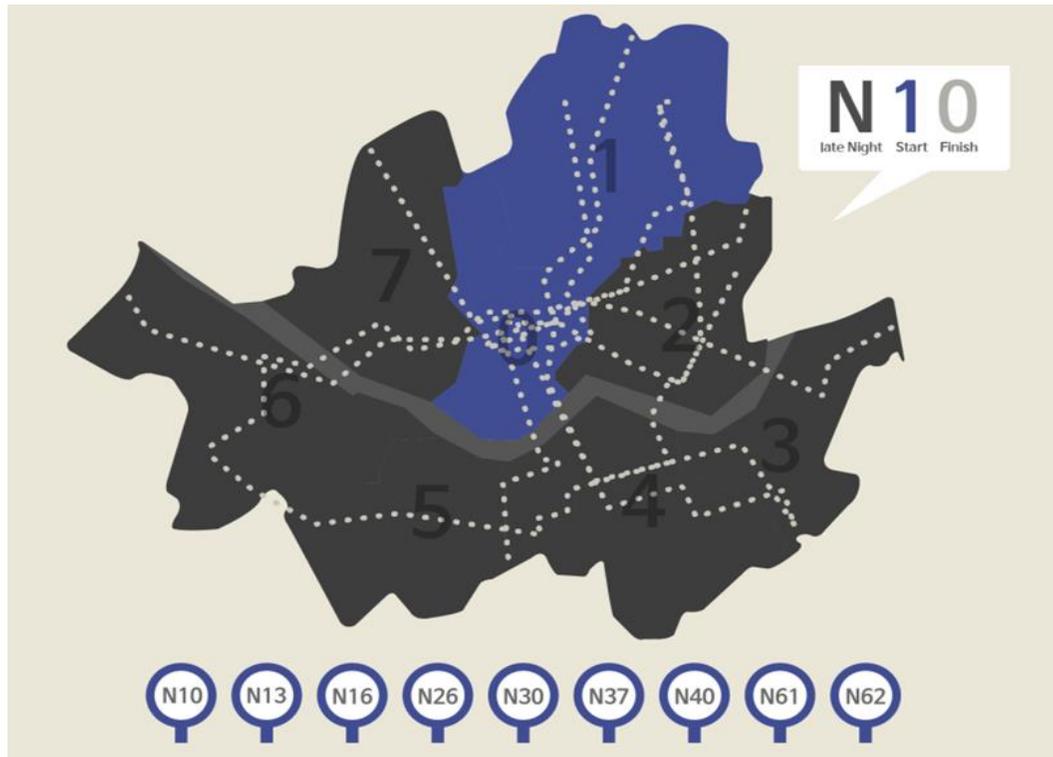
3.2 Night Bus based on a Big-Data Analysis

City of Seoul map



3.2 Night Bus based on a Big-Data Analysis

□ City of Seoul and night bus line number naming convention

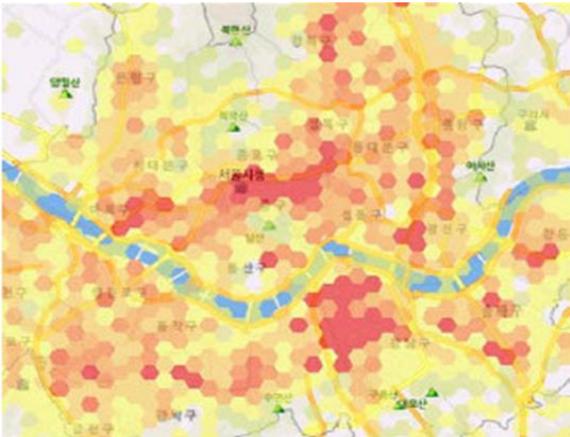


- Including the data from ①Taxi (location of entry/exit of 5 Million customers) ②Mobile phone base station traffic data ③Routes of daily bus lines
- The size of 1km of hexagon of 1,250 cells were identified
- 2013 September, the service is launched
- After the first three months of launching, on the average 6,079 passengers were using the service per one night
- Overall 300,000 passengers used the service for first three months

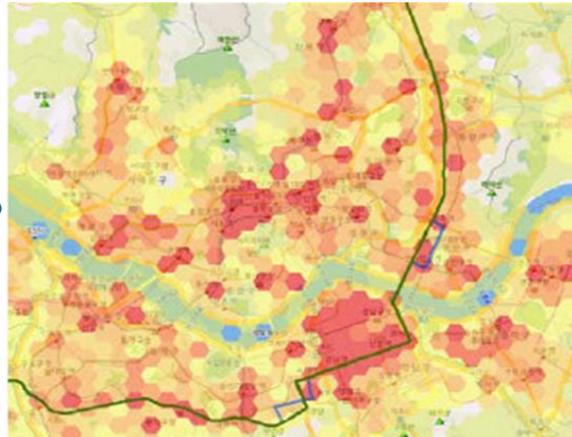
3.2 Night Bus based on a Big-Data Analysis

□ Big-Data analysis process of night bus lines

Identifying population density



Identifying optimized routes



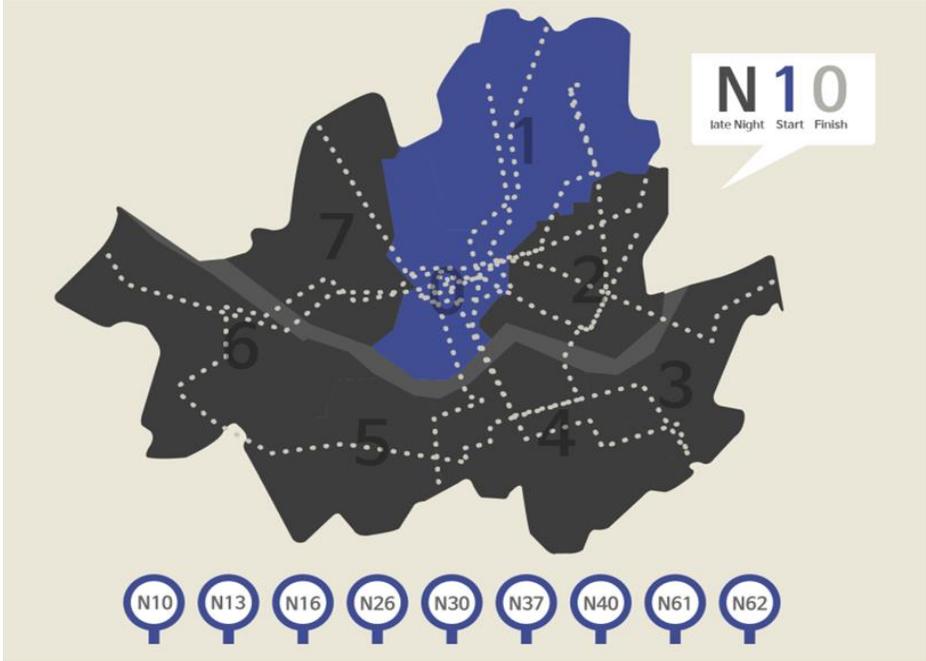
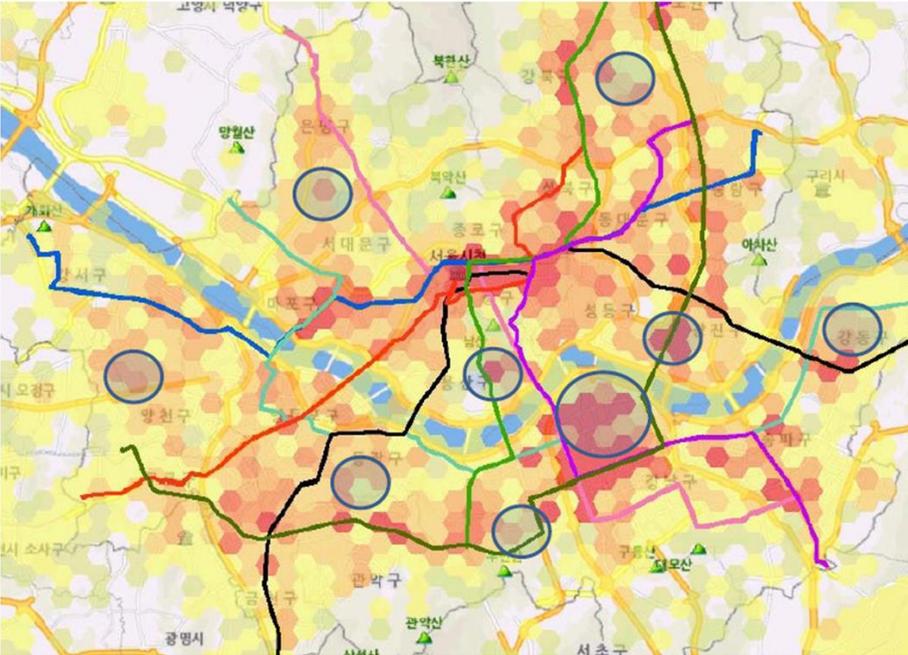
Set time interval of busses



