TPG's Journey in Singapore

Agenda:

- Introduction of TPG
- IMDA Quality of Service (QoS)
- Milestones and Achievements
- Challenges Overcome
- Network Quality Vision

TPG TELECOM

Introduction of TPG

- 2nd largest fixed voice and data network in Australia with 27,000km+ of metropolitan and inter-capital fibre
- Listed in ASX with Enterprise Value of ~A$8.0Bn
- 4th full service mobile operator in Singapore
- Offering free service trial since 21st Dec 2018
  - Unlimited data with 2GB daily FUP
  - Free unlimited calls to any local mobile number
  - Unlimited data and voice roaming to Malaysia and Indonesia
  - Response to launch has exceeded TPG's expectations

TPG TELECOM

Introduction of TPG

- LTE Spectrum Info
  - FDD900 (10M) as coverage layer
  - TDD2300 (40M) as capacity layer
  - TDD2500 (10M) as capacity layer

- Technology
  - Whole networkwide 4T4R & 256QAM
  - Massive MIMO AAU
  - 3CC CA

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IMDA Quality of Service (QoS)

- LTE coverage requirement and timelines set out by IMDA

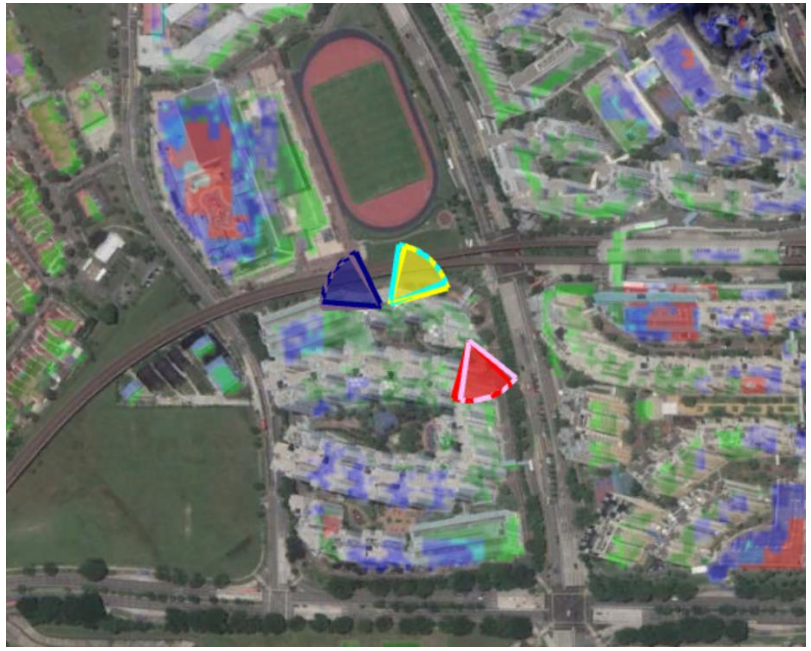
Performance Indicators (For Compliance)	QoS Standard	Effective Date
Data Service Coverage (signal strength -109 dBm or better)		
a) Nationwide Outdoor Service Coverage	>95% >99%	From 1 January 2019 From 1 January 2020
b) Road/MRT Tunnels Service Coverage	>99%	From 1 January 2020 (Road tunnels) From 1 January 2022 (MRT tunnels)
c) In-building Service Coverage	>85%	From 1 January 2020

