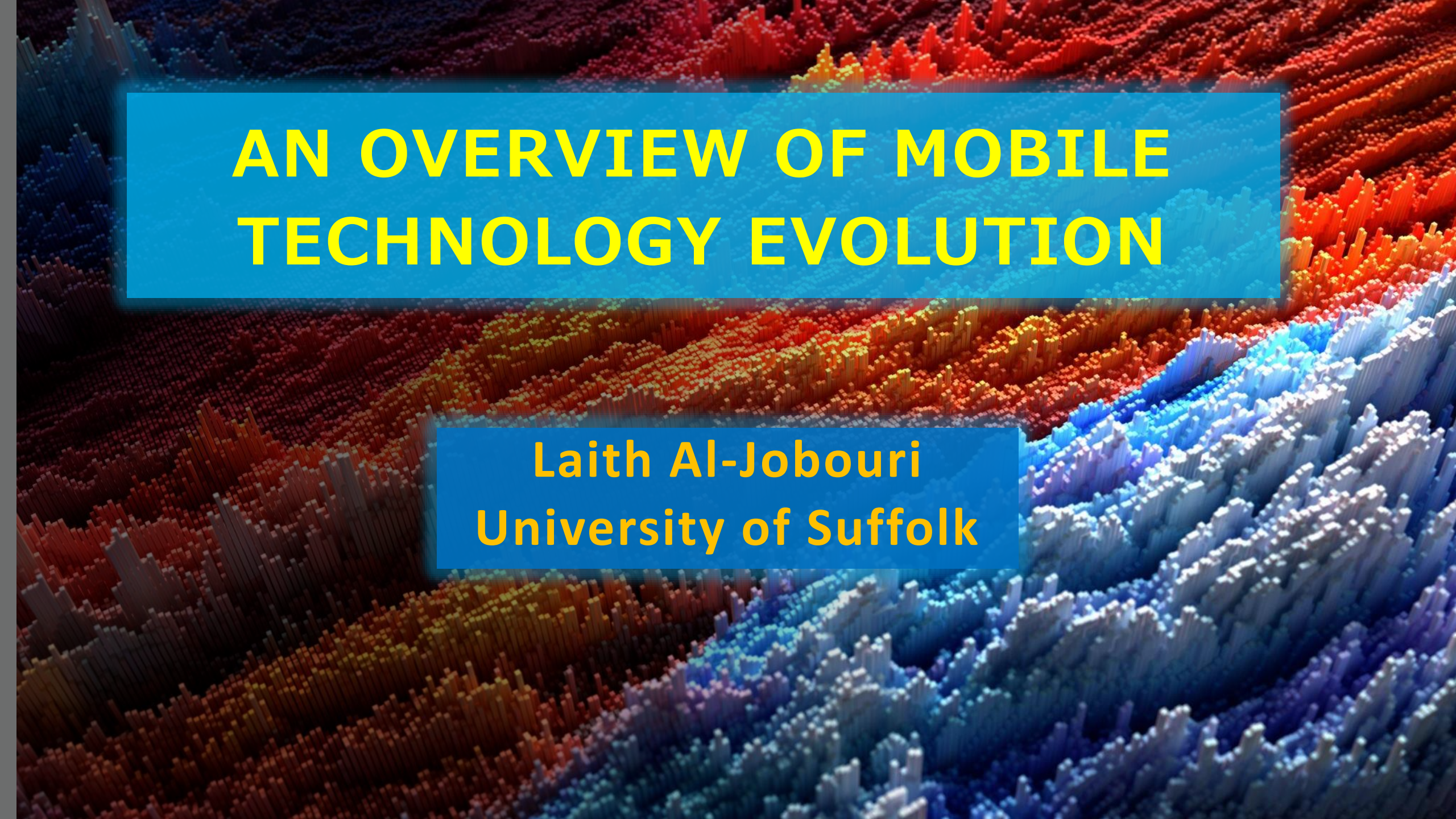




AN OVERVIEW OF MOBILE TECHNOLOGY EVOLUTION

Laith Al-Jobouri
University of Suffolk

Global Market

MOBILE INTERNET USERS



2019-2025
CAGR: 4.6%

2019

3.8bn



49%

2025

5.0bn

Penetration Rate
(% of population)

61%

UNIQUE MOBILE SUBSCRIBERS



2019-2025
CAGR: 1.9%

2019

5.2bn



67%

2025

5.8bn

Penetration Rate
(% of population)

