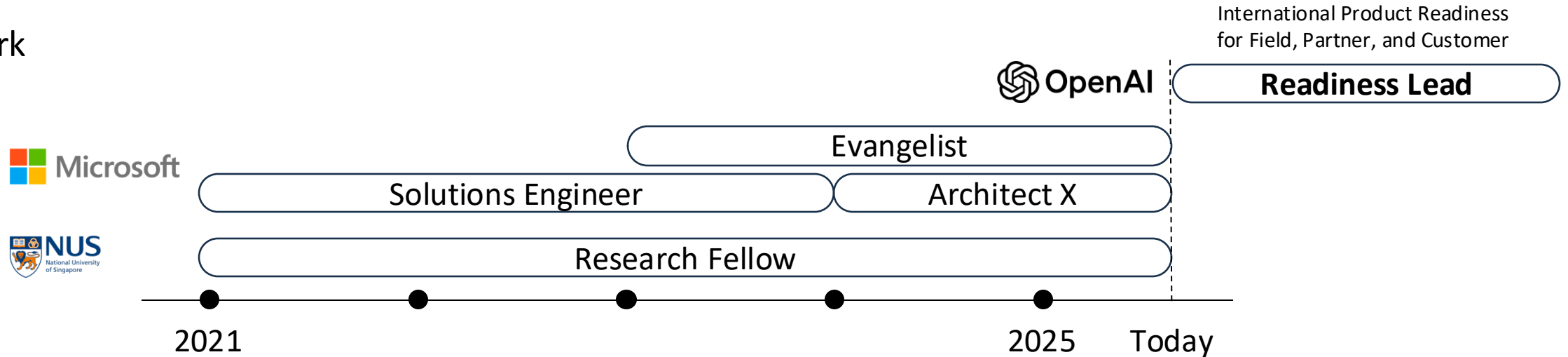


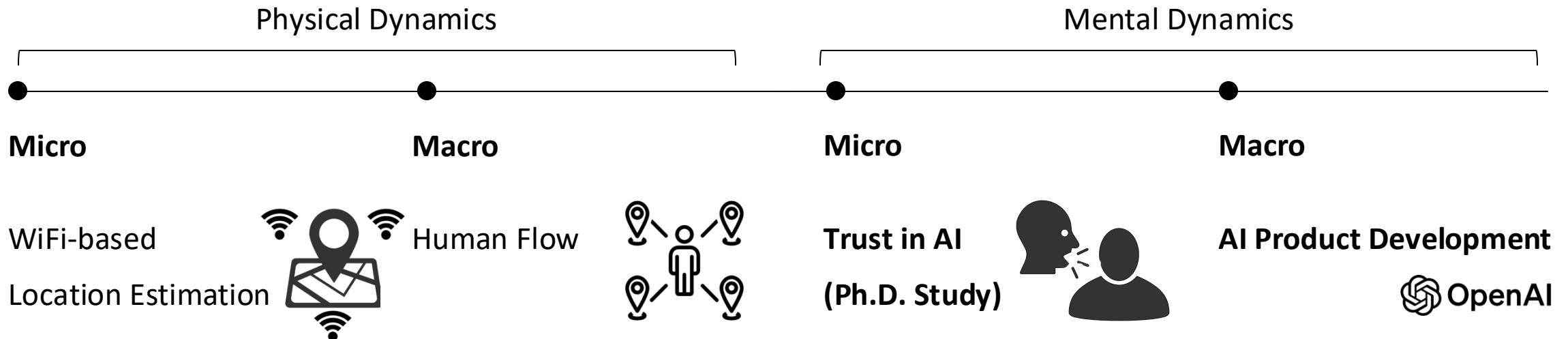
# Kohei Yamamoto

Readiness Lead at OpenAI | Ph.D. Student (Cognitive Informatics)

