

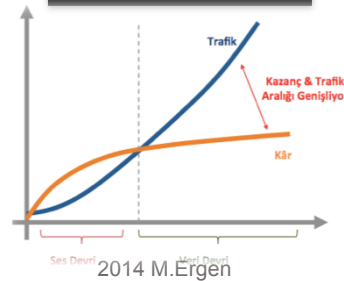
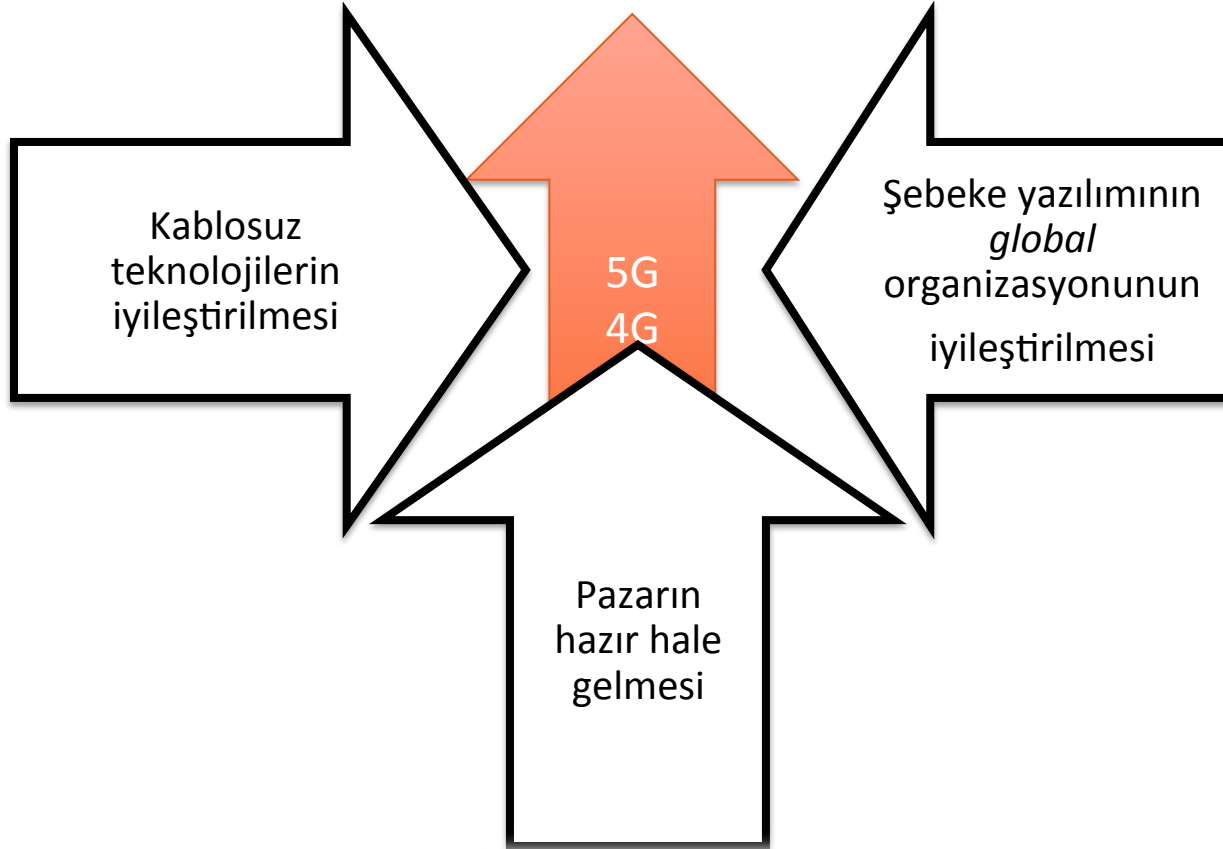
5G gelirken....