- First, based on mobile phone base station and billing addresses of 300,000 customers, 3 billion data of March of 2013 were analyzed for identifying the patterns of foot traffic (population density of a hexagon cell)
- Next, identifying the patterns of population density and adjust time intervals of bus routes reflecting timely, daily variance weights

3.2 Night Bus based on a Big-Data Analysis

□ Final routes by big-data analysis



1.3 Open Transport Data and Application

□ Seoul Traffic Information Center (TOPIS)



3.3 Open Transportation Data and Application

Public bus route suggestions with real-time traffic data

경로 1 약 **1시간 4분**(도보 17분) | **2,600원**

9 삼성중앙역 → **광역** 9711A(논현역) → 월드컵파크5단지.상암중고등학교입구 정류장 하차
버스정류장 9개 + 지하철역 3개 | 총 24.10km

경로 2 약 **1시간 5분**(도보 21분) | **2,600원**

2 선릉역 → **광역** 9711A(신논현역) → 월드컵파크5단지.상암중고등학교입구 정류장 하차
버스정류장 11개 + 지하철역 2개 | 총 24.51km

경로 3 약 **1시간 22분**(도보 19분) | **1,550원**

9 삼성중앙역 → **간선** 670(이마트.강서소방서) → 월드컵파크5단지 정류장 하차
버스정류장 4개 + 지하철역 20개 | 총 25.84km

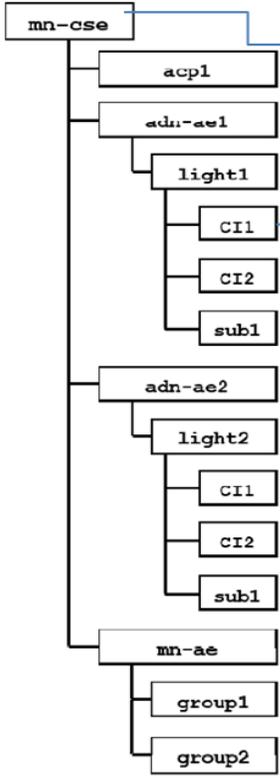
경로 4 약 **1시간 15분**(도보 19분) | **2,600원**

분당 선릉역 → 7 강남구청역 → **광역** 9711A(신사역) → 월드컵파크5단지.상암중고등학교입구 정류장 하차
버스정류장 8개 + 지하철역 4개 | 총 24.27km

14.0°C 서울특별시 용산구 원효로1동

교통상황 CCTV 자전거 날씨 지적편집도 일반

Open API example (XML)



MN-CSE Registration

HTTP Request:
POST ~/in-cse/server?rcn=0 HTTP/1.1
Host:http://in.provider.com:8080
X-M2M-Origin:/mn-cse
Content-Type:application/vnd.onem2m-res+xml;ty=16
X-M2M-RI: incse/88643
<?xml version="1.0" encoding="UTF-8"?>
<m2m:csr
xmlns:m2m="http://www.onem2m.org/xml/protocols"
rn="home_gateway">
<csi>mn-cse</csi>
<cb>mn.provider.com/mn-cse</cb>
<rr>TRUE</rr>
<poa>http://mn.provider.com:8080</poa>
47
<cst>2</cst>
<acpi>/~/in-cse/acp-666957710</acpi>
</m2m:csr>

HTTP Response:
201 Created
X-M2M-RSC: 2001
X-M2M-RI: incse/88643
Content-Location: /in-cse/csr-299409504

ADN-AE1 Light1 ContentInstance

HTTP Request:
GET ~/mn-cse/home_gateway/light_ae1/light/la HTTP/1.1
Host:http://in.provider.com:8080
X-M2M-Origin:/in-cse/Csmartphone_ae
X-M2M-RI: mncse/11223
Accept:application/xml

HTTP Response:
200 OK
X-M2M-RSC: 2000
X-M2M-RI: mncse/11223
Content-Type: application/vnd.onem2m-res+xml
<?xml version="1.0" encoding="UTF-8"?>
<m2m:cin
xmlns:m2m="http://www.onem2m.org/xml/protocols"
rn="cin-394798749">
<ty>4</ty>
<ri>cin-394798749</ri>
<pi>cnt-181049109</pi>
<ct>20150925T045938</ct>
<lt>20150925T045938</lt>
<et>20151107T154802</et>
<st>0</st>
<cnf>text/plain:0</cnf>
<cs>3</cs>
<con>OFF</con>
</m2m:cin>

3.3 Open Transportation Data and Application

Real-time Traffic Open Data example and 9714 bus line route

The screenshot displays a web application interface for transportation data. At the top, there are navigation tabs: '검색' (Search), '길찾기' (Navigation), '버스' (Bus), '지하철' (Subway), and '즐거찾기' (Favorites). The current location is set to '경기도 > 고양시 덕양구 > 주교동' with a temperature of 12.9°C. The main map area shows a network of roads with color-coded traffic lines (green, yellow, red) indicating traffic conditions. A specific bus route, 9714, is highlighted in blue. On the left side, a sidebar provides detailed information for the selected bus line: '9714 검색결과 (총 1건)', '9714 | 서울', '교하운정 ↔ 송례문', '첫차 05:00 | 막차 01:00', '배차간격 30분 | 현재 5대 운행중'. Below this, there are sections for '전체 노선', '관련 정보 신고', and a list of bus stops including '신성교하차고지 63736', '청석마을8단지 63655', '숲속길마을7단지 63657', '교하중앙공원 63659', '책향기마을14단지 63674', '대화역 36601', and '문촌마을(중) 36691'. A legend at the bottom left indicates '원할' (Normal) with a green line and '정보없음' (No info) with a grey line. The source is noted as '서울교통정보센터 제공'.

3.3 Open Transportation Data and Application

3. Smart City Application for Transportation

- Open Data example
 - number of passengers by bus stops (cont'd)



| Station Name | Entry | Exit |
|--------------------------------|-------|------|
| DMC station (H) | 1763 | 209 |
| Kyoha Bus Parks (H) | 189 | 8 |
| Kyoha Bus Parks (L) | 0 | 151 |
| Madoo Station | 743 | 496 |
| Central Park (H) | 1 | 1504 |
| Central Park (L) | 1115 | 9 |
| Woori Bank | 51 | 4042 |
| Triple Medical Town | 4359 | 46 |
| Cungsok 8 th Town | 5 | 1182 |
| Cungsok Town | 3089 | 16 |
| Soongreymoon | 1786 | 1099 |
| Haengsin Elementary School (H) | 1053 | 359 |
| Almee Park | 319 | 267 |
| Jooyeop Station (H) | 475 | 363 |
| Jooyeop Station (L) | 854 | 475 |
| Ilsan Dong Center (H) | 860 | 1325 |
| Ilsan Dong Center (L) | 1028 | 798 |
| Koyang Police Station (H) | 540 | 554 |
| Koyang Police Station (L) | 535 | 454 |
| Hanesindong (H) | 663 | 277 |
| Hanesindong (L) | 377 | 687 |
| Seojeong Town (H) | 308 | 108 |
| Seojong Town (L) | 134 | 503 |
| Moonchon Town (H) | 227 | 271 |
| Moonchon Town (L) | 131 | 306 |
| Kangsun Town (H) | 416 | 585 |
| Kangsun Town (L) | 331 | 543 |
| Madoo Station (H) | 860 | 972 |
| Madoo Station (L) | 433 | 687 |
| Haensing Elementary School (L) | 459 | 759 |
| Soman Town (H) | 519 | 123 |
| Soman Town (L) | 184 | 544 |
| Yonsei Univ (H) | 2787 | 90 |
| Yonsei Univ (L) | 139 | 1995 |
| DMC station (L) | 290 | 1788 |
| Seodaemoon Police Station | 479 | 184 |
| Daewha Station (H) | 2679 | 1049 |
| Daewha Station (L) | 716 | 2965 |
| Chaekhyangi Town (H) | 1701 | 14 |
| Chaekhyangi Town (L) | 8 | 2895 |
| Kwangwhamoon Building | 2076 | 2931 |
| Shinhan Bank Main Building | 1519 | 1481 |

3.3 Open Transportation Data and Application

Open Transport Data by Seoul Metropolitan Government (Example)

The screenshot shows a search interface for the Seoul Metropolitan Government. The top navigation bar includes '검색' (Search), '길찾기' (Map), '버스' (Bus), '지하철' (Subway), and '즐거찾기' (Fun Search). The search results on the left list '삼청터널' (Samchung Tunnel) as the top result, with details such as '서울 성북구 대사관로 1' and '성북동 산25-1'. Below it are '숙정문' and '버스정류장' (Bus Stop) results. The main content area features a street view image of the tunnel entrance, with a blue callout bubble containing the text 'Samchung Tunnel 2015/12 Traffic Volume Data'. A vertical sidebar on the left contains icons for '출발' (Start), '버스' (Bus), '지하철' (Subway), '스쿠터' (Scooter), '음식점' (Restaurant), and '주차장' (Parking). A small map inset is visible at the bottom left of the main image.