## Work



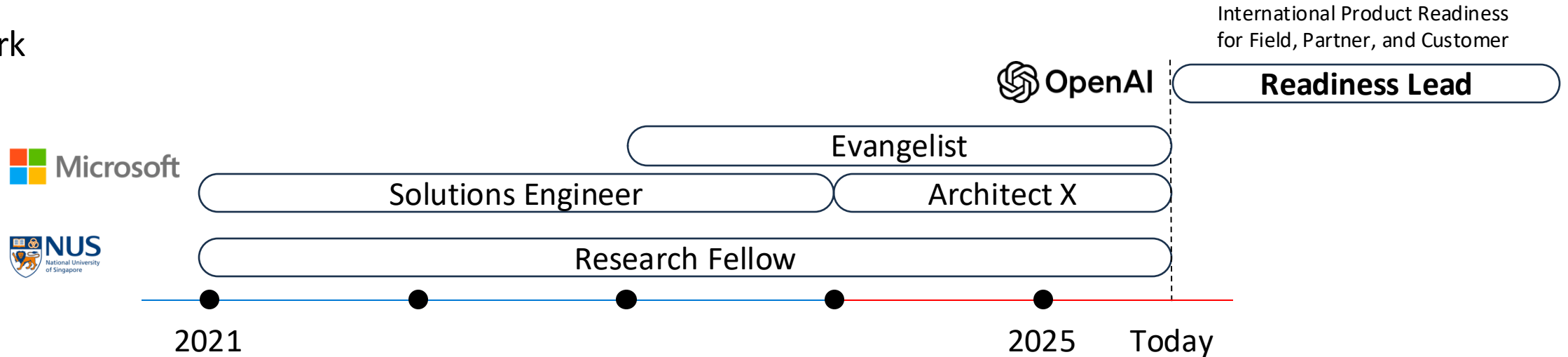
## Research (Human Dynamics)