Accurate Radio Planning

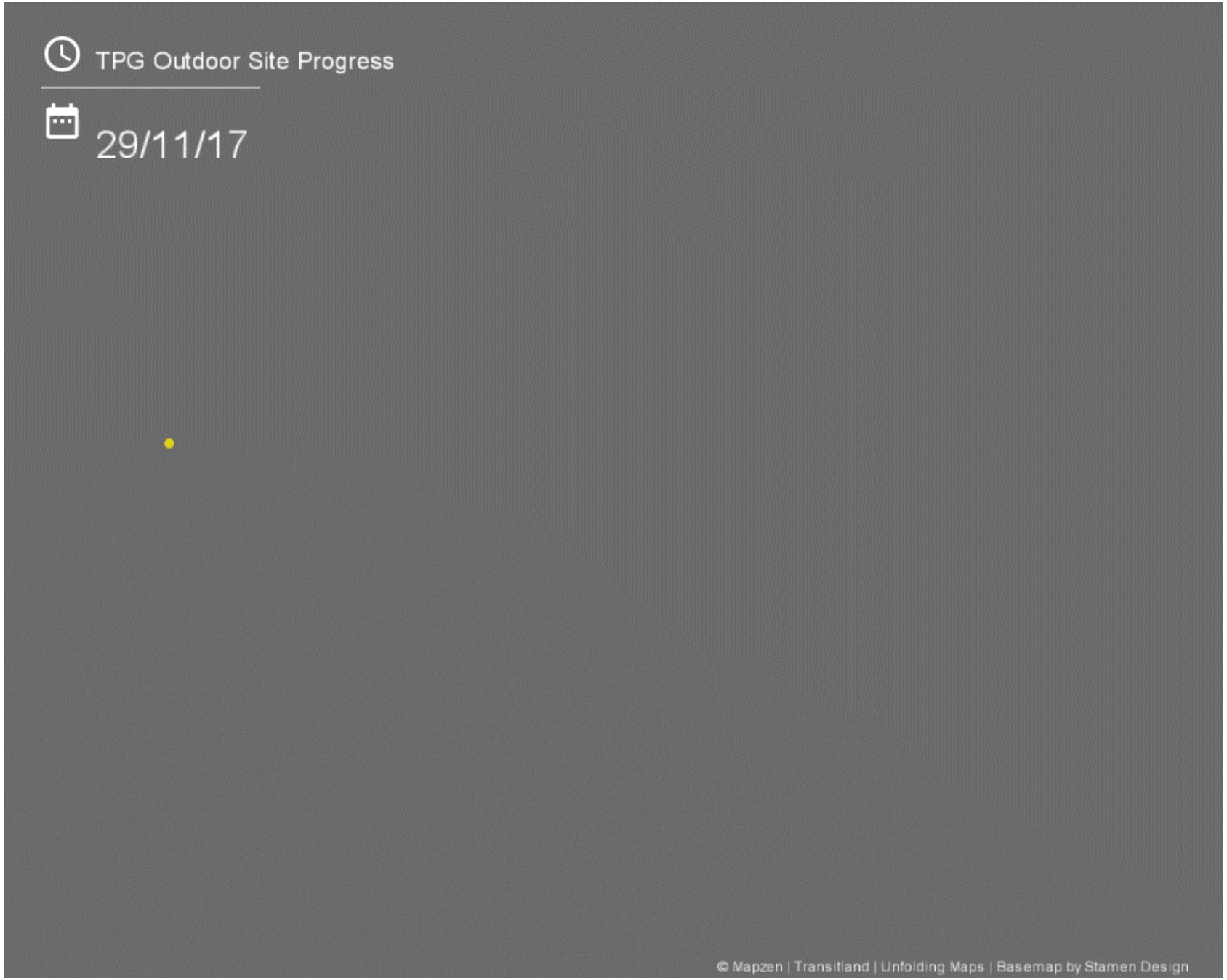
- 3D ray-tracing model

Outdoor

Indoor



TRG TELECOM



Outdoor Build

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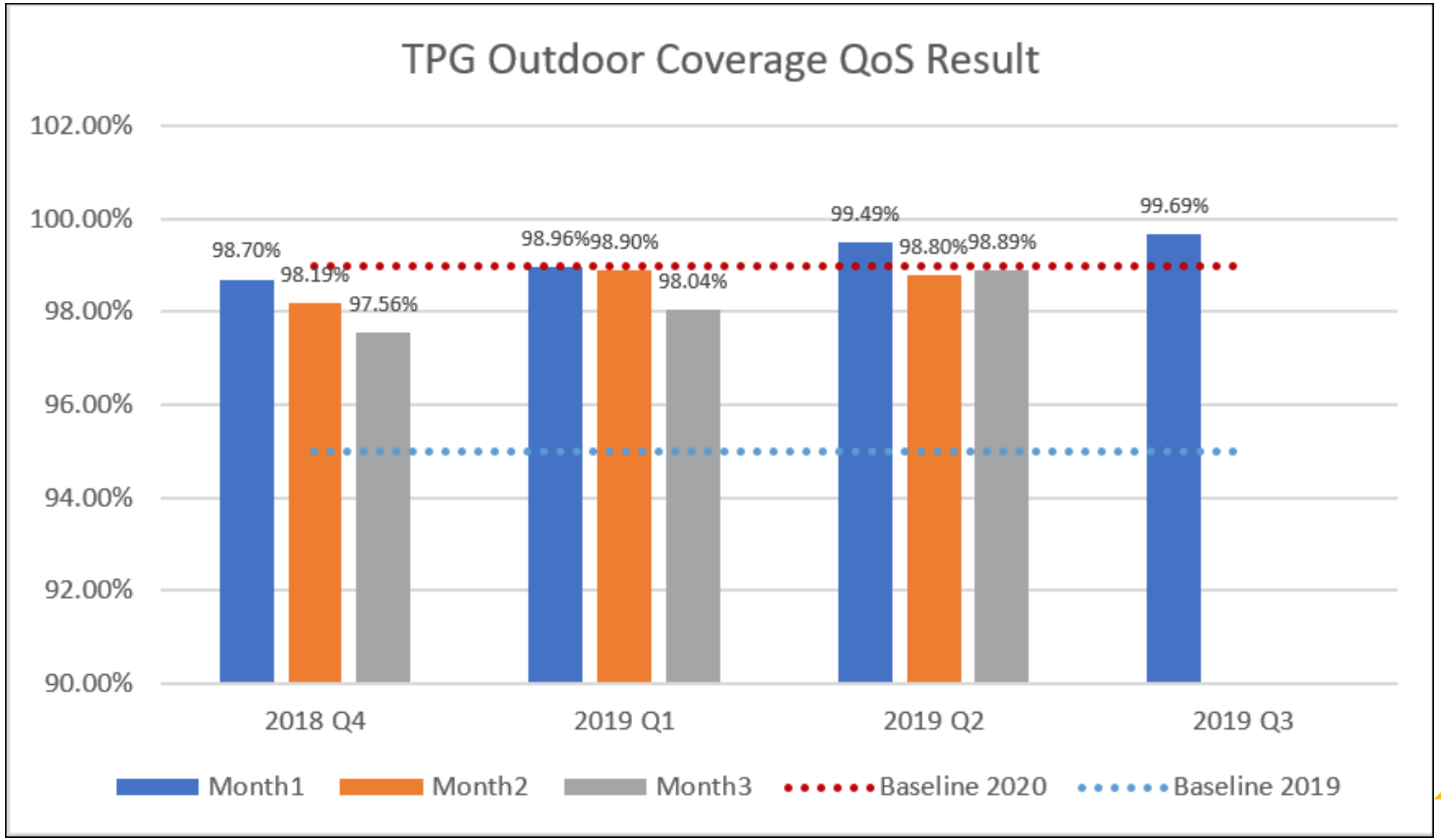
TPG Outdoor Coverage QoS Result
102.00%
100.00%
98.00%
96.00%
94.00%
92.00%
90.00%
98.70%
98.19%
97.56%
98.96%
98.90%
98.04%
99.49%
98.80%
98.89%
99.69%
2018 Q4
2019 Q1
2019 Q2
2019 Q3
Month1
Month2
Month3
Baseline 2020
Baseline 2019

Indoor Coverage Validation

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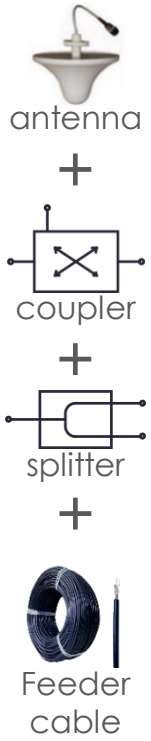
TPG Active Indoor System