3.3 Open Transportation Data and Application

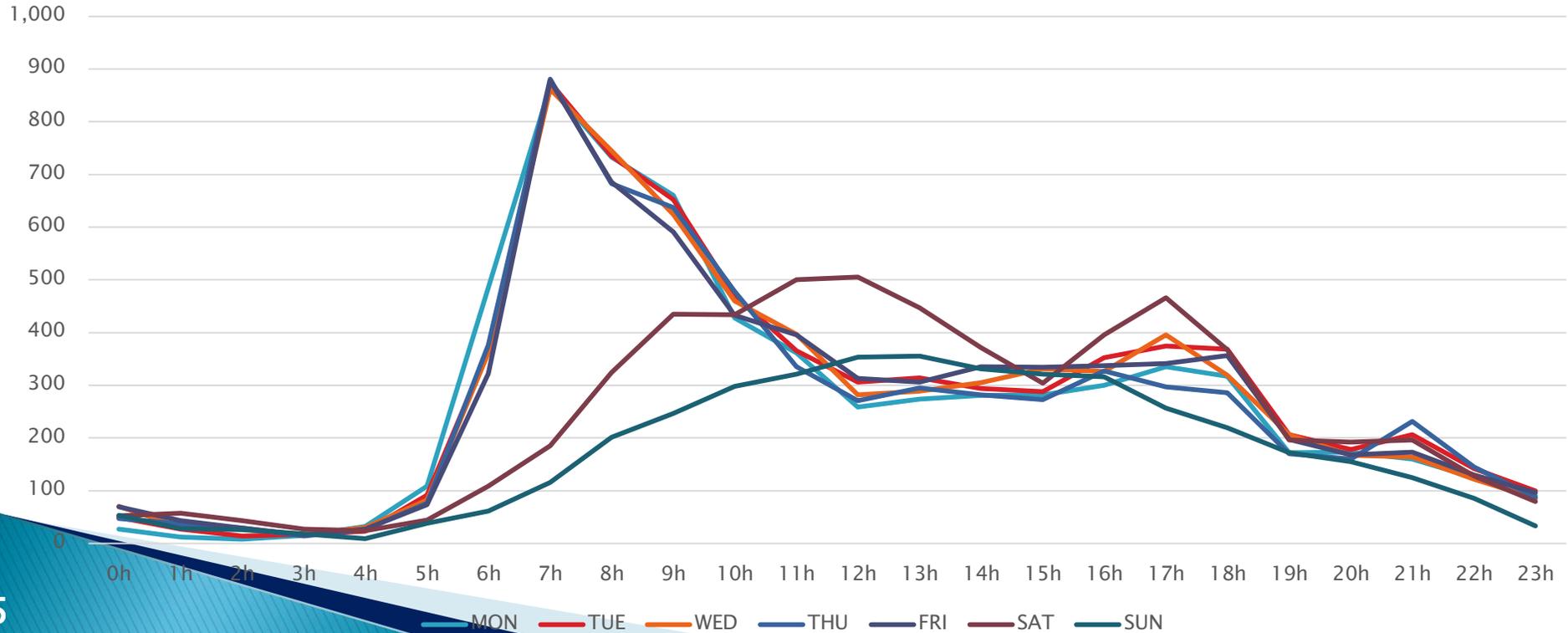
□ Monthly number of cars at a place (by hour, month of December, 2015)

