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Empowering smart city situational awareness via big mobile data

Key words: Smart city; Mobile data; Situational awareness

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Background



Mobile Internet &
big data in China



Smart city 2.0 &
data governance



AI technology &
situational awareness

Smart city situational awareness:
multi-source, hard to discover, invisible

Mobile big data analysis:
correlation, anomaly detection, visualization

High-dimensional

Urban big data with many dimensions such as spatial, temporal, event, and trends

Multiple-source

Typical urban big data source: public sector, transportation, etc.
Hard to fuse & analyze

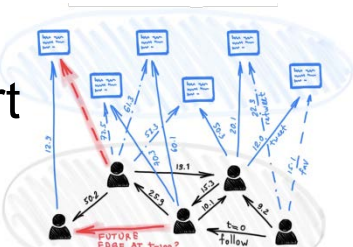
Situation-awareness

Urban data risk awareness: lack the capability to locate, sense, defend, and resolve

Key challenges

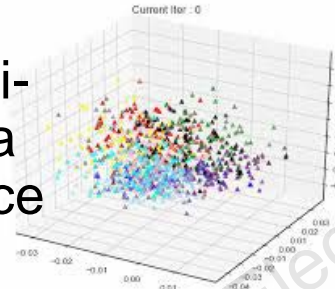
C1: high data dim.