Mustafa Ergen

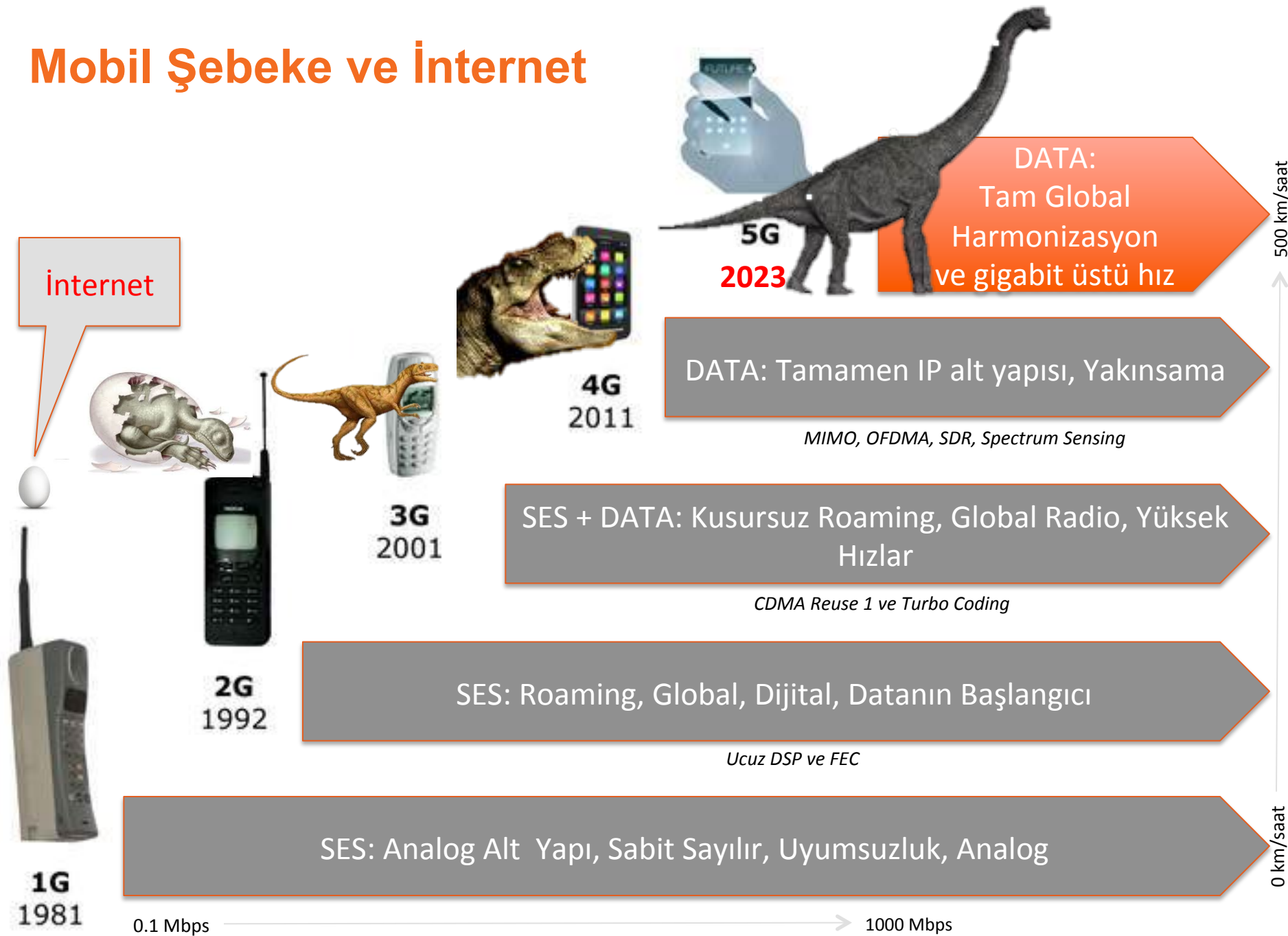
6 Mart 2014 – 3. Savunma, Güvenlik ve Bilgi Teknolojileri
Sektörel İşbirliği Çırağan Toplantıları

Yeni Nesil

1000
kat trafik



Mobil Şebeke ve İnternet



Data tsunami ne zaman?