| 일자 | 요일 | 지점명 | 유입유출구분 | 0시 | 1시 | 2시 | 3시 | 4시 | 5시 | 6시 | 7시 | 8시 | 9시 | 10시 | 11시 | 12시 | 13시 | 14시 | 15시 | 16시 | 17시 | 18시 | 19시 | 20시 | 21시 | 22시 | 23시 |
|----------|----|------|--------|-----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 20151201 | 화 | 삼정터널 | 유입 | 72 | 40 | 13 | 16 | 29 | 93 | 355 | 856 | 748 | 716 | 475 | 352 | 279 | 328 | 276 | 299 | 298 | 327 | 301 | 183 | 177 | 186 | 130 | 86 |
| 20151202 | 수 | 삼정터널 | 유입 | 63 | 38 | 19 | 17 | 29 | 97 | 385 | 846 | 730 | 719 | 541 | 403 | 312 | 283 | 256 | 272 | 296 | 277 | 275 | 176 | 193 | 156 | 125 | 67 |
| 20151203 | 목 | 삼정터널 | 유입 | 45 | 45 | 18 | 10 | 32 | 71 | 309 | 884 | 669 | 587 | 325 | 352 | 196 | 221 | 239 | 240 | 248 | 266 | 196 | 169 | 135 | 133 | 114 | 90 |
| 20151204 | 금 | 삼정터널 | 유입 | 47 | 32 | 18 | 13 | 22 | 75 | 312 | 890 | 744 | 624 | 471 | 344 | 304 | 305 | 307 | 317 | 331 | 372 | 339 | 181 | 160 | 218 | 148 | 95 |
| 20151205 | 토 | 삼정터널 | 유입 | 66 | 42 | 42 | 19 | 28 | 42 | 121 | 189 | 298 | 413 | 391 | 419 | 393 | 322 | 259 | 262 | 256 | 262 | 220 | 178 | 142 | 166 | 120 | 63 |
| 20151206 | 일 | 삼정터널 | 유입 | 52 | 34 | 26 | 8 | 12 | 22 | 54 | 120 | 184 | 251 | 283 | 306 | 312 | 329 | 346 | 305 | 257 | 233 | 211 | 188 | 153 | 118 | 67 | 42 |
| 20151207 | 월 | 삼정터널 | 유입 | 27 | 12 | 8 | 15 | 32 | 109 | 485 | 867 | 733 | 660 | 428 | 361 | 259 | 274 | 281 | 282 | 300 | 335 | 317 | 172 | 173 | 160 | 125 | 91 |
| 20151208 | 화 | 삼정터널 | 유입 | 49 | 27 | 14 | 17 | 23 | 92 | 367 | 875 | 735 | 652 | 471 | 366 | 306 | 314 | 294 | 288 | 352 | 375 | 369 | 206 | 178 | 206 | 142 | 100 |
| 20151209 | 수 | 삼정터널 | 유입 | 71 | 31 | 27 | 17 | 30 | 83 | 361 | 862 | 745 | 624 | 460 | 397 | 282 | 289 | 305 | 331 | 326 | 396 | 319 | 206 | 167 | 164 | 122 | 86 |
| 20151210 | 목 | 삼정터널 | 유입 | 47 | 37 | 29 | 14 | 26 | 77 | 377 | 881 | 683 | 637 | 478 | 335 | 271 | 295 | 282 | 273 | 327 | 297 | 286 | 170 | 160 | 232 | 145 | 88 |
| 20151211 | 금 | 삼정터널 | 유입 | 70 | 43 | 29 | 16 | 27 | 74 | 322 | 878 | 686 | 591 | 433 | 396 | 313 | 306 | 335 | 334 | 337 | 341 | 356 | 197 | 168 | 173 | 130 | 97 |
| 20151212 | 토 | 삼정터널 | 유입 | 52 | 57 | 43 | 27 | 24 | 44 | 109 | 185 | 324 | 435 | 434 | 500 | 505 | 447 | 372 | 304 | 396 | 466 | 368 | 196 | 192 | 196 | 128 | 80 |
| 20151213 | 일 | 삼정터널 | 유입 | 53 | 28 | 26 | 18 | 9 | 38 | 61 | 116 | 201 | 247 | 298 | 321 | 353 | 355 | 331 | 321 | 316 | 257 | 220 | 172 | 155 | 125 | 86 | 33 |
| 20151214 | 월 | 삼정터널 | 유입 | 17 | 9 | 9 | 14 | 24 | 97 | 479 | 936 | 667 | 687 | 455 | 324 | 272 | 281 | 270 | 245 | 248 | 279 | 238 | 157 | 138 | 150 | 108 | 69 |
| 20151215 | 화 | 삼정터널 | 유입 | 57 | 21 | 18 | 13 | 21 | 79 | 358 | 850 | 715 | 611 | 469 | 346 | 304 | 305 | 317 | 266 | 294 | 284 | 281 | 178 | 163 | 160 | 179 | 100 |
| 20151216 | 수 | 삼정터널 | 유입 | 62 | 50 | 18 | 19 | 25 | 92 | 349 | 908 | 713 | 584 | 453 | 398 | 291 | 275 | 281 | 311 | 294 | 308 | 269 | 164 | 153 | 161 | 134 | 88 |
| 20151217 | 목 | 삼정터널 | 유입 | 68 | 42 | 23 | 16 | 16 | 93 | 333 | 901 | 724 | 678 | 510 | 391 | 306 | 303 | 291 | 290 | 294 | 345 | 265 | 204 | 179 | 196 | 163 | 91 |
| 20151218 | 금 | 삼정터널 | 유입 | 63 | 43 | 27 | 14 | 25 | 88 | 361 | 835 | 728 | 602 | 497 | 414 | 296 | 308 | 310 | 333 | 330 | 334 | 361 | 233 | 176 | 169 | 147 | 114 |
| 20151219 | 토 | 삼정터널 | 유입 | 74 | 47 | 32 | 27 | 23 | 50 | 126 | 176 | 326 | 402 | 418 | 477 | 481 | 577 | 397 | 337 | 365 | 285 | 269 | 173 | 180 | 155 | 115 | 69 |
| 20151220 | 일 | 삼정터널 | 유입 | 65 | 21 | 22 | 14 | 16 | 31 | 66 | 114 | 204 | 289 | 321 | 330 | 334 | 338 | 316 | 282 | 291 | 258 | 202 | 154 | 151 | 154 | 95 | 45 |
| 20151221 | 월 | 삼정터널 | 유입 | 33 | 9 | 14 | 12 | 32 | 107 | 461 | 828 | 667 | 787 | 607 | 436 | 280 | 274 | 263 | 284 | 287 | 313 | 254 | 172 | 146 | 159 | 132 | 89 |
| 20151222 | 화 | 삼정터널 | 유입 | 61 | 38 | 18 | 21 | 19 | 77 | 339 | 859 | 722 | 617 | 542 | 407 | 276 | 333 | 311 | 323 | 327 | 360 | 324 | 213 | 196 | 164 | 153 | 75 |
| 20151223 | 수 | 삼정터널 | 유입 | 61 | 49 | 23 | 14 | 20 | 85 | 364 | 822 | 708 | 605 | 515 | 389 | 286 | 320 | 269 | 273 | 283 | 335 | 322 | 179 | 161 | 180 | 140 | 107 |
| 20151224 | 목 | 삼정터널 | 유입 | 82 | 53 | 27 | 20 | 19 | 68 | 334 | 808 | 689 | 614 | 467 | 397 | 291 | 313 | 290 | 291 | 320 | 317 | 288 | 244 | 203 | 220 | 167 | 108 |
| 20151226 | 토 | 삼정터널 | 유입 | 36 | 19 | 14 | 11 | 12 | 37 | 76 | 125 | 208 | 320 | 314 | 331 | 338 | 308 | 327 | 325 | 295 | 300 | 240 | 168 | 179 | 143 | 120 | 85 |
| 20151227 | 일 | 삼정터널 | 유입 | 43 | 36 | 30 | 11 | 12 | 21 | 60 | 99 | 189 | 231 | 271 | 288 | 342 | 365 | 353 | 349 | 307 | 233 | 157 | 159 | 146 | 121 | 71 | 37 |
| 20151228 | 월 | 삼정터널 | 유입 | 15 | 14 | 8 | 13 | 24 | 85 | 449 | 891 | 710 | 606 | 510 | 373 | 274 | 327 | 262 | 267 | 295 | 285 | 252 | 180 | 153 | 154 | 119 | 76 |
| 20151229 | 화 | 삼정터널 | 유입 | 51 | 33 | 15 | 13 | 22 | 79 | 324 | 834 | 674 | 598 | 491 | 362 | 329 | 293 | 304 | 266 | 323 | 317 | 282 | 173 | 186 | 177 | 130 | 91 |
| 20151230 | 수 | 삼정터널 | 유입 | 56 | 54 | 29 | 18 | 25 | 71 | 337 | 807 | 680 | 541 | 441 | 386 | 299 | 321 | 315 | 265 | 312 | 276 | 261 | 166 | 156 | 144 | 123 | 56 |
| 20151231 | 목 | 삼정터널 | 유입 | 53 | 33 | 28 | 22 | 21 | 59 | 255 | 691 | 678 | 483 | 471 | 361 | 285 | 297 | 301 | 258 | 303 | 286 | 276 | 207 | 180 | 173 | 177 | 115 |
| 20151201 | 화 | 삼정터널 | 유출 | 137 | 52 | 35 | 13 | 21 | 29 | 63 | 168 | 233 | 242 | 225 | 307 | 258 | 286 | 273 | 318 | 438 | 593 | 703 | 654 | 428 | 429 | 380 | 186 |
| 20151202 | 수 | 삼정터널 | 유출 | 124 | 65 | 25 | 27 | 25 | 28 | 62 | 183 | 222 | 234 | 240 | 246 | 242 | 286 | 320 | 325 | 406 | 509 | 683 | 679 | 432 | 425 | 334 | 181 |
| 20151203 | 목 | 삼정터널 | 유출 | 94 | 60 | 34 | 26 | 17 | 28 | 79 | 159 | 206 | 211 | 145 | | 214 | 212 | 248 | 270 | 332 | 415 | 574 | 528 | 341 | 304 | 293 | 173 |
| 20151204 | 금 | 삼정터널 | 유출 | 94 | 63 | 33 | 20 | 22 | 32 | 67 | 165 | 214 | 221 | 242 | 275 | 261 | 278 | 332 | 379 | 451 | 574 | 678 | 699 | 488 | 406 | 388 | 252 |
| 20151205 | 토 | 삼정터널 | 유출 | 117 | 98 | 48 | 28 | 29 | 28 | 48 | 82 | 135 | 225 | 242 | 277 | 280 | 266 | 301 | 253 | 299 | 411 | 516 | 544 | 350 | 299 | 207 | 132 |
| 20151206 | 일 | 삼정터널 | 유출 | 78 | 47 | 42 | 20 | 17 | 14 | 25 | 47 | 107 | 131 | 217 | 185 | 204 | 295 | 388 | 411 | 398 | 439 | 305 | 338 | 282 | 238 | 166 | 90 |
| 20151207 | 월 | 삼정터널 | 유출 | 63 | 24 | 15 | 13 | 13 | 27 | 62 | 157 | 215 | 241 | 259 | 256 | 243 | 249 | 298 | 318 | 403 | 519 | 679 | 608 | 453 | 404 | 322 | 181 |
| 20151208 | 화 | 삼정터널 | 유출 | 101 | 59 | 24 | 25 | 24 | 22 | 64 | 160 | 202 | 217 | 228 | 270 | 285 | 283 | 328 | 387 | 447 | 565 | 754 | 707 | 499 | 468 | 381 | 182 |
| 20151209 | 수 | 삼정터널 | 유출 | 103 | 55 | 35 | 19 | 34 | 27 | 76 | 165 | 248 | 212 | 222 | 269 | 261 | 281 | 315 | 416 | 466 | 570 | 650 | 667 | 465 | 437 | 353 | 181 |
| 20151210 | 목 | 삼정터널 | 유출 | 122 | 79 | 43 | 21 | 24 | 32 | 63 | 156 | 215 | 240 | 272 | 274 | 309 | 306 | 348 | 377 | 430 | 491 | 658 | 642 | 458 | 398 | 345 | 223 |
| 20151211 | 금 | 삼정터널 | 유출 | 122 | 53 | 32 | 32 | 27 | 25 | 59 | 160 | 226 | 253 | 270 | 246 | 278 | 309 | 381 | 382 | 427 | 564 | 699 | 676 | 491 | 429 | 411 | 225 |
| 20151212 | 토 | 삼정터널 | 유출 | 115 | 79 | 62 | 42 | 27 | 36 | 47 | 91 | 95 | 197 | 215 | 261 | 306 | 354 | 355 | 469 | 440 | 504 | 484 | 395 | 359 | 359 | 276 | 166 |
| 20151213 | 일 | 삼정터널 | 유출 | 111 | 59 | 37 | 30 | 23 | 26 | 23 | 51 | 95 | 161 | 187 | 221 | 249 | 299 | 327 | 413 | 463 | 430 | 394 | 290 | 357 | 248 | 162 | 99 |
| 20151214 | 월 | 삼정터널 | 유출 | 38 | 26 | 20 | 13 | 12 | 27 | 62 | 169 | 226 | 209 | 213 | 241 | 252 | 246 | 257 | 299 | 338 | 502 | 597 | 629 | 450 | 375 | 354 | 163 |
| 20151215 | 화 | 삼정터널 | 유출 | 71 | 53 | 31 | 24 | 18 | 29 | 62 | 147 | 199 | 208 | 235 | 246 | 269 | 261 | 333 | 354 | 409 | 548 | 634 | 572 | 457 | 403 | 394 | 196 |
| 20151216 | 수 | 삼정터널 | 유출 | 100 | 67 | 40 | 26 | 24 | 39 | 73 | 136 | 206 | 219 | 183 | 249 | 272 | 287 | 302 | 361 | 483 | 528 | 666 | 615 | 446 | 412 | 353 | 207 |
| 20151217 | 목 | 삼정터널 | 유출 | 119 | 64 | 36 | 28 | 22 | 21 | 64 | 161 | 219 | 222 | 200 | 244 | 262 | 318 | 321 | 346 | 430 | 559 | 653 | 633 | 487 | 466 | 400 | 222 |
| 20151218 | 금 | 삼정터널 | 유출 | 116 | 78 | 37 | 32 | 22 | 28 | 48 | 153 | 200 | 229 | 265 | 284 | 302 | 273 | 307 | 377 | 454 | 606 | 631 | 584 | 468 | 434 | 432 | 269 |
| 20151219 | 토 | 삼정터널 | 유출 | 155 | 76 | 72 | 44 | 22 | 30 | 52 | 82 | 101 | 183 | 193 | 242 | 297 | 338 | 336 | 391 | 431 | 485 | 568 | 486 | 367 | 293 | 276 | 144 |
| 20151220 | 일 | 삼정터널 | 유출 | 93 | 69 | 46 | 34 | 24 | 13 | 39 | 49 | 87 | 155 | 232 | 238 | 275 | 288 | 333 | 369 | 410 | 415 | 346 | 275 | 307 | 257 | 195 | 81 |
| 20151221 | 월 | 삼정터널 | 유출 | 51 | 33 | 17 | 11 | 20 | 21 | 61 | 152 | 191 | 189 | 201 | 199 | 237 | 276 | 277 | 335 | 375 | 518 | 608 | 538 | 412 | 428 | 362 | 184 |
| 20151222 | 화 | 삼정터널 | 유출 | 109 | 75 | 36 | 24 | 20 | 28 | 46 | 157 | 236 | 241 | 218 | 271 | 315 | 272 | 310 | 383 | 462 | 506 | 674 | 626 | 472 | 397 | 365 | 208 |
| 20151223 | 수 | 삼정터널 | 유출 | 112 | 81 | 48 | 29 | 25 | 25 | 48 | 143 | 191 | 217 | 205 | 243 | 270 | 280 | 286 | 372 | 381 | 565 | 628 | 598 | 431 | 413 | 373 | 216 |
| 20151224 | 목 | | | | | | | | | | | | | | | | | | | | | | | | | | |