Smart city



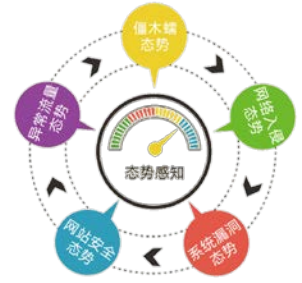
C2: info. integration

Multi-data source



C3: poor sensing

Real-time awareness



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Method I

Spatiotemporal visualization

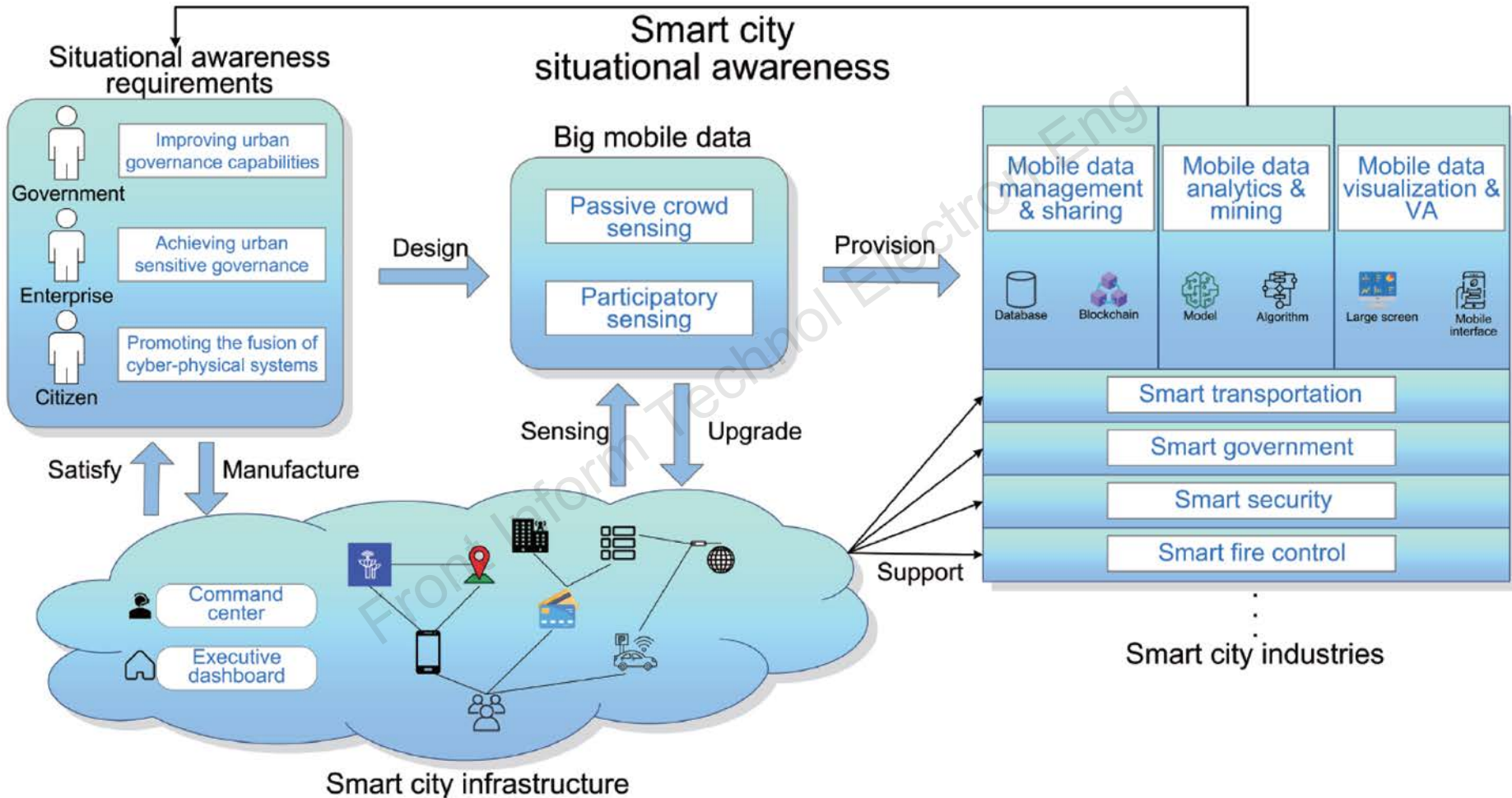
Method II

Urban semantic modeling

Method III

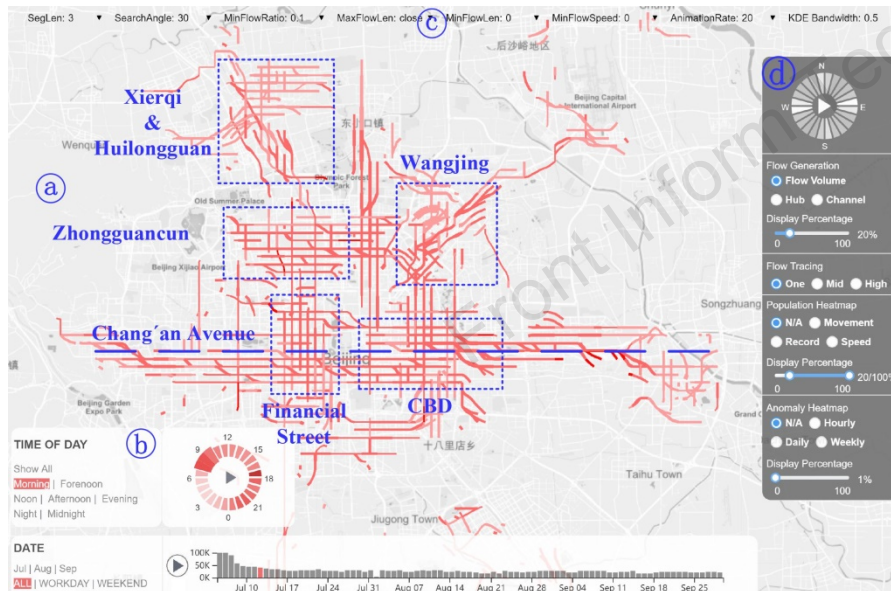
Cybersecurity insurance

Technology framework

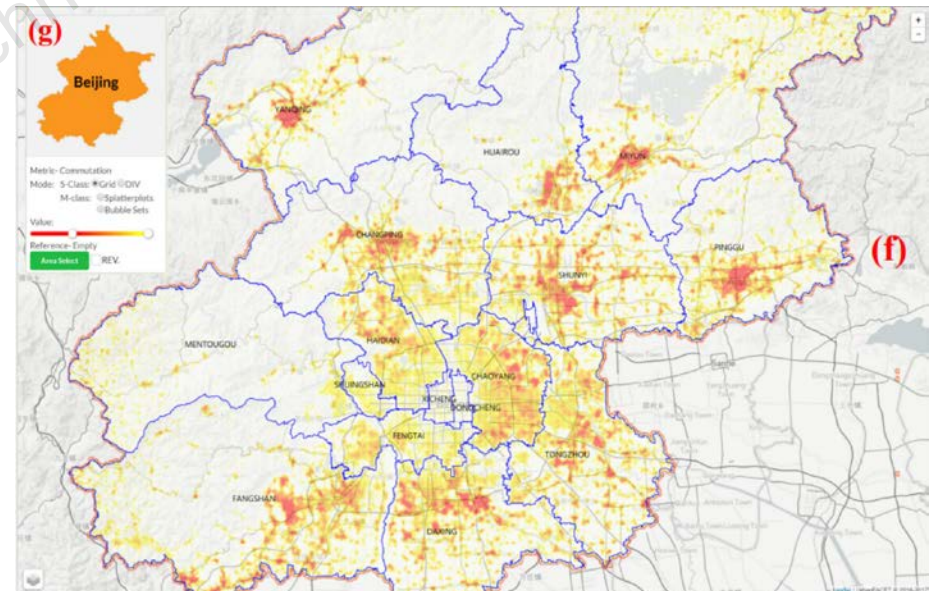


1) Spatiotemporal visualization of big mobile data

- ❑ Mapping human movement in urban areas has gained significant attention in the fields of GIS and visualization
- ❑ We propose the UrbanMotion framework which leverages the long-tailed sparsity of sparse trajectory datasets to extract and aggregate population movements from dense parts of trajectories, allowing for global and local movements to be visualized simultaneously