70%

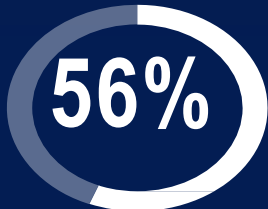
4G

2019



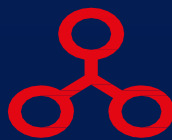
% of connections Excluding licensed cellular IoT

2025



5G

2025



1.8bn
connections

20%

% of total connections
Excluding licensed cellular IoT

INTERNET OF THINGS



2019

12.0bn

Total connections

2025

24.6bn

Total connections

MOBILE INDUSTRY CONTRIBUTION TO GDP



2019

\$4.1tn



of GDP

2024

\$4.9tn



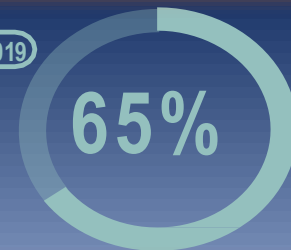
of GDP

SMARTPHONES

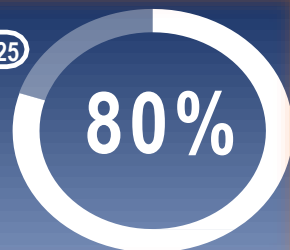
% of connections
Excluding licensed cellular IoT



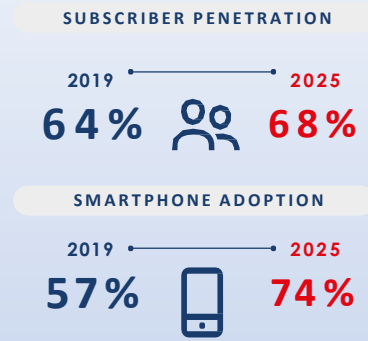
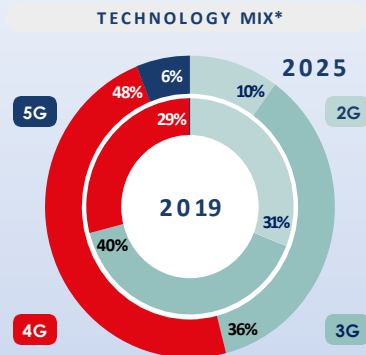
2019



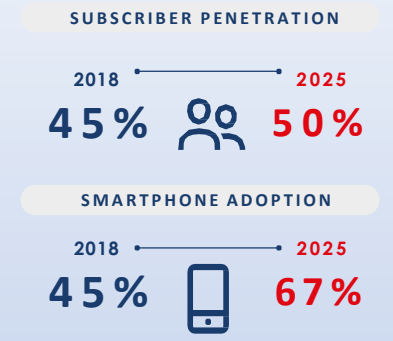
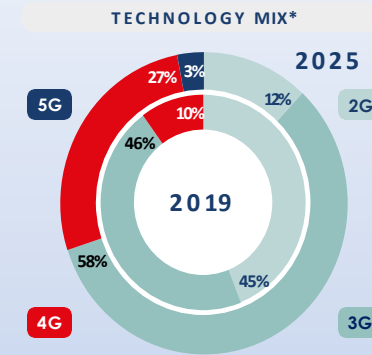
2025



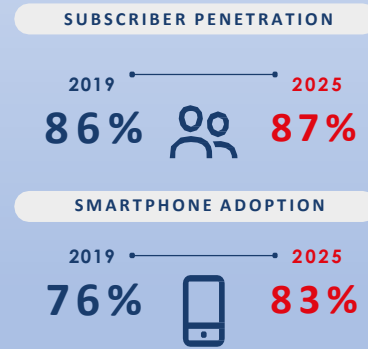
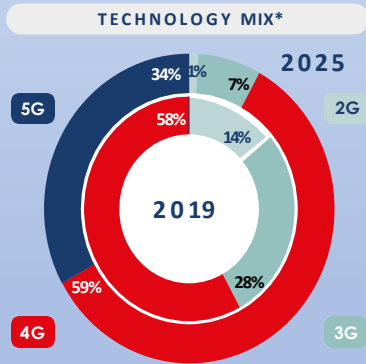
MEN