3.3 Open Transportation Data and Application

□ Weekly Traffic Volume Open Data at Samchung Tunnel

| DATES | DAY | 0h | 1h | 2h | 3h | 4h | 5h | 6h | 7h | 8h | 9h | 10h | 11h | 12h | 13h | 14h | 15h | 16h | 17h | 18h | 19h | 20h | 21h | 22h | 23h |
|----------|-----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 20151207 | MON | 27 | 12 | 8 | 15 | 32 | 109 | 485 | 867 | 733 | 660 | 428 | 361 | 259 | 274 | 281 | 282 | 300 | 335 | 317 | 172 | 173 | 160 | 125 | 91 |
| 20151208 | TUE | 49 | 27 | 14 | 17 | 23 | 92 | 367 | 875 | 735 | 652 | 471 | 366 | 306 | 314 | 294 | 288 | 352 | 375 | 369 | 206 | 178 | 206 | 142 | 100 |
| 20151209 | WED | 71 | 31 | 27 | 17 | 30 | 83 | 361 | 862 | 745 | 624 | 460 | 397 | 282 | 289 | 305 | 331 | 326 | 396 | 319 | 206 | 167 | 164 | 122 | 86 |
| 20151210 | THU | 47 | 37 | 29 | 14 | 26 | 77 | 377 | 881 | 683 | 637 | 478 | 335 | 271 | 295 | 282 | 273 | 327 | 297 | 286 | 170 | 160 | 232 | 145 | 88 |
| 20151211 | FRI | 70 | 43 | 29 | 16 | 27 | 74 | 322 | 878 | 686 | 591 | 433 | 396 | 313 | 306 | 335 | 334 | 337 | 341 | 356 | 197 | 168 | 173 | 130 | 97 |
| 20151212 | SAT | 52 | 57 | 43 | 27 | 24 | 44 | 109 | 185 | 324 | 435 | 434 | 500 | 505 | 447 | 372 | 304 | 396 | 466 | 368 | 196 | 192 | 196 | 128 | 80 |
| 20151213 | SUN | 53 | 28 | 26 | 18 | 9 | 38 | 61 | 116 | 201 | 247 | 298 | 321 | 353 | 355 | 331 | 321 | 316 | 257 | 220 | 172 | 155 | 125 | 86 | 33 |



□ Calculating the speed of a road link

Total Distance Driven

$$tot(tacho_l) = \sum_{i=1}^n tacho_{li}$$

Total Driven Hours (sec)

$$tot(tick_l) = \sum_{i=1}^n tick_{li}$$

Calculating Velocity

$$v_l = \frac{tot(tacho_l)}{tot(tick_l)} \times 3.6$$

- Velocity of each 5 minutes will be averaged for an hourly basis

$$v_r^{avg} = \frac{(v_r^{00:05} + v_r^{00:10} + v_r^{00:15} + \dots + v_r^{00:50} + v_r^{00:55} + v_r^{00:60})}{n^t}$$

- Tick : Total time of duration from start to end of a road link (in terms of seconds)
- Tacho : Real distance of a Taxi from start to end of a rod link (in terms of meter)