Yıl	Ortalama Hız	İnsan Sayısı	Cihaz Sayısı	Kullanım Oranı	Kapasite İhtiyacı
2012	0.3Mbps	4984/km ²	1.2	15%	0.26Gbps/km ²
2016	4 YIL 2.9Mbps	5191/km ²	1.4	20%	4.2Gbps/km ² 16X
2020	4 YIL 30Mbps	5477/km ²	1.7	25%	69.8Gbps/km ² 16X

5G hangisi olabilir?

Kablosuz haberleşmede teknoloji bariyerlerini zorlama

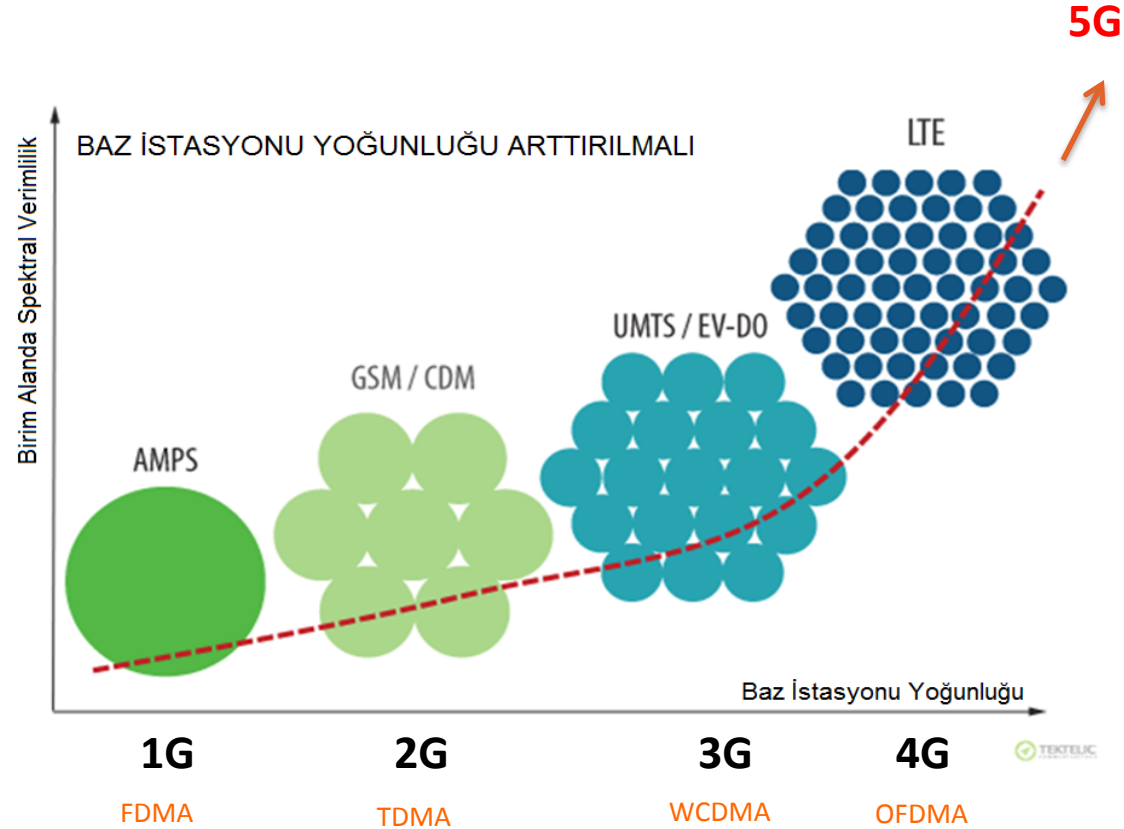
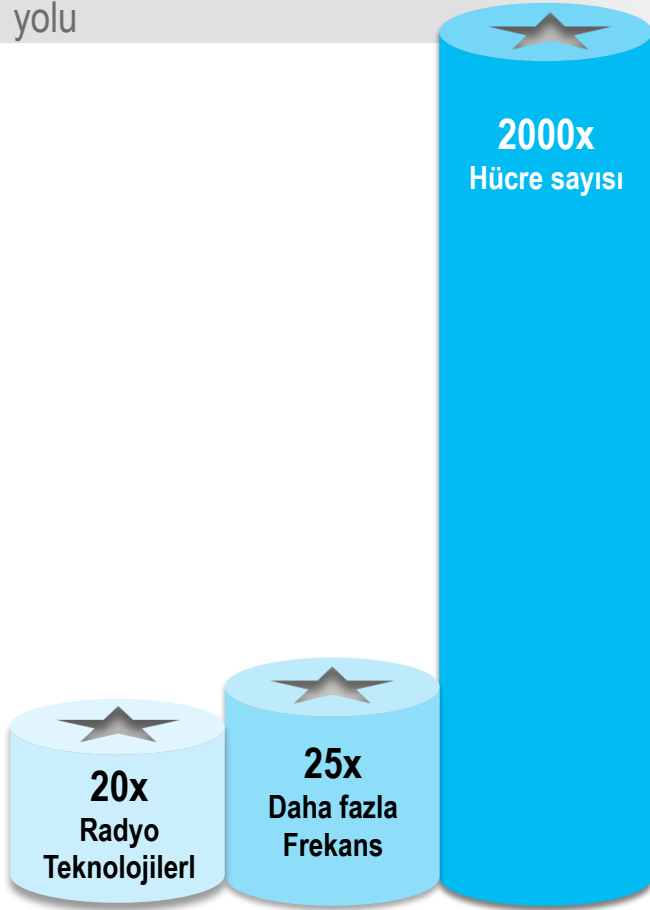
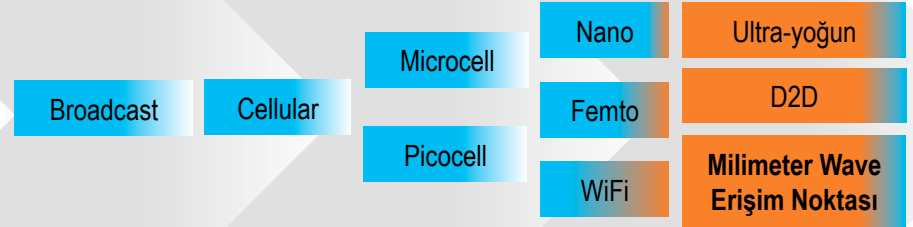
- OFDMA'den (4G) daha iyi kablosuz teknoloji
- Tek kanal'da full-duplex
- Milimeter Wave'de haberleşme
- Işık ile haberleşme
- Cihazdan-Cihaza haberleşme (D2D)