Other MNOs: Using DAS Infra



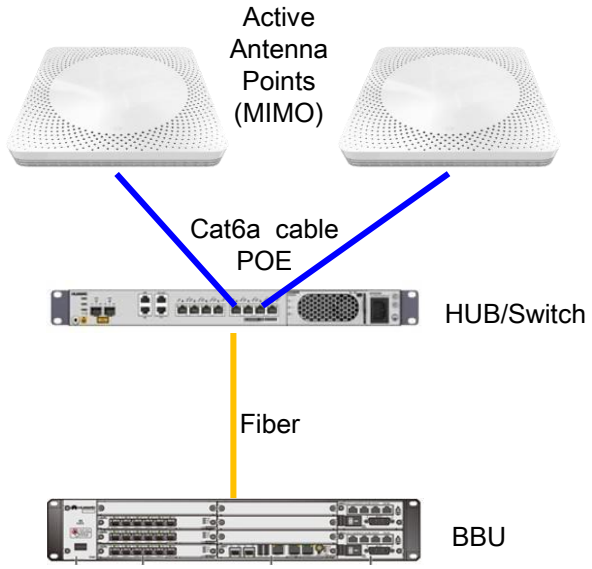
Issues:

- Analog
- No Frequency Support @ 3.5GHz
- No MIMO

Outcome:

- Poor performance
  - Low peak speed
  - Low capacity
- No upgrade path to 5G

TPG's Indoor System



Digital Indoor System (DIS)

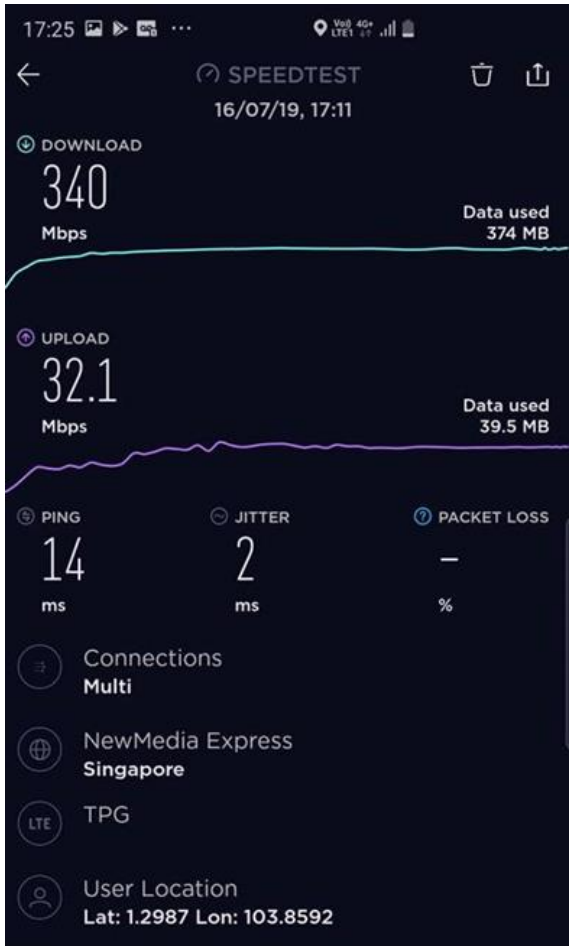
Infrastruture:

- Digital
- LAN + Fiber
- 2x2 MIMO, 256QAM

Benefits:

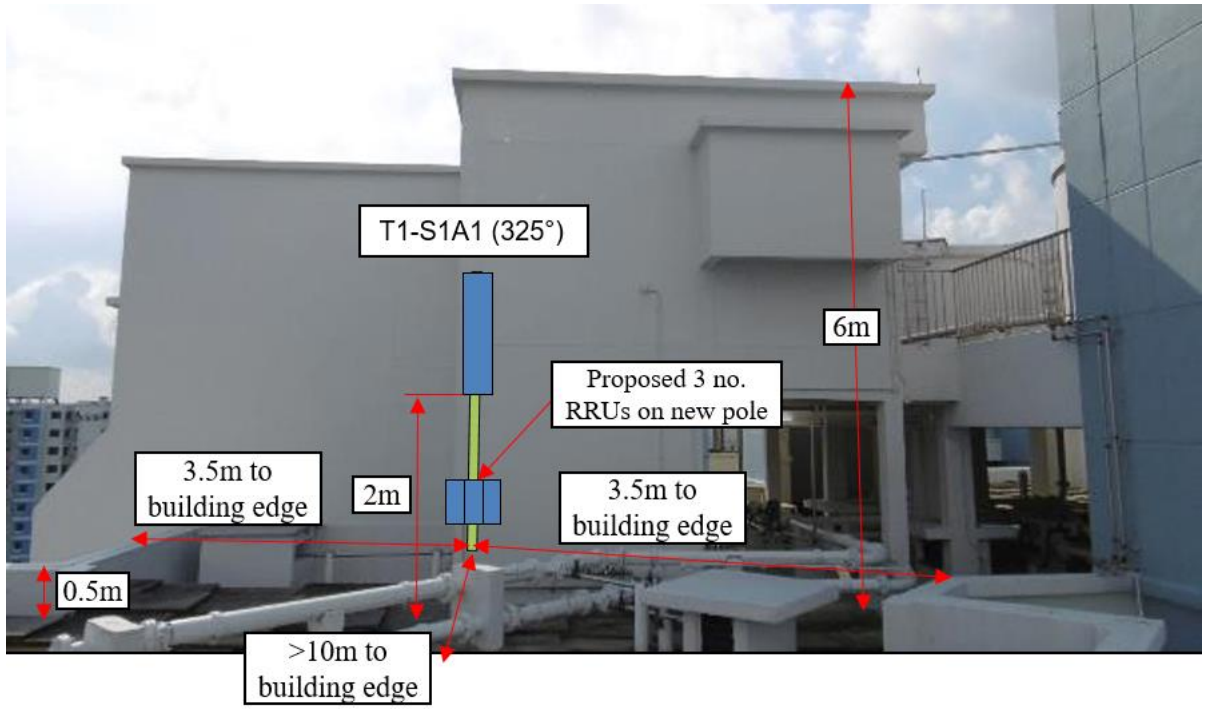
- High performance
  - Faster speeds
  - Large capacity
- Simple upgrade to 5G