4. IoT Platform Deployment for Smart City

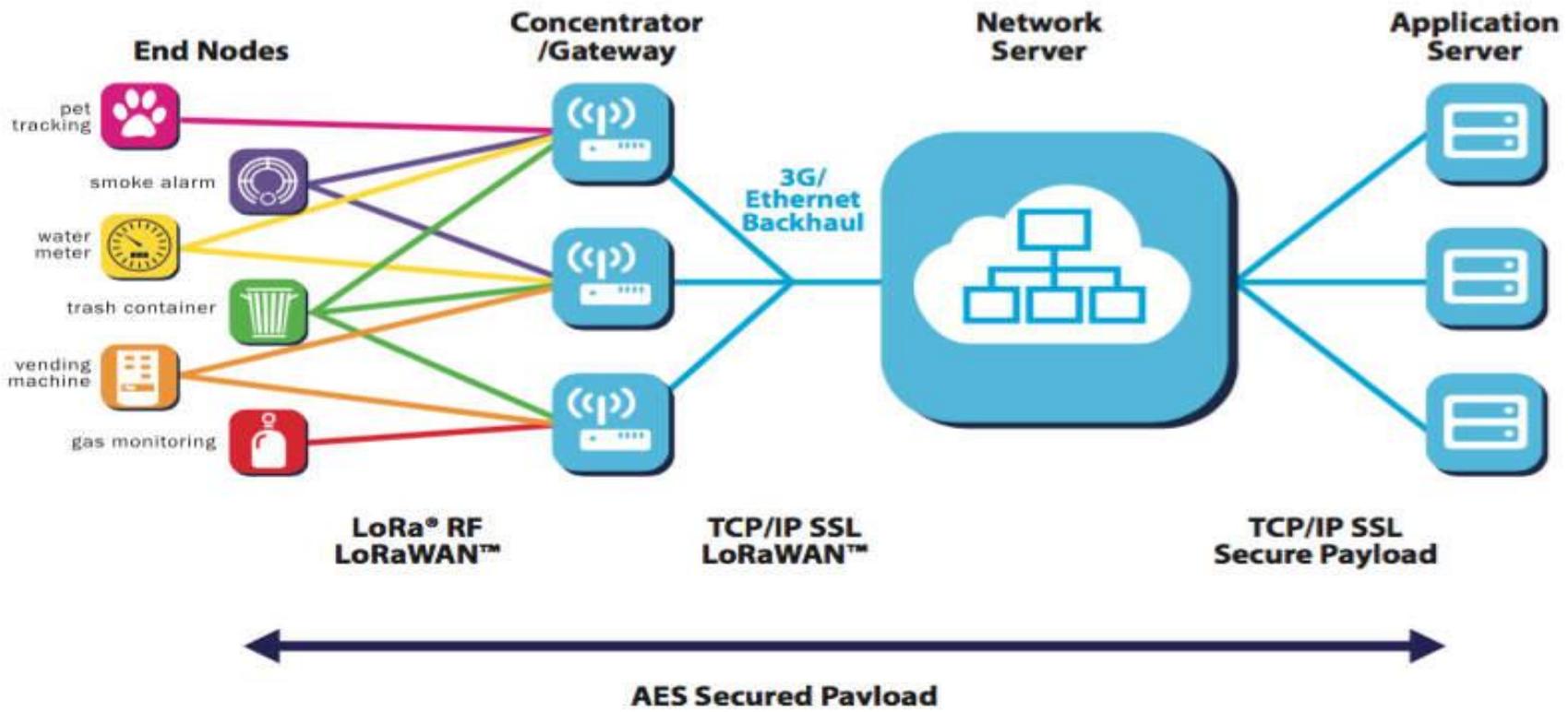
4.1 LoRa IoT Network and Eco-system

4.1 Busan Case



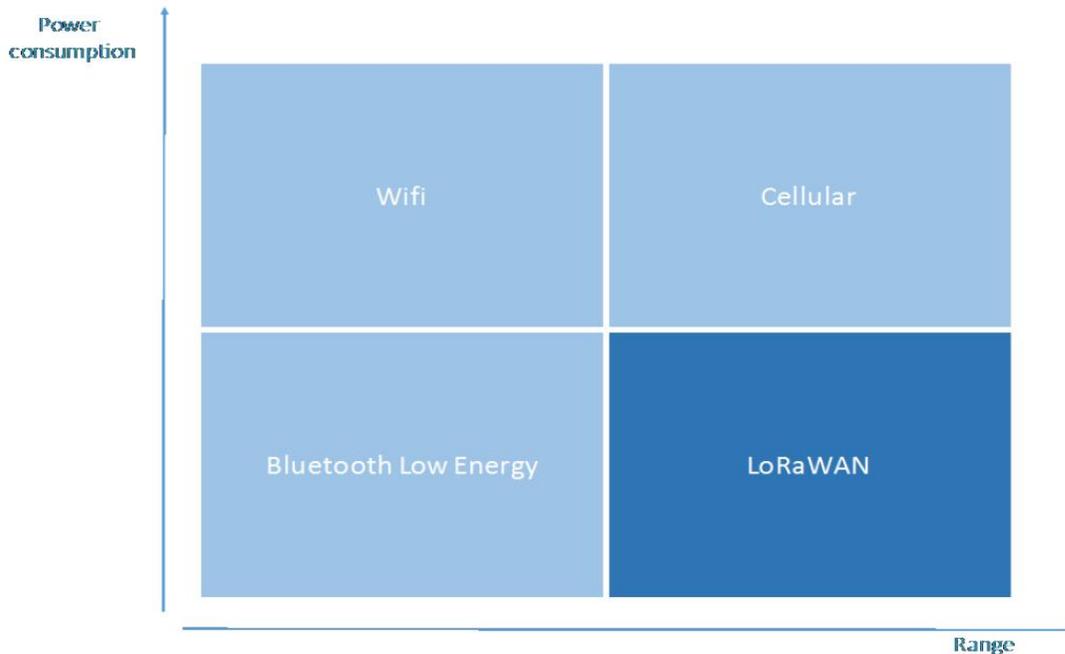
4.1 Lora IoT Network and Eco-system

□ IoT (Internet of Things) Specialized network – LoRa network (1)



Source: A Technical Overview of LoRa and LoRaWAN, 2015

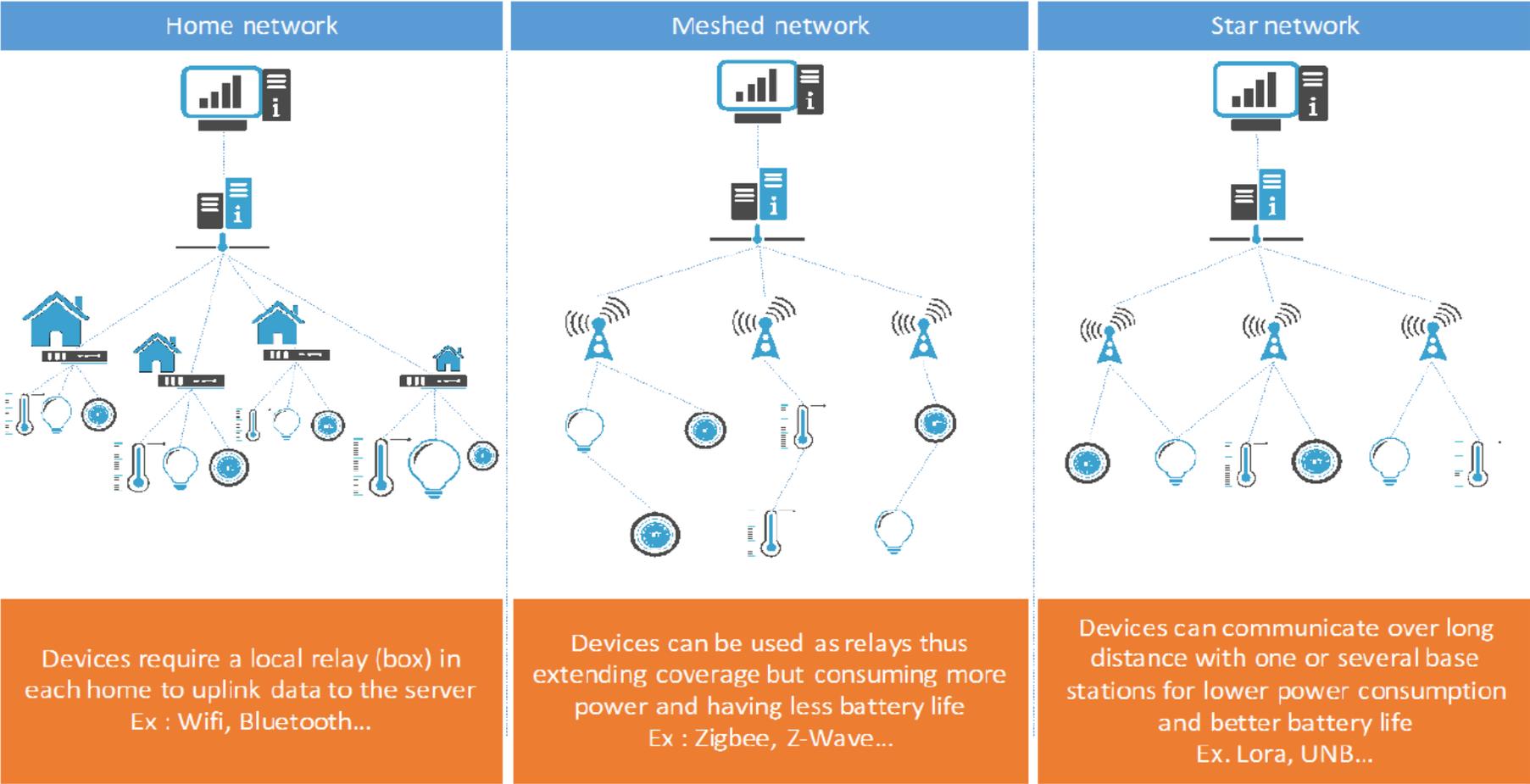
□ IoT (Internet of Things) Specialized network (2)



- LPWAN (Low Power Wide Area Network) such as LoRa Network includes applications for Smart Cities such as;
 - smart parking,
 - intelligent street lighting,
 - supply chain management with asset tracking & condition monitoring,
 - smart grids with electricity,
 - water & gas metering,
 - smart agriculture with land condition monitoring
 - animal tracking
 - geo-fencing, etc.