Şebeke ve ağ yapısında daha iyi organize olma

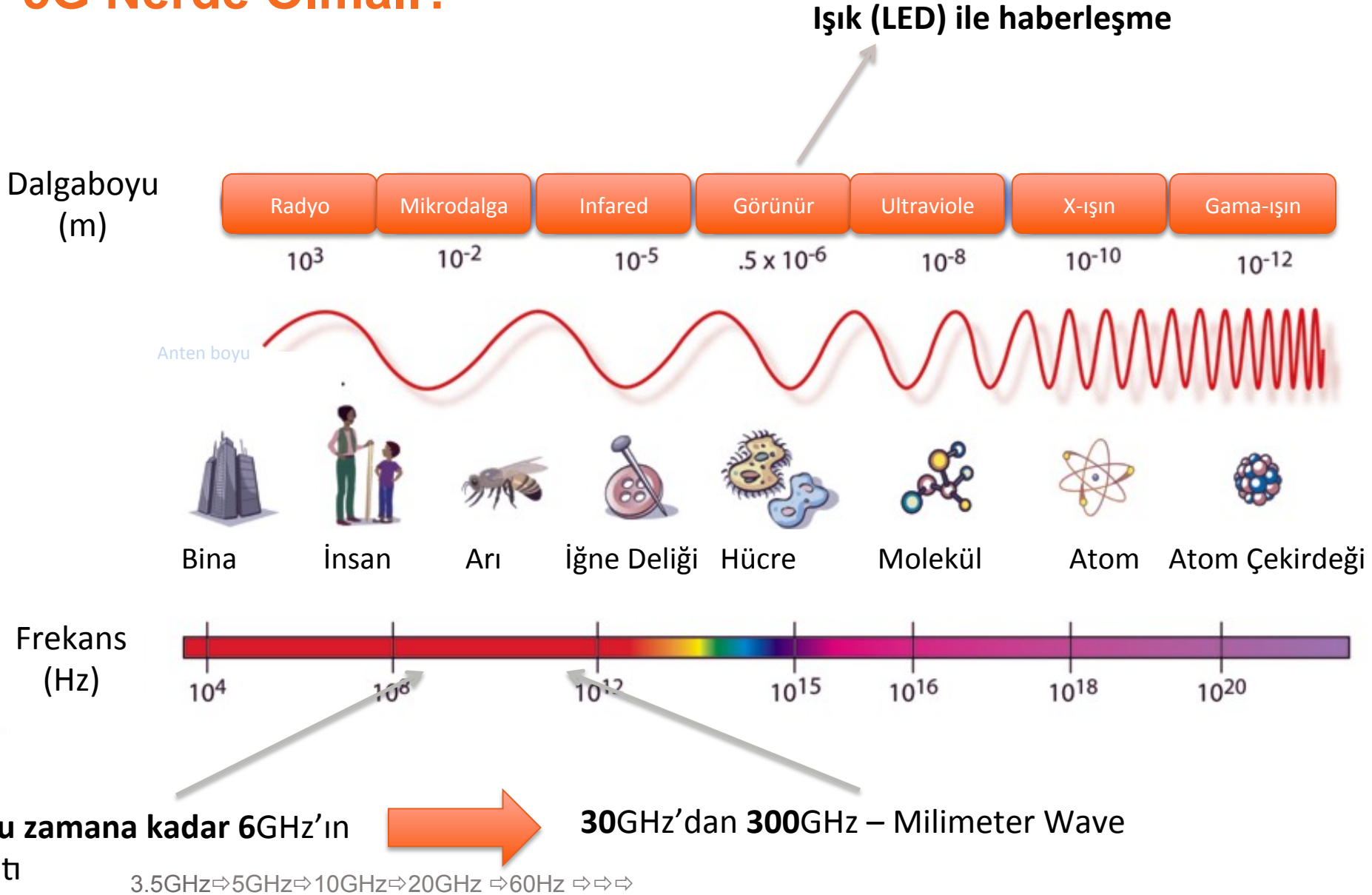
- Yazılım destekli ve sanallaştırılmış ağlar (ortak şebeke +kamu)
- Operatörlerin anlık frekans paylaşması
- Small Cell ve heterojen ağlar (WiFi, Mobil, Broadband, Sensör, vs)
- Akıllı video veri aktarımı
- Arabalar arası haberleşme

Kapsama Alanı ve Kapasite

Kapsamayı küçültmek son 50 yıldır kapasiteyi artırmanın en uygulamalı yolu

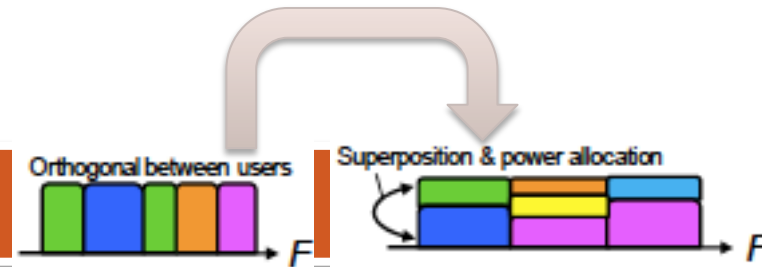


5G Nerde Olmalı?