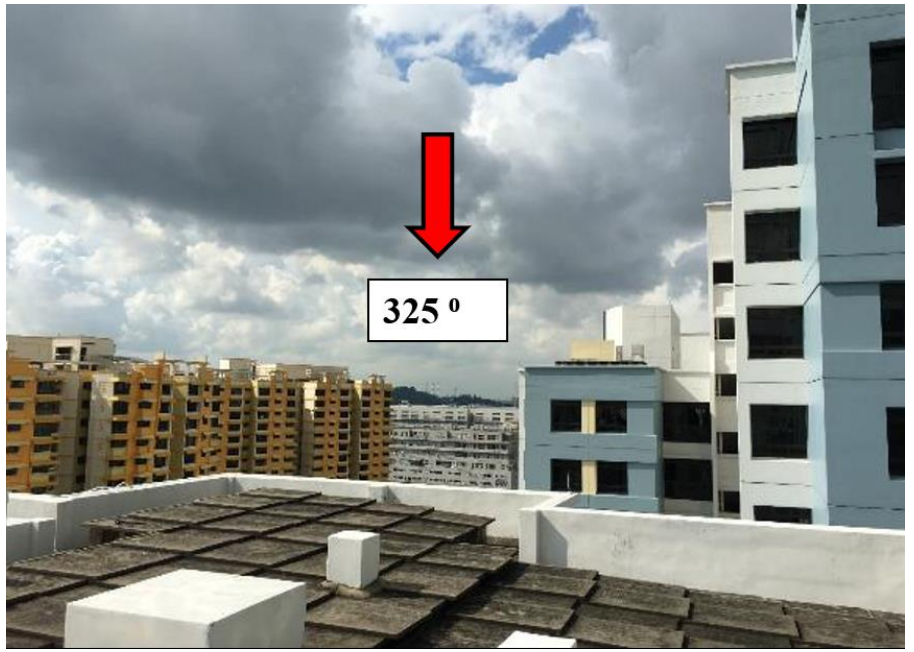
Indoor System Examples



Challenges – Roof Top Setup

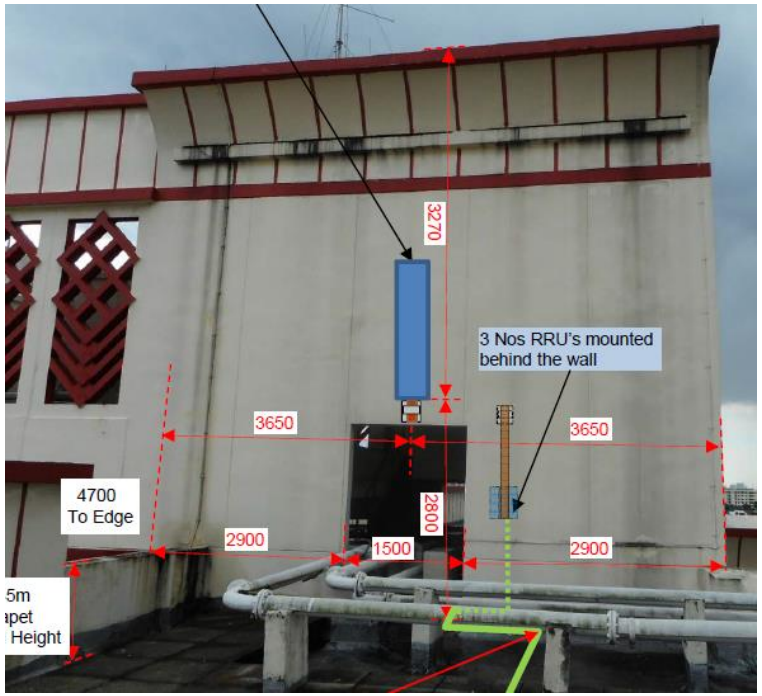
- Over 80% of Singaporeans live in HDB flats
  - Safety (Setback & shadowing) issue