4.1 Lora IoT Network and Eco-system

□ Lora uses Star network topology



Source: LoRa Device Developer Guide, Orange, 2016

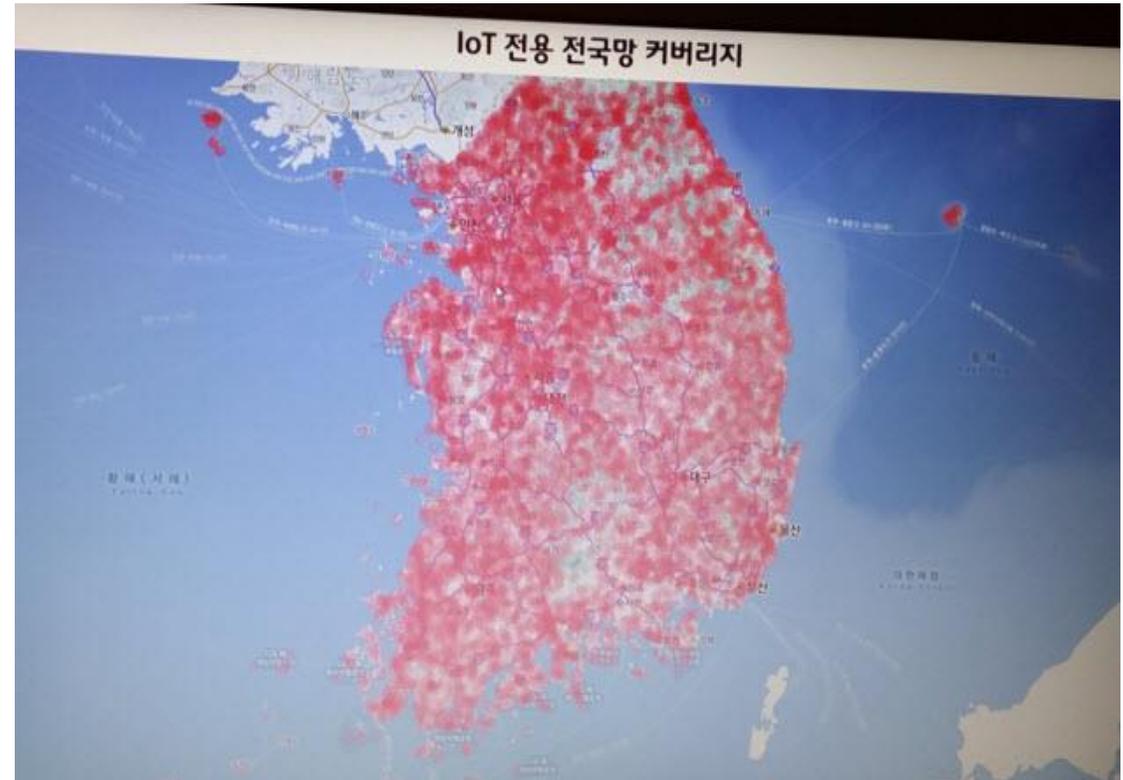
4.1 Lora IoT Network and Eco-system

□ SK Telecom had implemented nationwide LORA IoT network in Korea

LoRa Base Stations



SK LoRa network coverage of Korean Peninsula



4.1 Lora IoT Network and Eco-system

□ SK Telecom’s Monthly Amounts for IoT Services

Unit : 1,000 Won = 1 USD

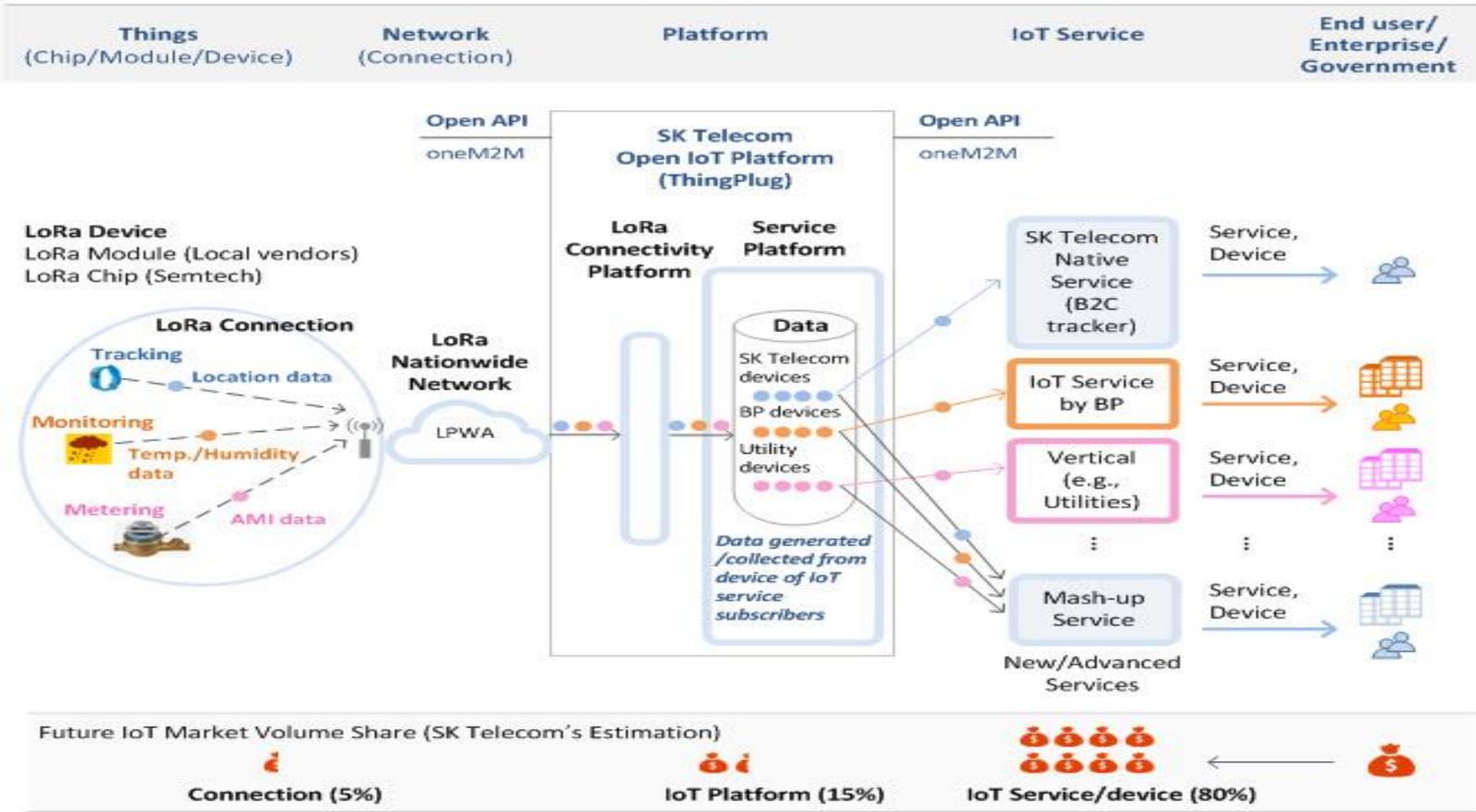
| Data | Monthly Base Amounts | Services | Etc. |
|---|----------------------|---|--|
| 100KB (1 time per 1 hour) | 35 cents | Gas/Water AMI and Monitoring | <ul style="list-style-type: none"> Discount 2 year contract (5%), 5 year contract (20%), Multi-lines (500, 2%) Additional data rate 0.05cents/0.5KB |
| 500KB (1 time per 10 minutes) | 50 cents | Monitoring of facilities | |
| 3 MB (1 time per 1 Minute) | 70 cents | Asset management (public bicycles, etc.) | |
| 10 MB | 1 dollar | Safe watch for humans | |
| 50 MB | 1.5 dollars | Movable assets | |
| 100 MB | 2 dollars | Construction sites security management, Electricity AMI, etc. | |

Source: SK Telecom, IoT homepage, 2016

* The amount of new IoT fixed monthly fee is 1/3~1/10 of the current IoT fee rates