OFDMA'in ilerisi

Non-Orthogonal Multiple Access (NOMA)

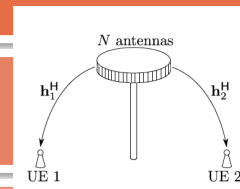


Filter Bank Multicarrier (FBMC)



Millimetre frequencies/waves

3D Massive MIMO



Cognitive radio spectrum sensing

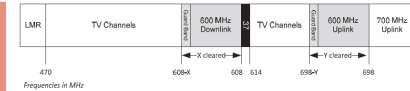
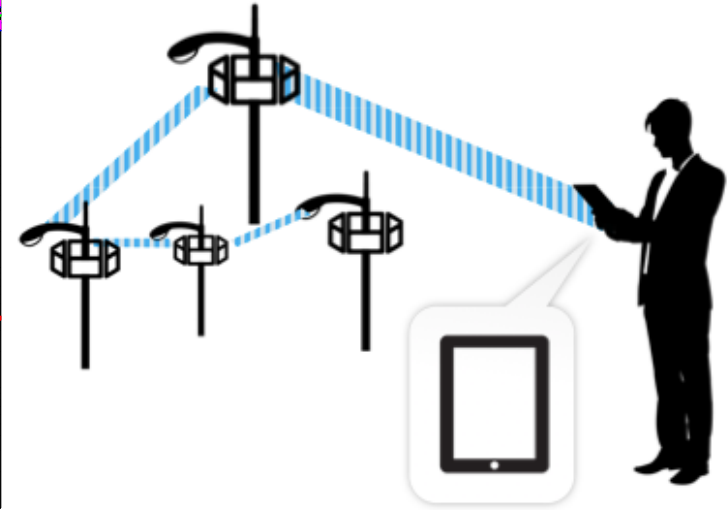
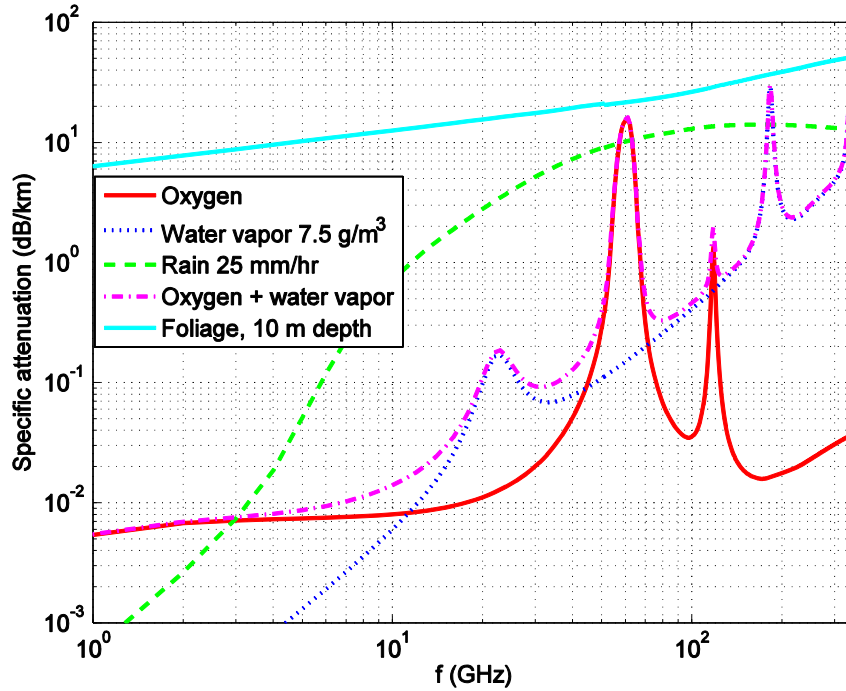