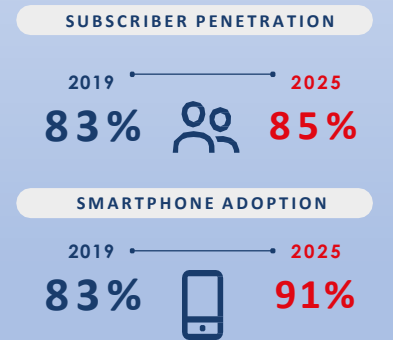
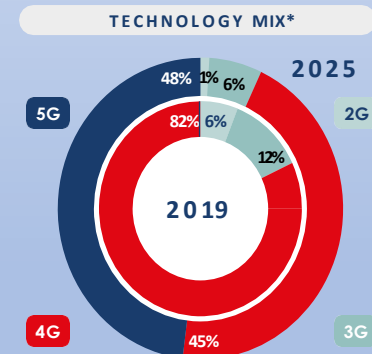
Sub-Saharan Africa



Europ



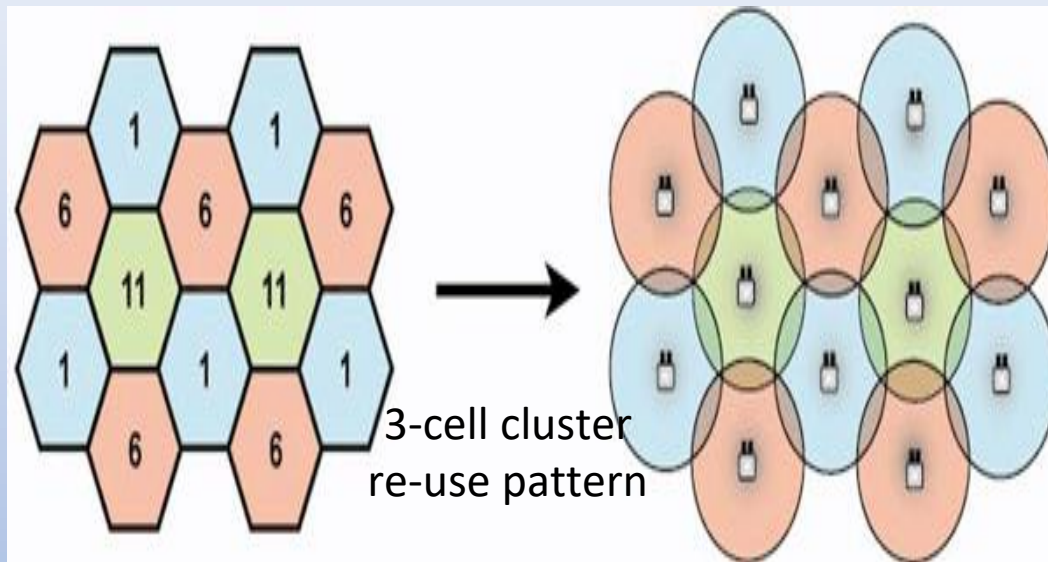
North America



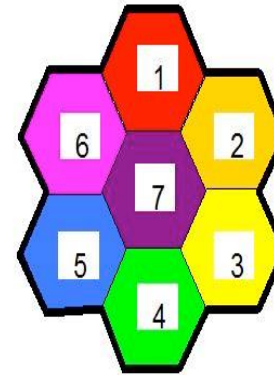


Back to History

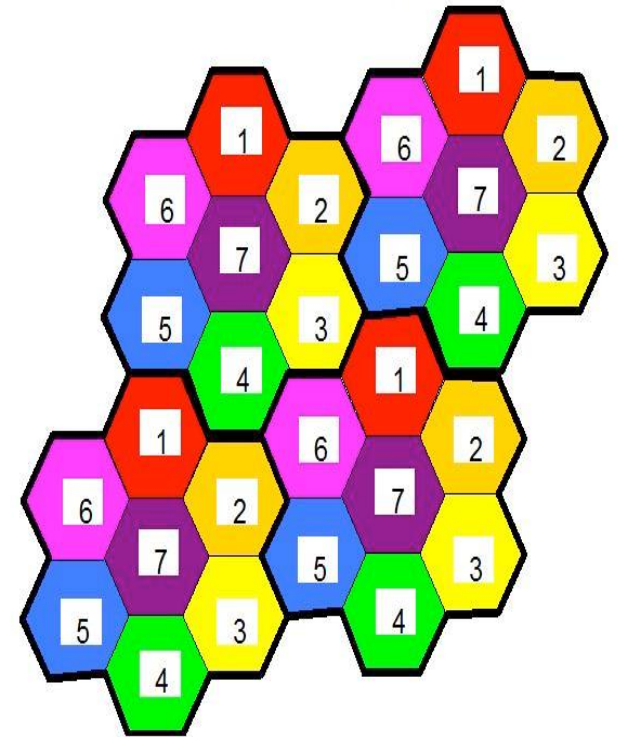
Cell Cluster Re-use Patterns



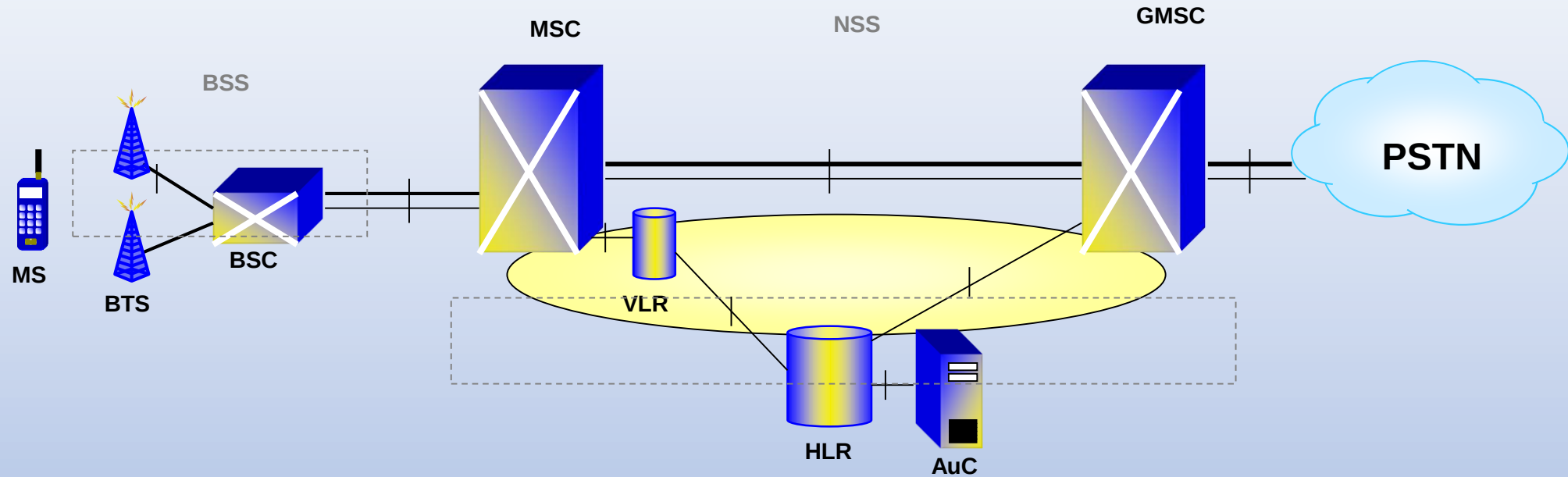
7-cell cluster



Coverage area 'tiled' with 7-cell clusters



1G & 2G Architecture



BSS — Base Station System

BTS — Base Transceiver Station

BSC — Base Station Controller

MS — Mobile Station

NSS — Network Sub-System