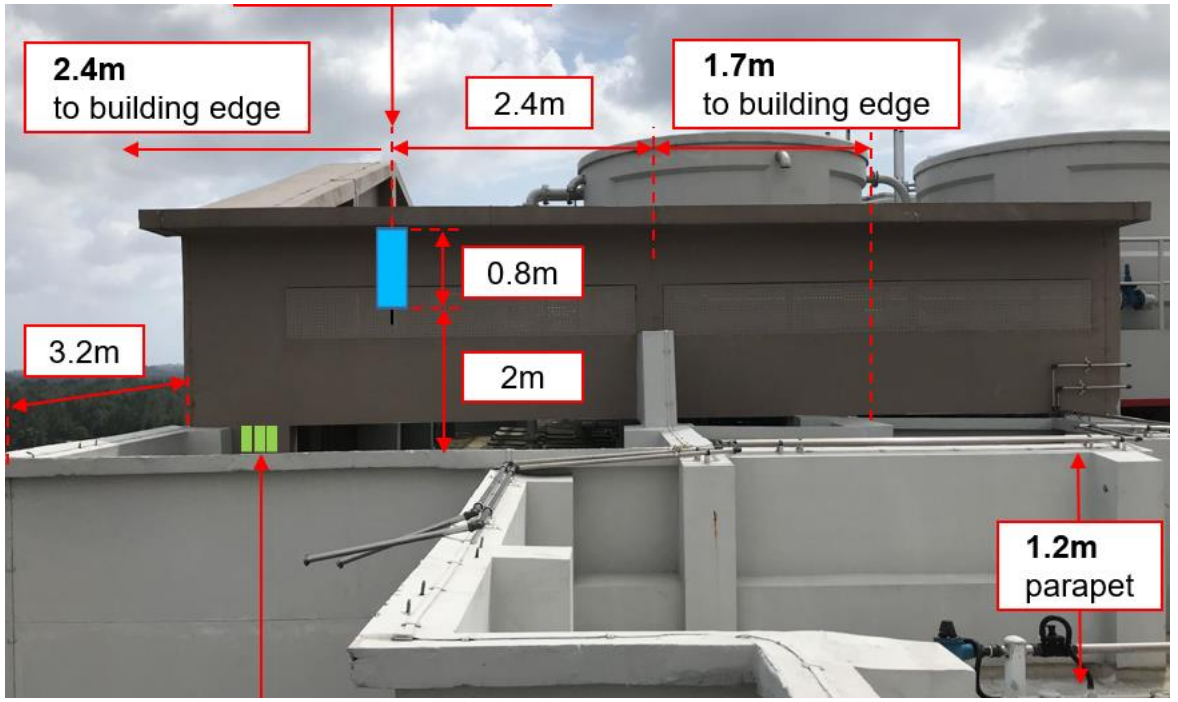




Challenges – Roof Top Setup

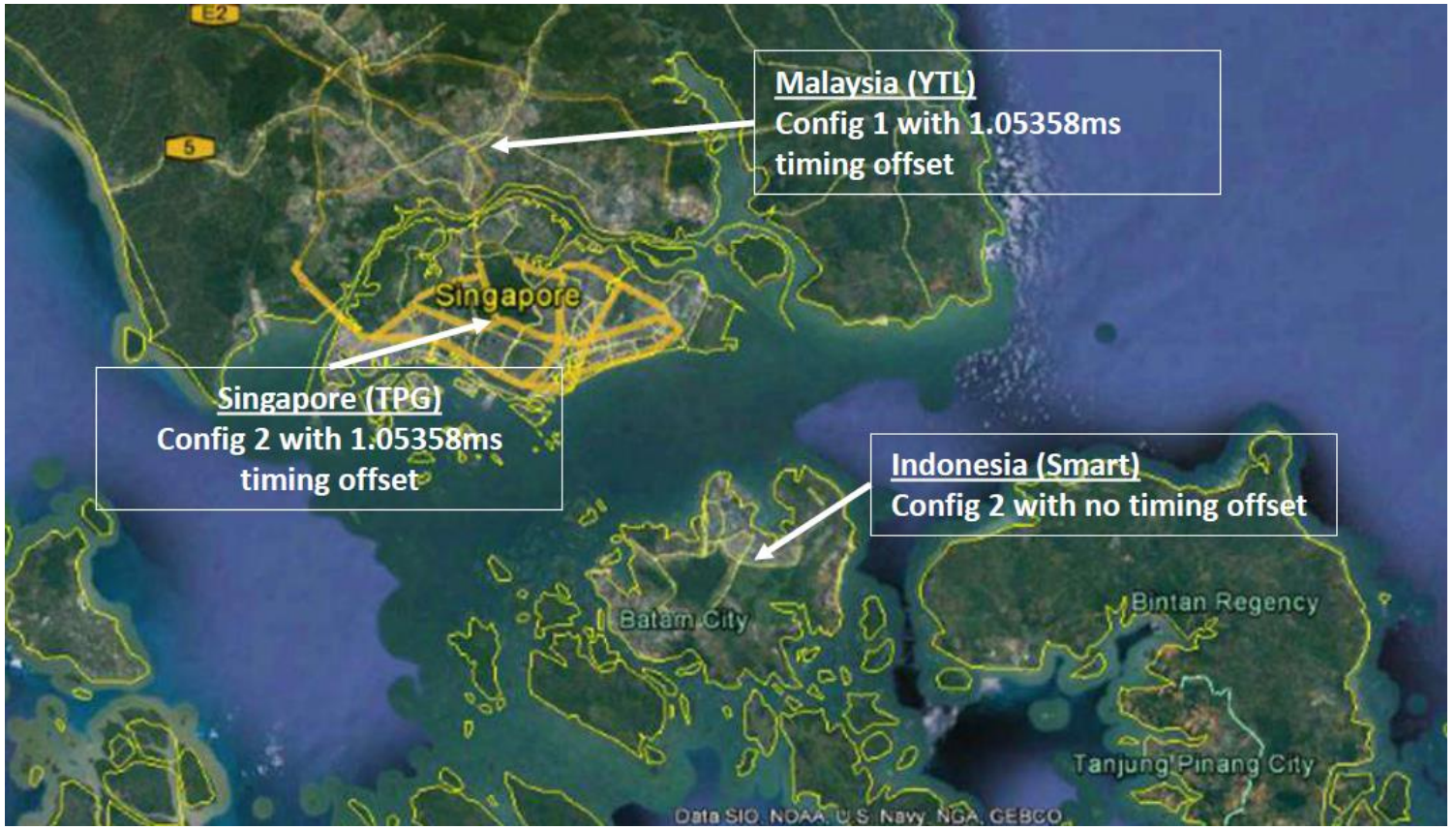
- Over 80% of Singaporeans live in HDB flats
  - Aesthetic (Feature wall) issue