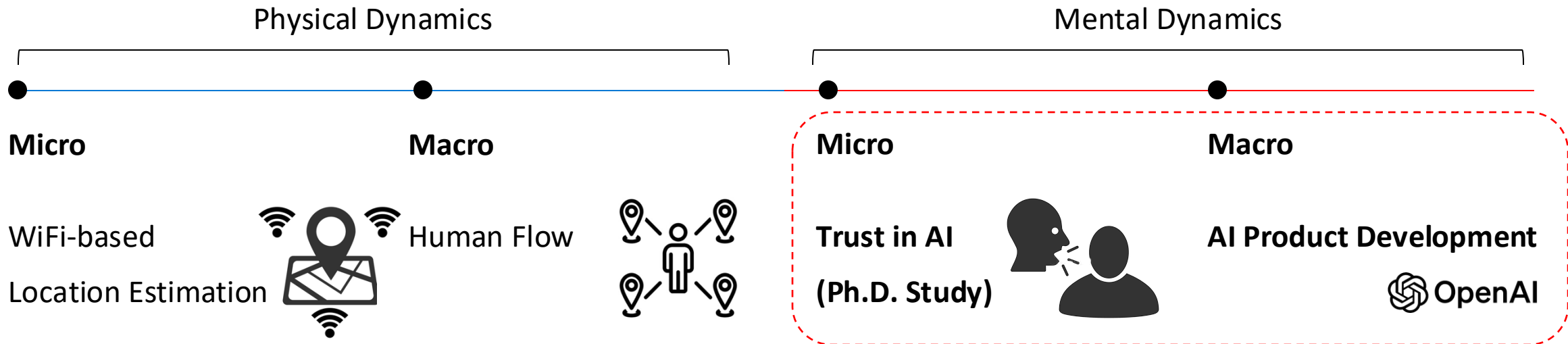
# Kohei Yamamoto

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## Work



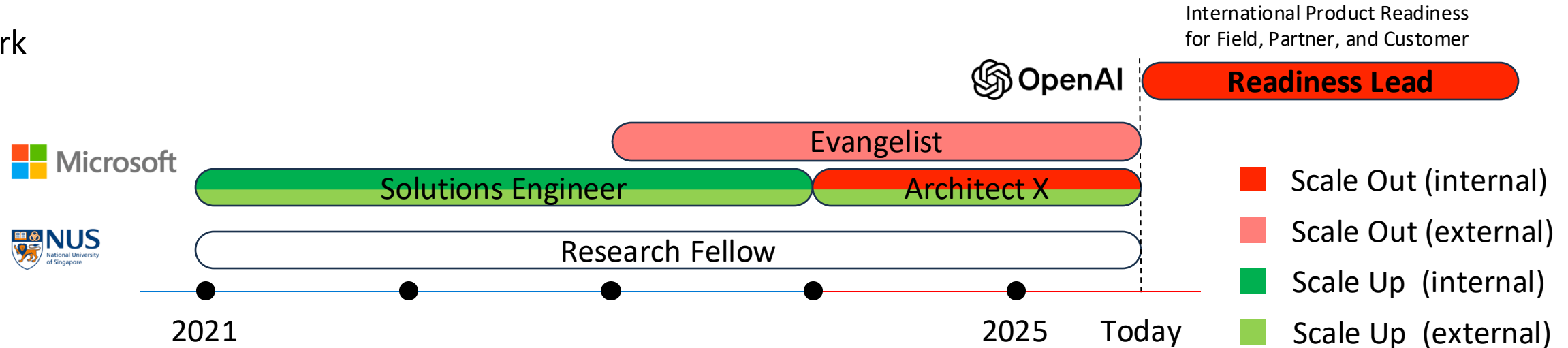
## Research (Human Dynamics)



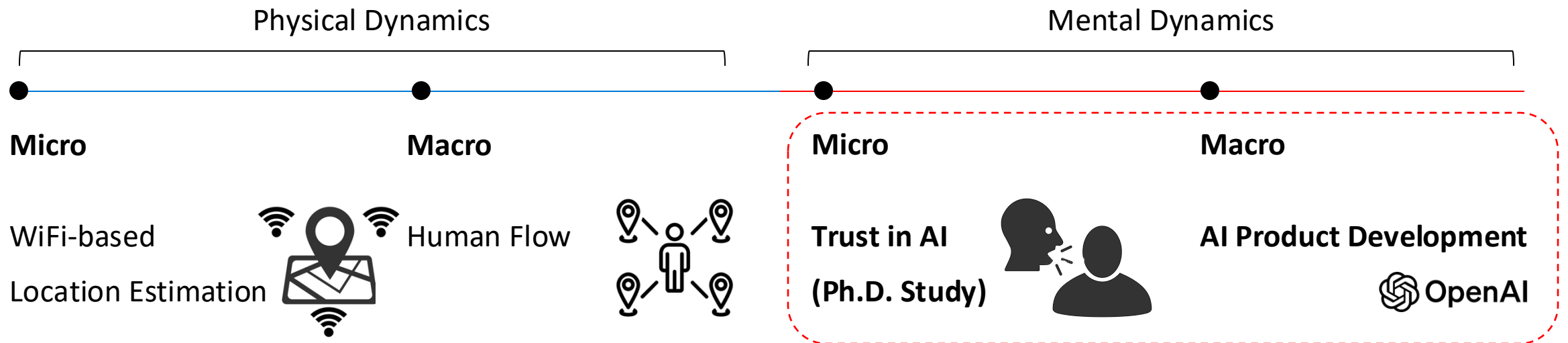
# Kohei Yamamoto

Readiness Lead at OpenAI | Ph.D. Student (Cognitive Informatics)

## Work



## Research (Human Dynamics)



## Juxtaposing Individual and Group Mobility from Sparse WiFi Signatures with Cloud-Assisted Computing ~ Transforming Juxtaposed Mobility Framework into Cloud-Native Solution ~