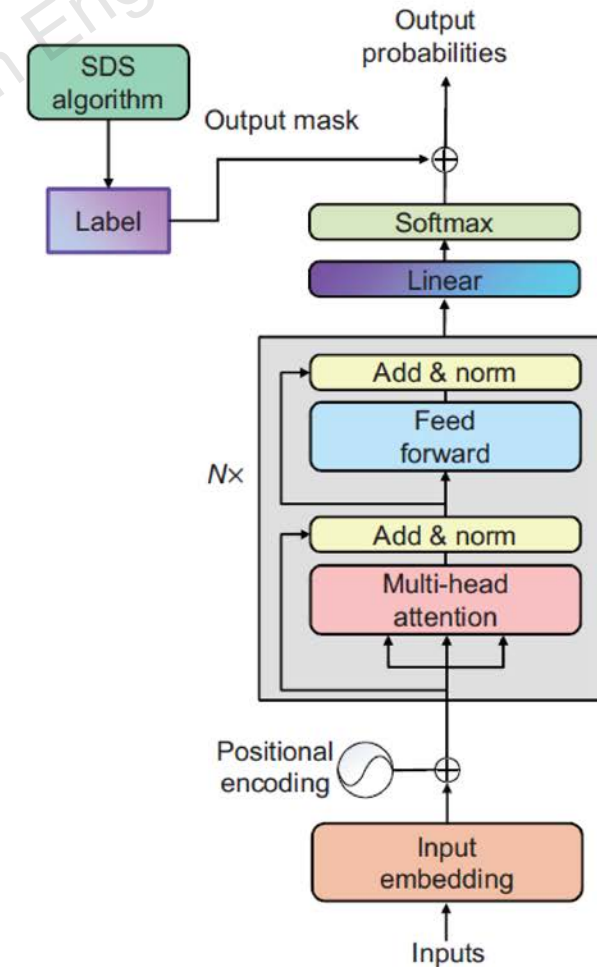
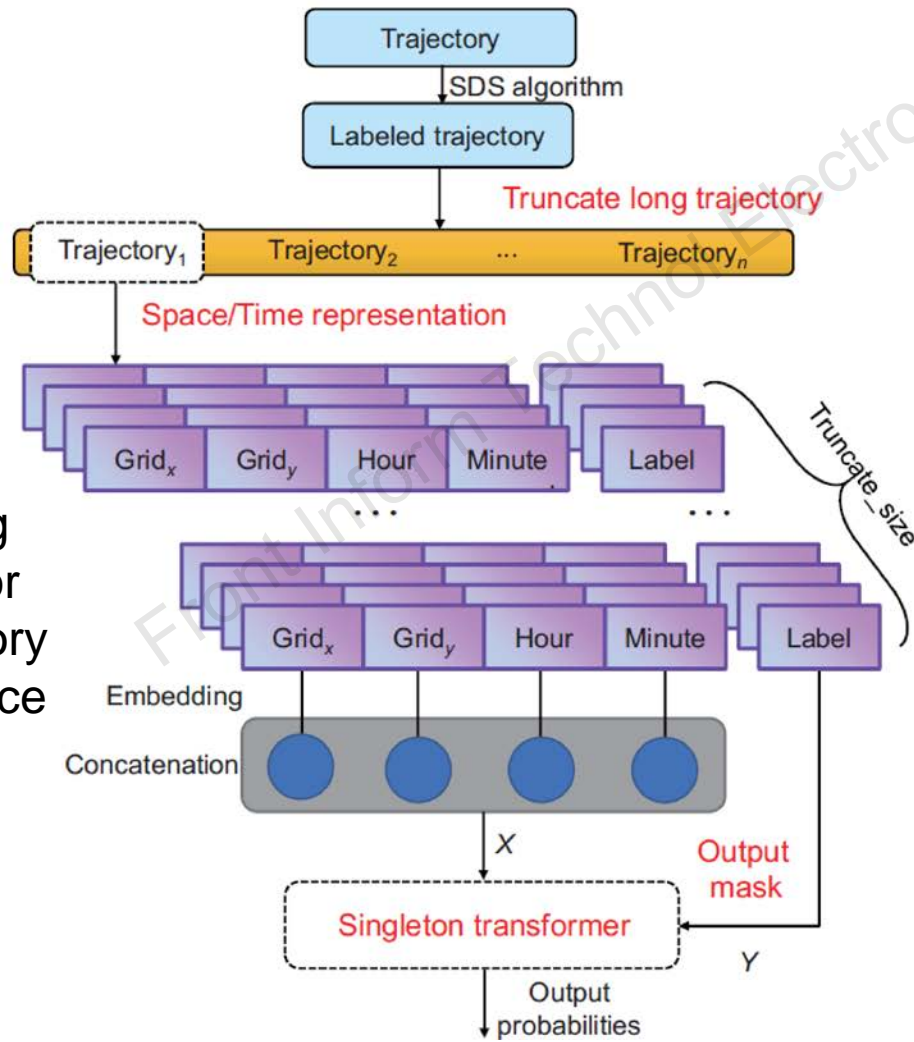
Visualization of millions of urban trajectories in Beijing, China



Spatial visualization of mobility metrics

2) Urban spatiotemporal semantic modeling

- We present a formal definition of stay/travel in the context of sparse trajectory, and establish a deep learning approach to capture the regularity of human mobility at a population scale.