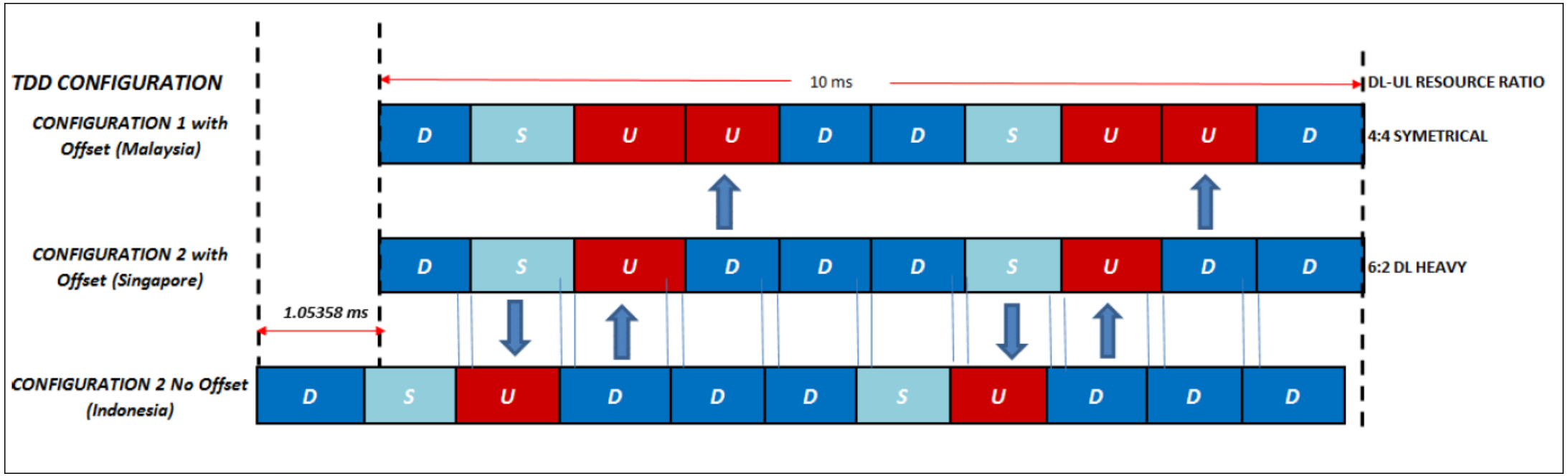
Challenges – TDD Interference

- Singapore is in-between Malaysia & Indonesia
- Harmonisation of TDD configuration is beneficial for all operators in the region



Challenges – TDD Interference

- Malaysia, Indonesia & Singapore have coordinated a joint meeting to discuss how to synchronize TDD configuration
- All operators agreed that final configuration is Config2 without time offset



Network Quality Vision

- Accurate radio planning
- Meeting IMDA coverage requirement
- Network/cluster level RF optimization
- Network performance KPI optimization
- GEO-based network evaluation and analysis
- QoS/QoE improvement for single user

Thank You