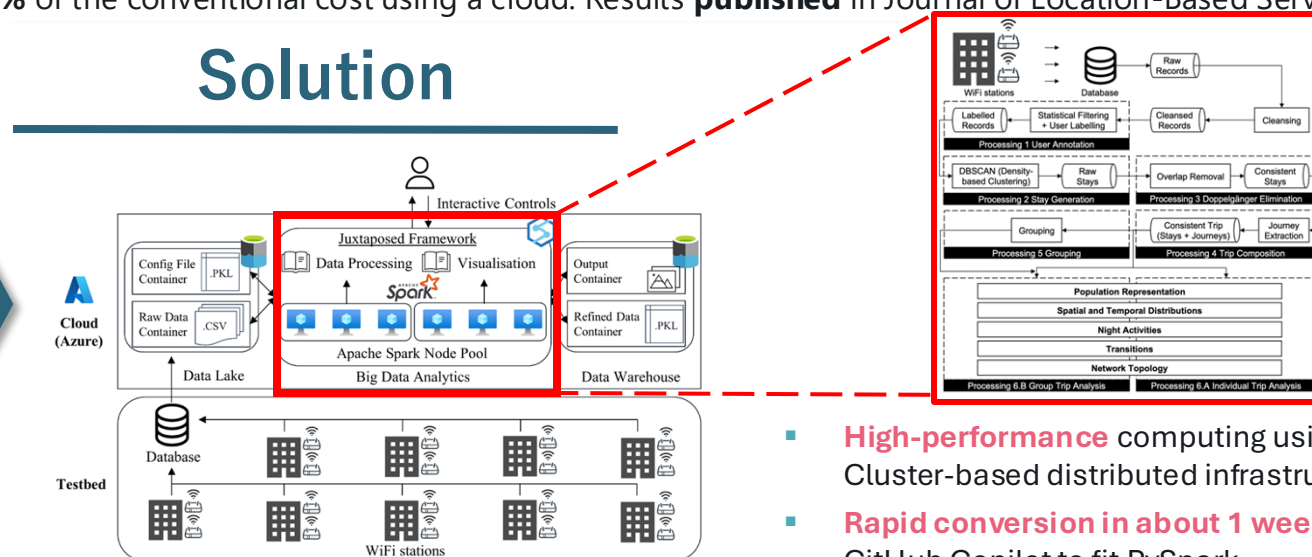
Kohei Yamamoto (Microsoft), Zhou Guo (Sun Yat-sen University), Chen-Chieh Feng (NUS; National University of Singapore)

Proposed a **juxtaposed analysis framework** on human mobility. Spatiotemporal patterns of individuals and groups from WiFi connections are investigated while **compressing the computation time to about 6%** of the conventional cost using a cloud. Results **published** in Journal of Location-Based Services.

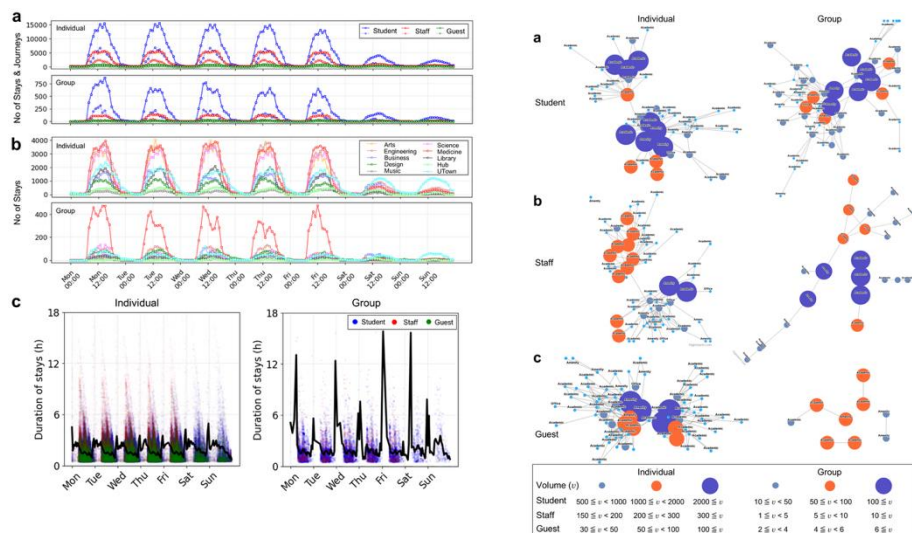
# Challenge

- Increased focus on **human mobility** after COVID-19 pandemic.
- Empirical **juxtaposed analysis** of individual and group mobility is still scarce.
- Testing the framework using WiFi histories spans **several days**
  - Heterogeneity between **individuals and groups**?
  - Variations among **different attributes**?
  - **Computation optimisation** on cloud-assisted infrastructure

## Solution



- **High-performance** computing using Spark Cluster-based distributed infrastructure.
- **Rapid conversion in about 1 week** using GitHub Copilot to fit PySpark.