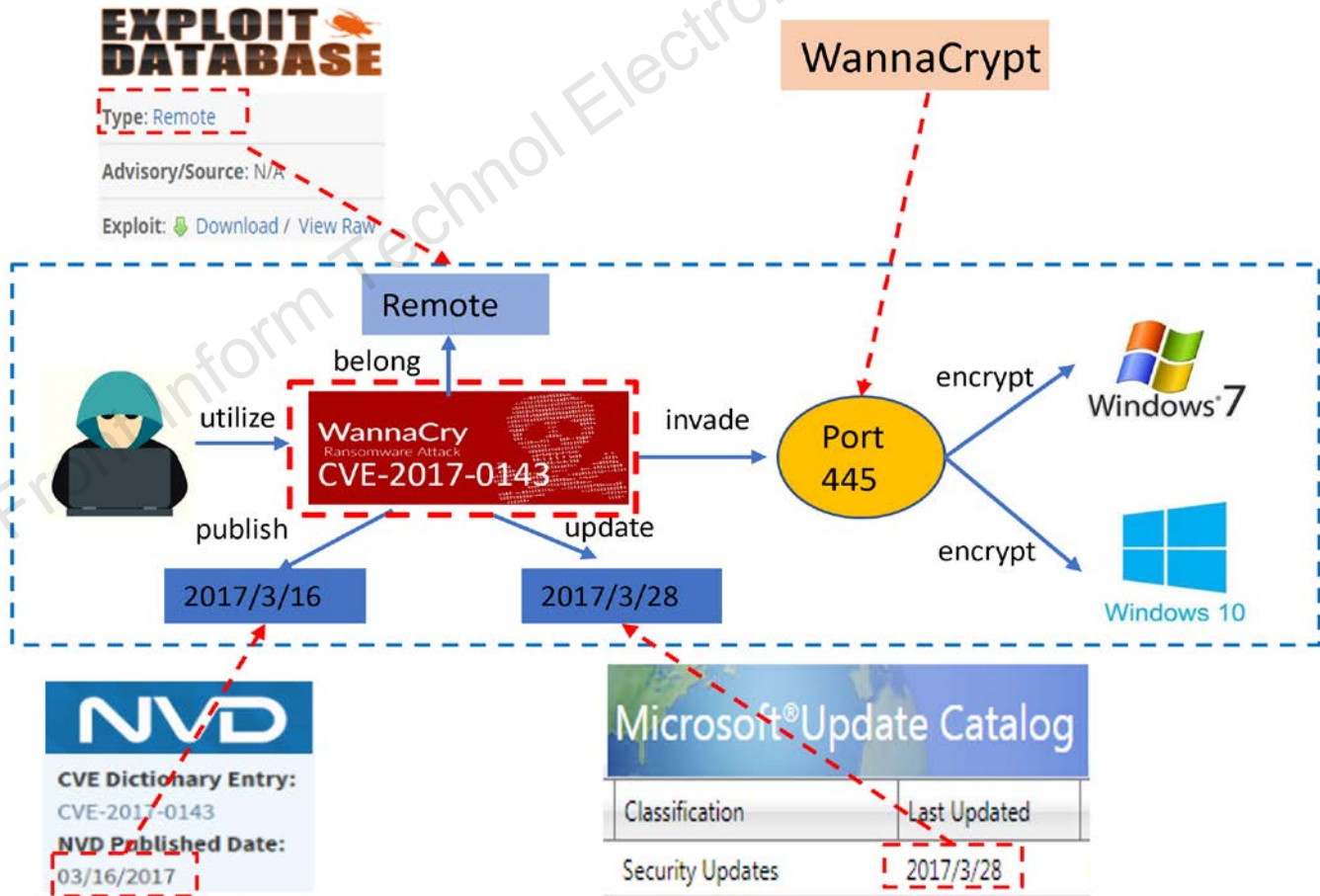


Deep learning architecture for multiple trajectory mobility inference

3) Cybersecurity insurance via big mobile data

- ❑ Cyber threat is normally organized according to the indicator of compromise (IOC), which is critical finger print information for network security protection
- ❑ We propose an intelligence representation learning method with unstructured threat embedding and IOC relationship calculation

Multi-source heterogeneous network threat intelligence analysis in smart cities



Future outlook

Smart city situational awareness research	Outlook
Large-scale deployment	<ul style="list-style-type: none">• The proposed technologies generally have small to medium experiment scale• Large-scale deployment of smart city situational awareness systems will be essential for technological validation• Also essential for understanding the pros and cons when interacting with hundreds of smart city sub-systems
New sensing technology	<ul style="list-style-type: none">• The emergence of 5G technology and the potential roll-out of 6G in the foreseeable future• Urban infrastructure can be further integrated with a variety of mobile devices with real-time data analytics capability• This enables innovative/immersive urban applications via augmented reality and virtual reality technologies
Artificial intelligence	<ul style="list-style-type: none">• The intersection of big mobile data with artificial intelligence holds significant promise• Give birth to predictive analytics in smart cities• Potential incidents can be forecast, allowing authorities to take preemptive measures

Biography



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