Figure 4. 600 MHz Band Plan

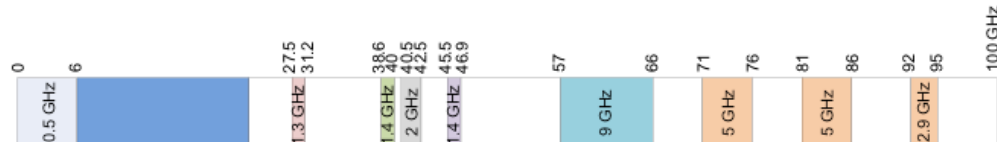
Super wideband spectrum

Multi-technology carrier aggregation

Milimeter Wave



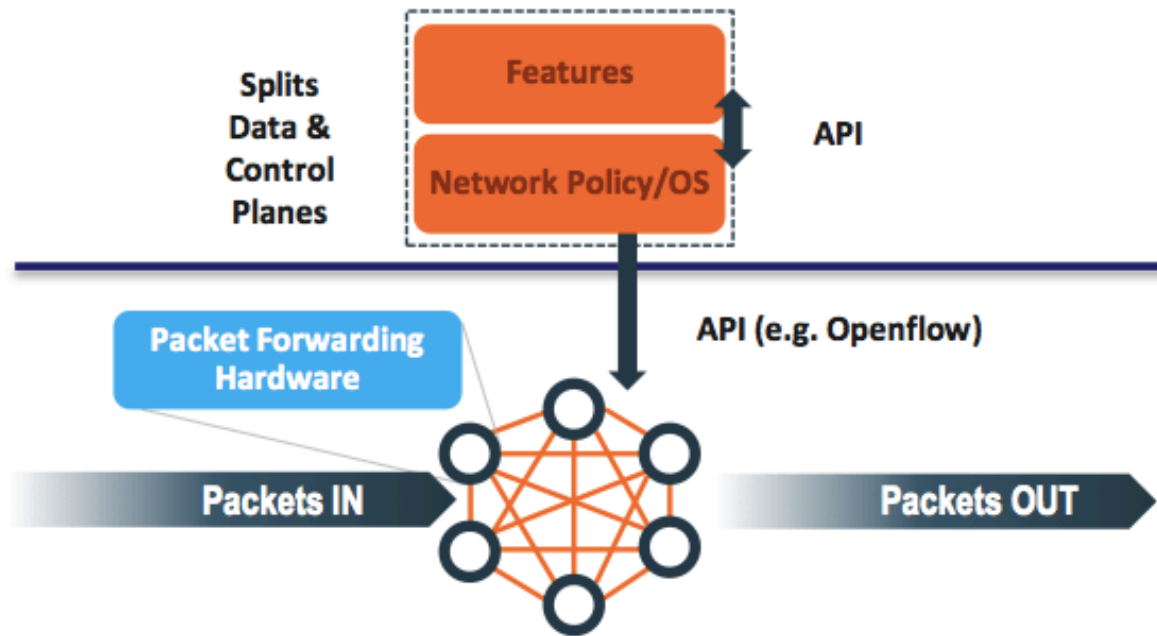
Sinyal Seviyesinde Çevresel Kayıplar	2GHz	40GHz	60GHz
Oksijen ve su buharı (km başına)	0.007dB	.1dB	15dB
Yağmur (km başına)	0.003dB	7dB	10dB
Yaprak örtüsü	8dB	20dB	22dB



SDN – Yazılım Destekli Ağlar

80'lerden kalan İnternet ağ yapısı yenilenecek

- Routing, Multicasting, Naming, Addressing, TCP over Wireless, Mobility, Multi-homing, Flaws in Security



SDN Transport Network – Distributed Intelligence

Bir Kurulum, Milyon Konfigurasyon

Görünür Işık ile Haberleşme nasıl 5G'ye bağlanır?