MSC — Mobile-service Switching Controller

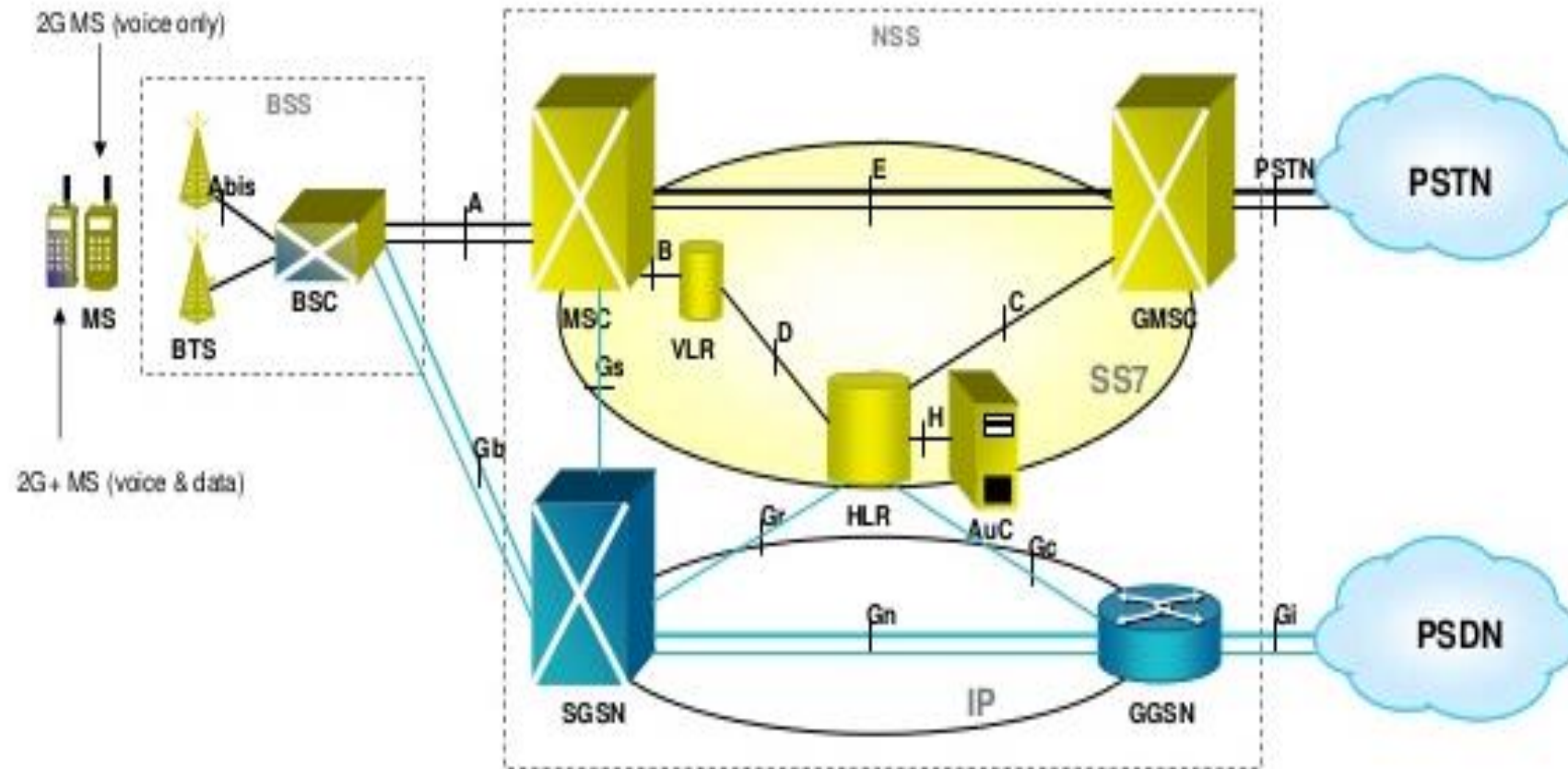
VLR — Visitor Location Register

HLR — Home Location Register

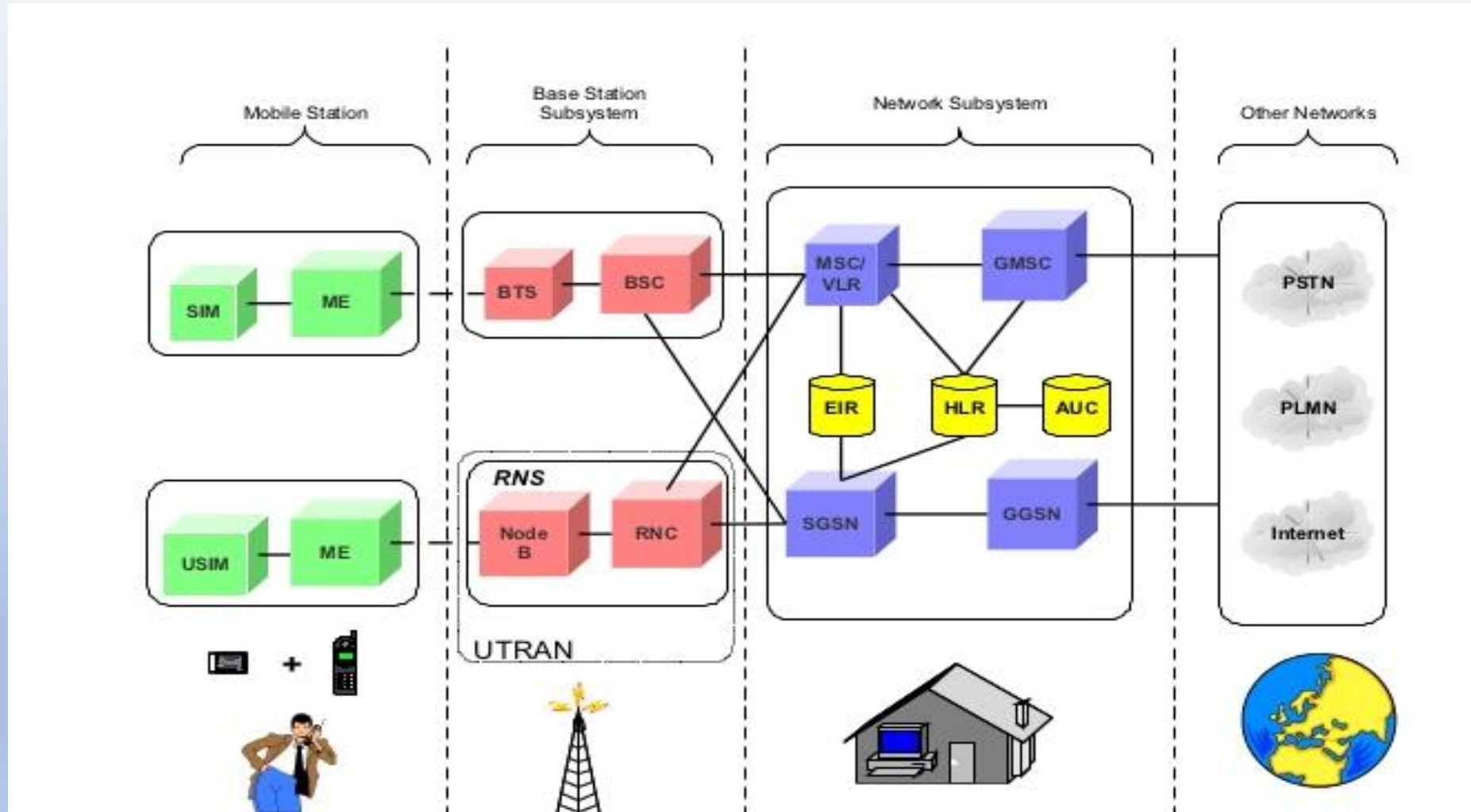
AuC — Authentication Server

GMSC — Gateway MSC

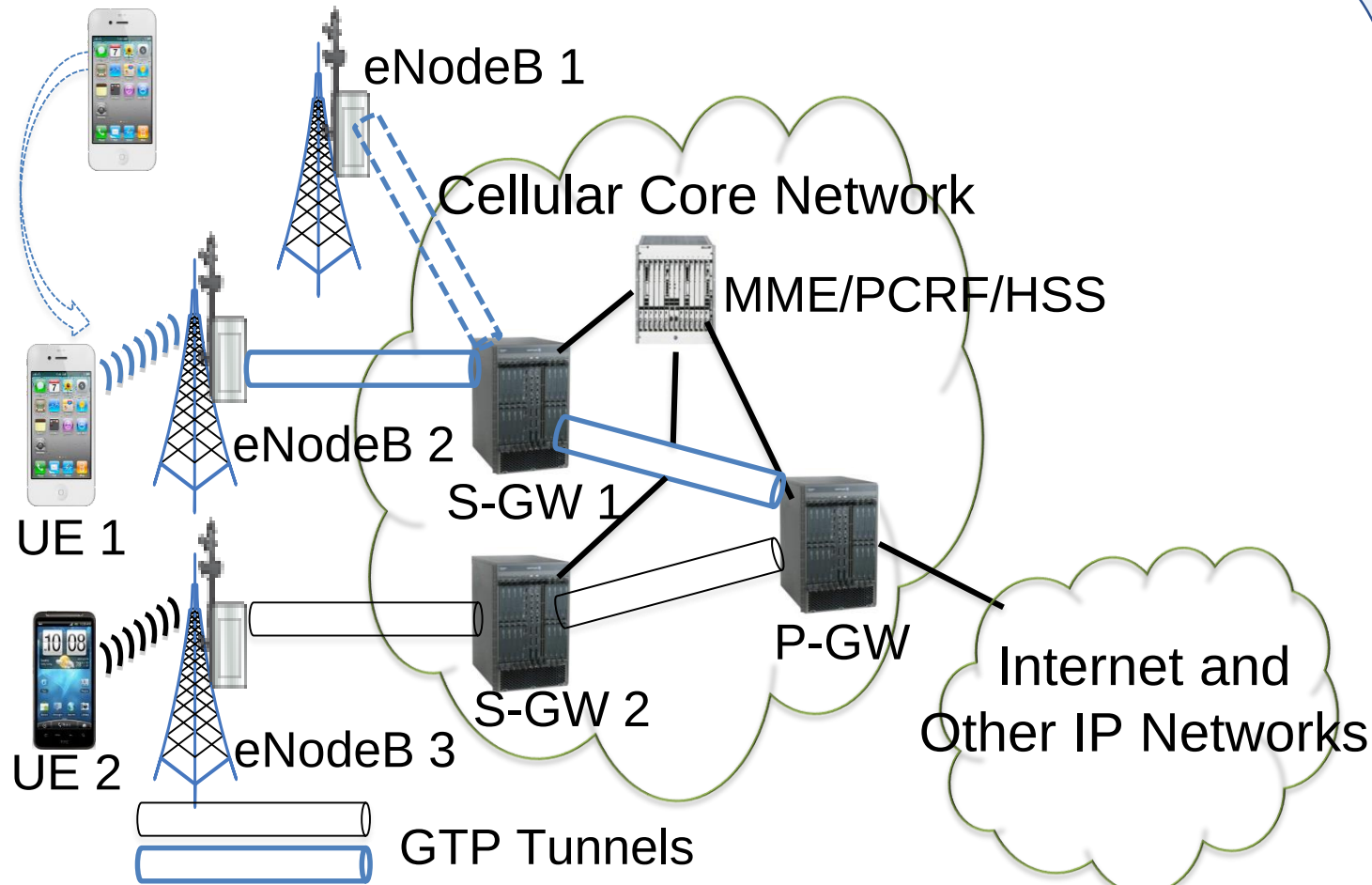
Typical 2.5G Architecture



3G/UMTS Architecture



4G Architecture



- UE: user equipment
- eNodeB: base station
- S-GW: serving gateway
- P-GW: packet data network gateway
- MME: mobility management entity
- HSS: home subscriber server
- PCRF: policy charging and rule function

5G



Low frequency