## Agility

## Scalability

## Performance

# Benefit

- Implemented **scalably** on a big data platform
- Compressed cost spanning 2-3 days to **2-3 hours**
- Investigating 100M records from 46K people on **NUS** campus, proved **the validity of juxtaposed framework** in a **real-world** scenario.
- Suggested the **practicality** of cloud architecture
- **Published** in **Journal of Location-Based Services**

## User Voice

*"It proposes a novel framework utilising Wi-Fi and Geo-spatial technology to analyse both individual and group mobility dynamics, offering valuable insights into human behaviour and mobility patterns with practical applications."*

**Guo Zhou**

**Associate Professor, Sun Yat-Sen University**

*"The Azure-based geospatial framework greatly improved our ability to make sense of human mobility dynamics by offering a computationally efficient means to analyse massive amount of Wi-Fi data."*

**Chen-Chieh Feng**  
**Associate Professor, NUS**

Yamamoto, K., Zhou, G., and Feng, C. 2024. Juxtaposing individual and group mobility from sparse Wi-Fi signatures with cloud-assisted computing: a case study for a multidisciplinary university campus, *Journal of Location Based Services*, 18(2), 205–236. DOI: 10.1080/17489725.2024.2330922

## Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts ~ Transforming ML Framework into Cloud-Native Solution ~

Kohei Yamamoto (Microsoft), Joie Lim (NUS; National University of Singapore), Filip Biljecki (NUS), Rudi Stouffs (NUS)

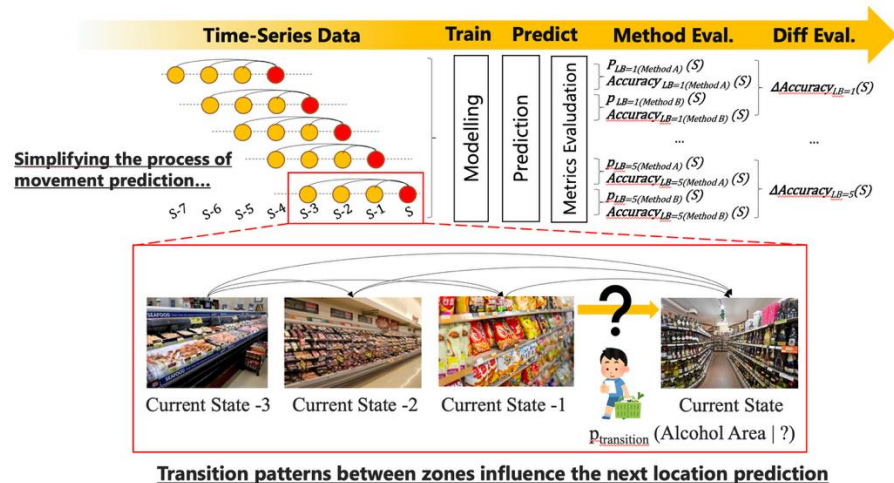
Approximately **60 times more efficient** in total computation time for machine learning parameter sets.

**Swiftly executed hypothesis validation** in academic institutions using **cloud-native architecture**, leading to **paper acceptance and presentation at IEEE**.