4.1 Lora IoT Network and Eco-system

□ SK Telecom's LoRa Architecture



4.1 Lora IoT Network and Eco-system

□ Examples of IoT services through LoRa network



IoT Meteorological Sensors

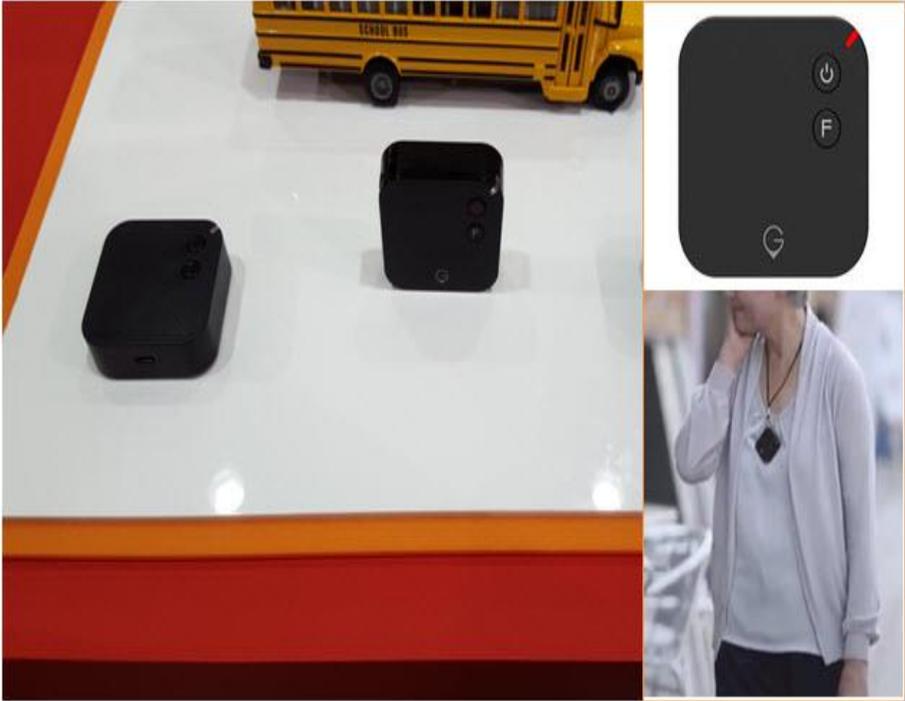


IoT based Gas detectors

□ Examples of IoT services through LoRa network

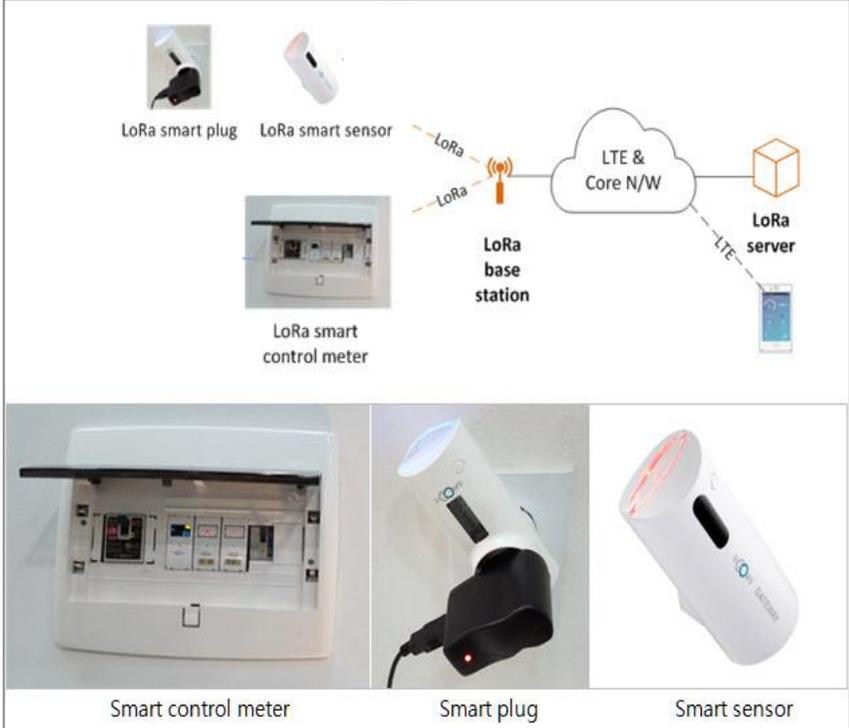


IoT based manhole cover



IoT based tracking device

□ Examples of IoT services through LoRa network



IoT based smart plugs and sensors



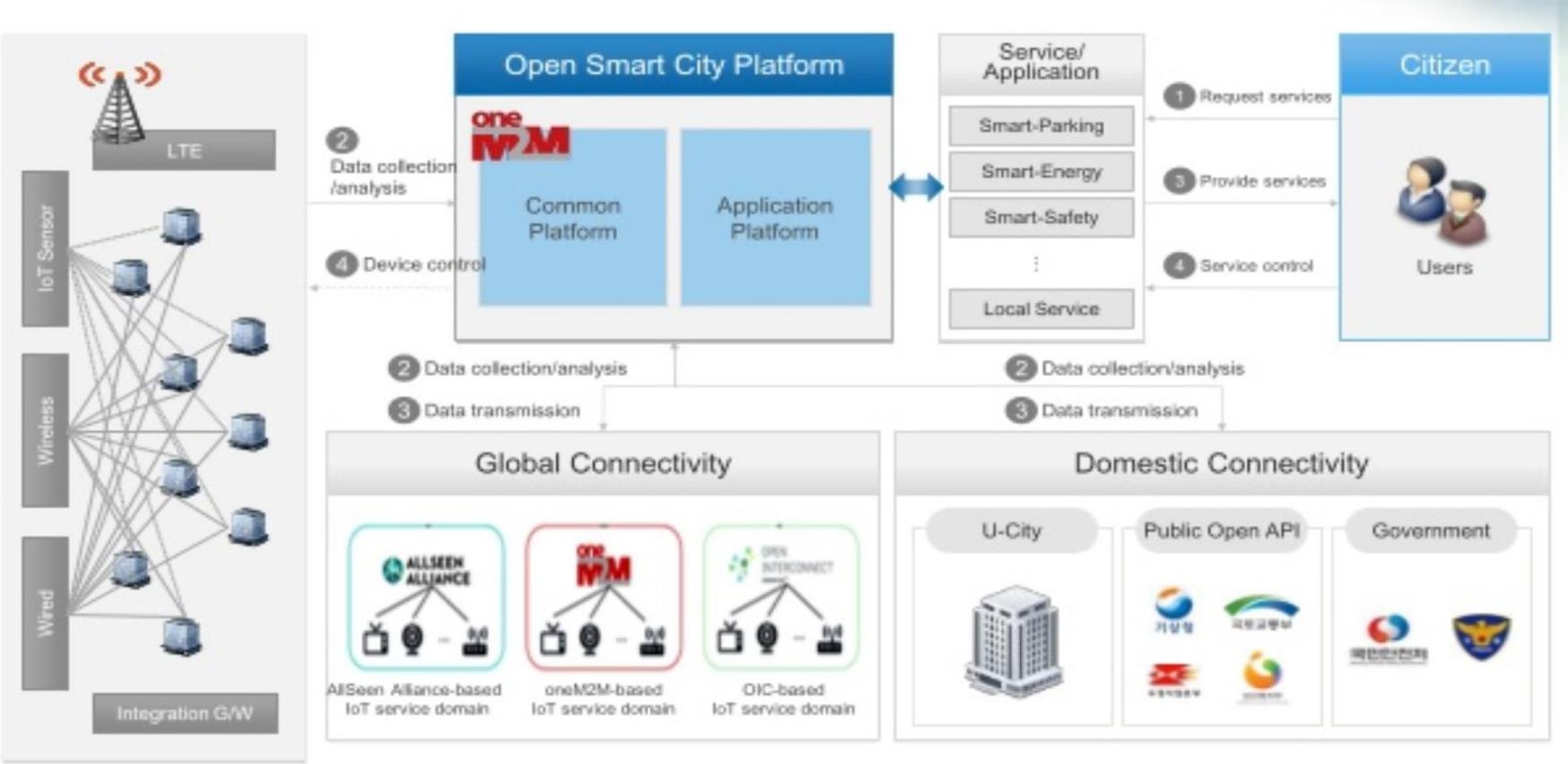
IoT based Security Devices

□ Busan, Korea



4.2 Busan Case

□ OneM2M based Smart City Platform named Mobius in Busan, Korea



Source: Busan city, 2015

□ Top 10 Big Data Analysis Candidates at Busan City

1. Traffic Congestions Analysis service
2. Smart Traffic Signaling Services
3. Smart Parking Services
4. Daily Security Guide Services
5. Smart Missing Child Protection Services
6. Maritime Security Services
7. Smart Security Services
8. Smart Crossroads Services
9. Pollution Forecasting Services
10. Social Disaster Management Services

Top ranked Smart City Services with Big Data are related to Transportation Services

5. Discussions

5.1 Smart Nation Perspective

5.2 Implications and a Way Forward



Next generation e-government for impressive public service and smart public administration management

Using cutting-edge technology such as AI, Big Data, and IoT

Secretary government suggesting customized services in advance on both online and offline

'Digital Brain' government finding and solving problems for itself by continuous learning using cutting-edge technology such as AI and big data

Open government for all people to participate in public administration communicating with people by wire-wireless network nationwide

Reliable and supported government leading the society of integrity and justice by opening and sharing all information transparently and safely

E-government

People/Civil Srtvant
Claim → Improvement

Administrative
Work

Government leading
policy management

Policy Decision

Focusing on Simple task

On-site
Administration

Quantitative and Efficient Service

Service Object

Customized Lifecycle service

Service

Online + Mobile
Channel

Delivery
Method



Smart Nation

Auto recognition of problem by digital
brain → Self-suggesting alternatives →
Improvement

People leading policy decision

Solving complex problems

Co-production
qualitative ·empathic service

Everyday and lifetime
assistant service

Demand-based
On-Off multi-channel

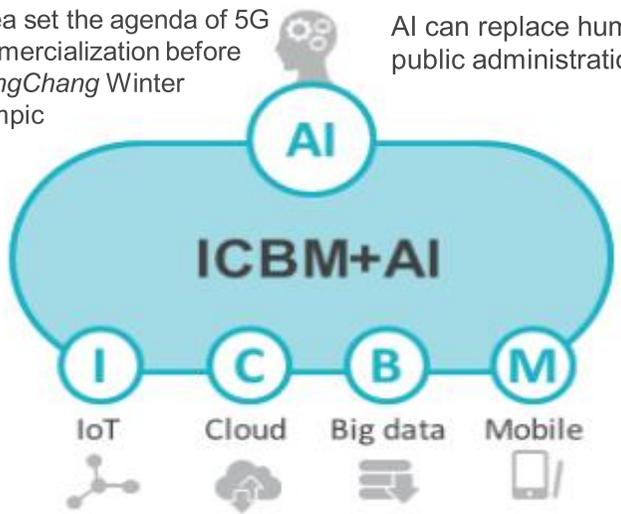
ICT advancement including AI, Big Data, IoT, 5G, etc. calls for a new digital government paradigm in Korea.

Intelligent Information Technology Convergence and Diffusion

Transformation into a New Digital Society

Korea set the agenda of 5G commercialization before PyungChang Winter Olympic

AI can replace human labor including public administration



Increasingly complex and difficult social issues

The 4th Industrial Revolution and emergence of individually tailored small scale production economy



The coming of a next generation digital age and diversification of policy demand

First in the world, national wide IoT network has been deployed in Korea

Owl Bus Case
Crime Prevention
Social Welfare

Emergence of a New Environment for Digital Government

- **Balanced Development between Technology and Law/Ordinances/Policy**
- **Clear understanding and vision for e-government and smart city forward looking into being a smart nation**
- **Ways to upgrade central and local governance structure by utilizing ICT Power (Smart City, Smart Communities, etc.)**
- **Start with seeding projects (e.g., Feasibility Study) support possibility by local governments?**
- **Power of IoT in citizen daily life – IoT Platform? IoT services? IoT network?**
- **Systemized development framework – network, platform, application layer based approach, for instance**
- **Increasing Citizen Participation is critical – applying Living Lab methodology with Social Digital Innovation?**

Thank You!

Questions and Comments

Dr. Sang-Baek Chris Kang
Director of External Cooperation, KLID
chriskang@klid.or.kr