cells **700 MHz**



High frequency
cells **3.4-3.8 GHz**



Millimetre wave
cells **26 GHz**



Large scale events
Thousands of users

Vehicle communications
Transport infrastructure

Environmental
monitoring &
Smart cities

Transport &
infrastructure

Improved residential
connections,
Smart energy

Up to 10Gbps data rate
10 to 100x improvement
over **4G** and **4.5G** networks



99.999% availability



1 millisecond latency



5G technology
is driven by

8

specification
requirements



coverage

90% reduction in network
energy usage



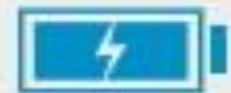
1000x bandwidth per unit area



Up to **100x** number of
connected devices per unit
area (compared with 4G LTE)



Up to **10-year** battery life
for low power IoT device





Human to Human



Human to Machine



Machine to Machine



Virtual Reality/Augmented Reality



Video Calling
Virtual Meetings



Fixed
Wireless



UHD
Video

Video
Monitoring



Mobile Cloud
Computing



Wearables



Social
Networking



Smart Home / Smart Cities



Health Care Monitoring

Vehicle
to
Infrastructure



Industrial
Automation



Public Safety



Remote
Surgery



Vehicle
to
Pedestrian
(V2P)



Vehicle
to
Vehicle
(V2V)



Timo Boll versus KUKA KR AGILUS



KUKA KR AGILUS, FASTEST ROBOT ON EARTH

A word cloud featuring the phrase "Thank You" in numerous languages and scripts. The words are arranged in a circular pattern, with "thank you" in large blue letters at the center. Other prominent words include "gracias" in red, "mercies" in blue, "danke" in orange, and "shukriya" in green. Smaller words like "arigato", "terima kasih", "mochchakkeram", and "maimn" are also visible. The colors of the words vary, including shades of blue, red, green, orange, and purple.