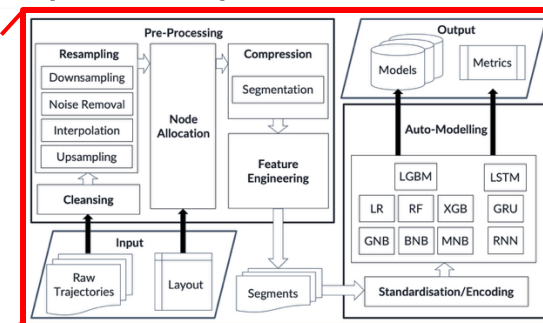
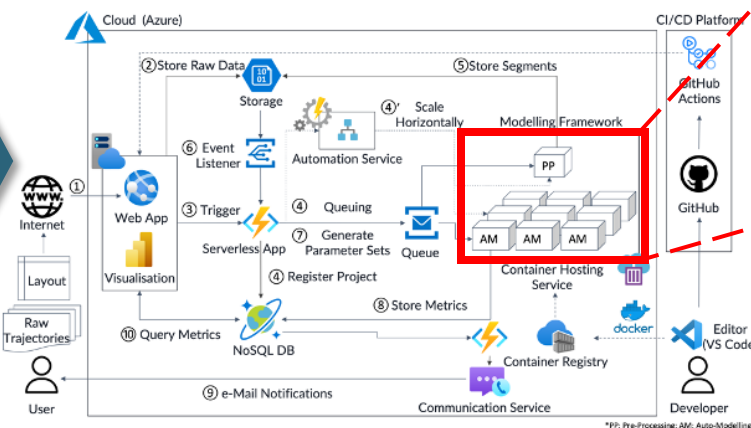
**Submitted to an international journal of cloud.**

## Challenge

- Increased focus on **individual movement predictions** due to the COVID-19 pandemic.
- Approximately **one week or less of computational cost** for iterative hypothesis testing of nearly 10,000 parameter sets:
  - How much past information should be incorporated?
  - How much difference will there be among methods?
  - How much difference will there be in feature importance?



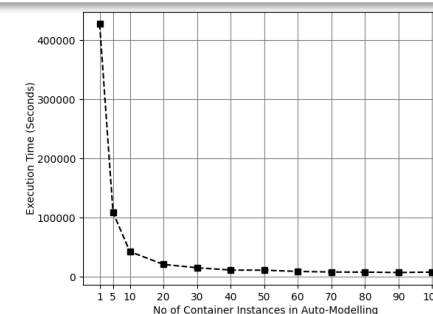
## Solution



- **Containerised** modelling framework and **parallelised** executions.
- **Rapid implementation in about 1 month** using serverless applications (Functions) and GitHub Copilot.

## Benefit

- Implemented **quickly and scalably** using PaaS.
- Compressed weekly computational costs to **1-2 hours**.
- Tested hypotheses using data from a supermarket within **Tsinghua University (China)**, **suggesting the practicality of the modelling framework and cloud architecture**.
- Academic **paper accepted at IEEE & presented in India**.
- Currently submitting to an **international journal in the field of cloud computing**.



## User Voice

*“Leveraging cloud technology in research and education enables the tackling of more computationally challenging tasks, leading to new opportunities.”*

**Rudi Stouffs**  
*Associate Professor & Assistant Dean, NUS*



K. Yamamoto, J. Lim, F. Biljecki and R. Stouffs, "Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts," 2023 13th International Conference on Cloud Computing, Data Science & Engineering, Noida, India, 2023, pp. 87-91.



# Juxtaposing Individual and Group Mobility from Sparse WiFi Signatures with Cloud-Assisted Computing ～ 個人と集団移動における並置解析フレームワークのクラウドネイティブ化 ～

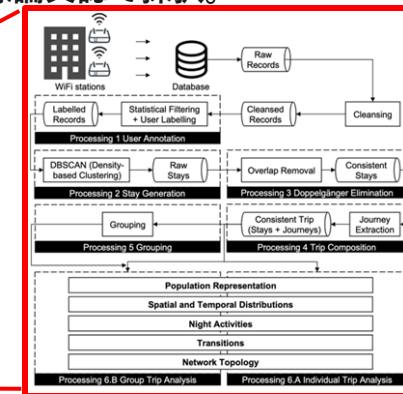
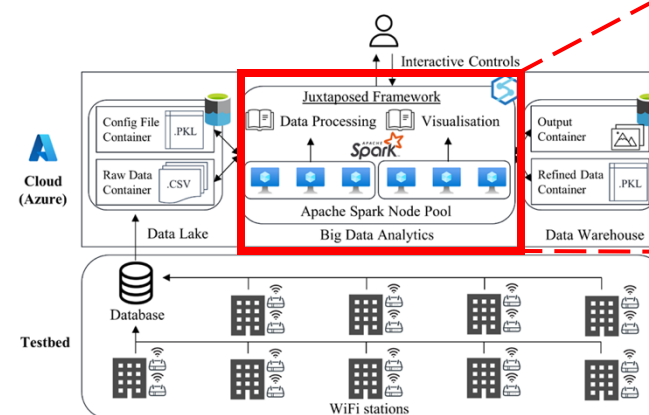
Kohei Yamamoto (マイクロソフト), Zhou Guo (中山大学), Chen-Chieh Feng (シンガポール国立大学)

膨大な WiFi の接続履歴から、個人と集団の時空間におけるパターン解析の総計算コストを従来の約 6 %までに圧縮。  
クラウドネイティブな並置解析フレームワークを提唱。学術機関での仮説検証を迅速に実行し、位置情報に関する国際論文誌で採択。

## Challenge

- コロナ禍もあり人の移動予測が大きく注目
- 個人と集団移動での実証的並置解析はまだ乏しい
- フレームワークは数日に及ぶ計算コストが発生
  - 仮説1: WiFi 接続履歴で個人と集団の異質性検証
  - 仮説2: 属性間での変異を検証
  - 仮説3: クラウド基盤での計算による計算効率化

## Solution



- 分析フレームワークを Spark Cluster ベースの分散基盤で高速解析
- GitHub Copilot の活用により隙間時間約1週間でコード変換・実装

Agility

Scalability

Performance

## Benefit

- ビッグデータ分析基盤でスケラブルに実装
- 数日をまたぐ計算コストが2~3時間に圧縮
- シンガポール国立大学キャンパスの4.6万人1億超レコードで仮説を検証し、個人と集団の並置解析フレームワークの妥当性を実証環境で証明
- クラウドアーキテクチャの実用性を示唆
- 位置情報専門の国際論文誌で採択

### User Voice

"It proposes a novel framework utilising Wi-Fi and Geo-spatial technology to analyse both individual and group mobility dynamics, offering valuable insights into human behaviour and mobility patterns with practical applications."

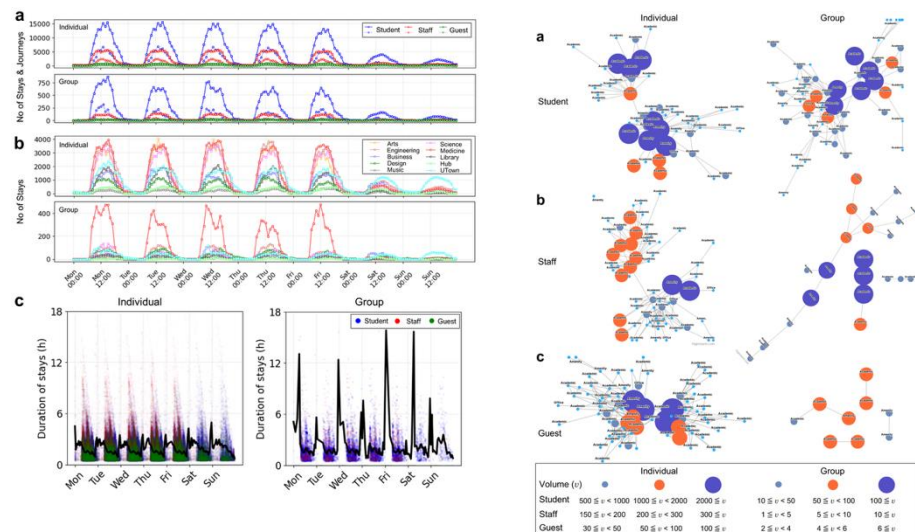
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"The Azure-based geospatial framework greatly improved our ability to make sense of human mobility dynamics by offering a computationally efficient means to analyse massive amount of Wi-Fi data."

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Yamamoto, K., Zhou, G., and Feng, C. 2024. Juxtaposing individual and group mobility from sparse Wi-Fi signatures with cloud-assisted computing: a case study for a multidisciplinary university campus, Journal of Location Based Services, 18(2), 205–236. DOI: 10.1080/17489725.2024.2330922



# Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts ～ 機械学習フレームワークのクラウドネイティブ化 ～

Kohei Yamamoto (マイクロソフト), Joie Lim (NUS; シンガポール国立大学), Filip Biljecki (NUS), Rudi Stouffs (NUS)

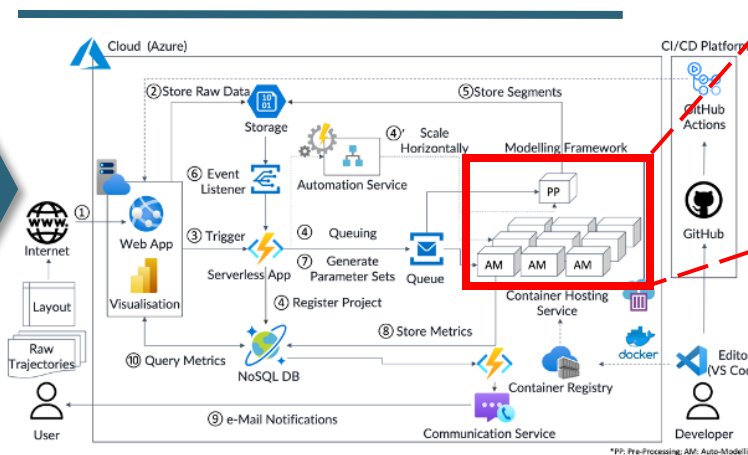
機械学習パラメータセット総計算時間を約60倍効率化。

クラウドネイティブなアーキテクチャで学術機関での仮説検証を迅速に実行し、IEEEにて学術論文採択・登壇。クラウドの国際論文誌に提出。

## Challenge

- コロナ禍もあり個人の移動予測が大きく注目
- 1万弱パラメータセットの反復的な仮説検証に1週間弱の計算コストが発生
  - 仮説1: どれほど過去情報を畳み込むべきか
  - 仮説2: 手法間でどれくらい差が出るか
  - 仮説3: 特徴量でどれくらい差が出るか

## Solution



- 分析フレームワークをコンテナ化・並列モジュール化
- サーバレス型のアプリ (Functions) や GitHub Copilot の活用により隙間時間約1ヶ月で迅速に実装

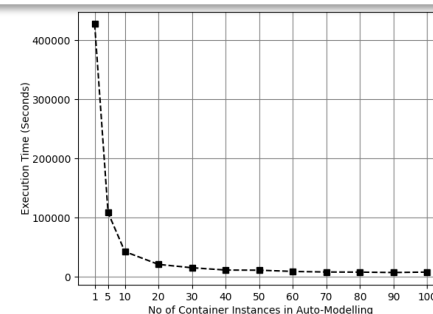
Agility

Scalability

Reliability

## Benefit

- PaaS の組み合わせで迅速かつスケーラブルに実装
- 週レベルの計算コストが1~2時間に圧縮
- 清華大学 (中国) 構内のスーパーマーケットのデータで仮説を検証し、分析フレームワークおよびクラウドアーキテクチャの実用性を示唆
- IEEEにて学術論文採択 & インドで登壇
- クラウド分野の国際論文誌への投稿中



### User Voice

"Leveraging cloud technology in research and education enables the tackling of more computationally challenging tasks, leading to new opportunities."

Rudi Stouffs  
Associate Professor & Assistant Dean, NUS

移動予測のプロセスを単純化してみると、



ゾーン間の遷移パターンは買い物客が次に行きそうな場所の予測に影響！

K. Yamamoto, J. Lim, F. Biljecki and R. Stouffs, "Analytical Framework in Cloud-Native Environments for Auto-Modelling Sparse Human Mobility Considering Memory of Past Contexts," 2023 13th International Conference on Cloud Computing, Data Science & Engineering, Noida, India, 2023, pp. 87-91.