Visual Light Communication

1. Fiziksel Katman

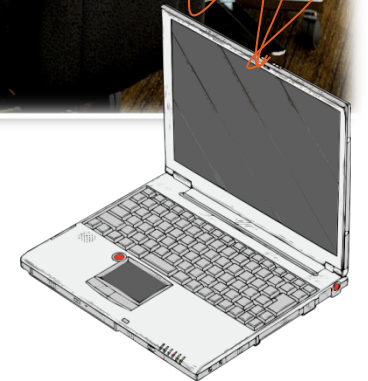
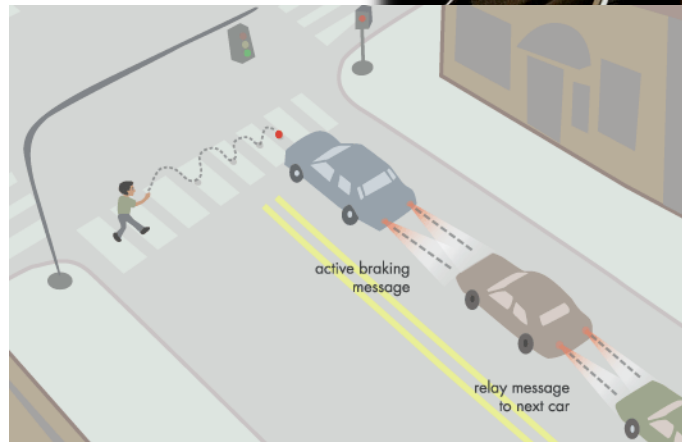
- Data rate granularity
- Complexity / Power efficiency / performance trade-off

2. Optik Devre Tasarımı

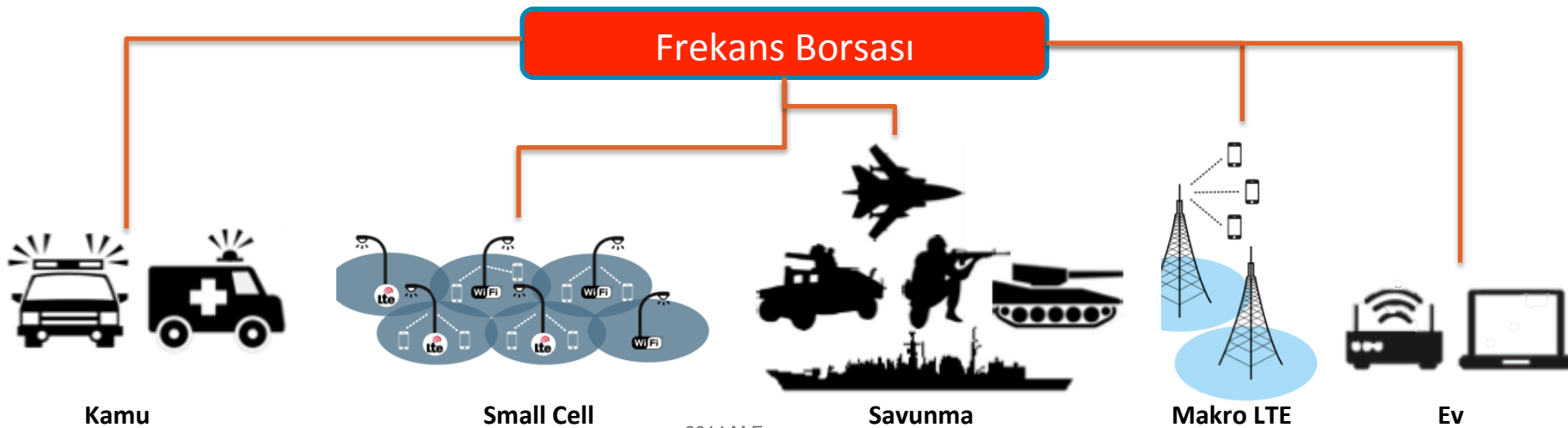
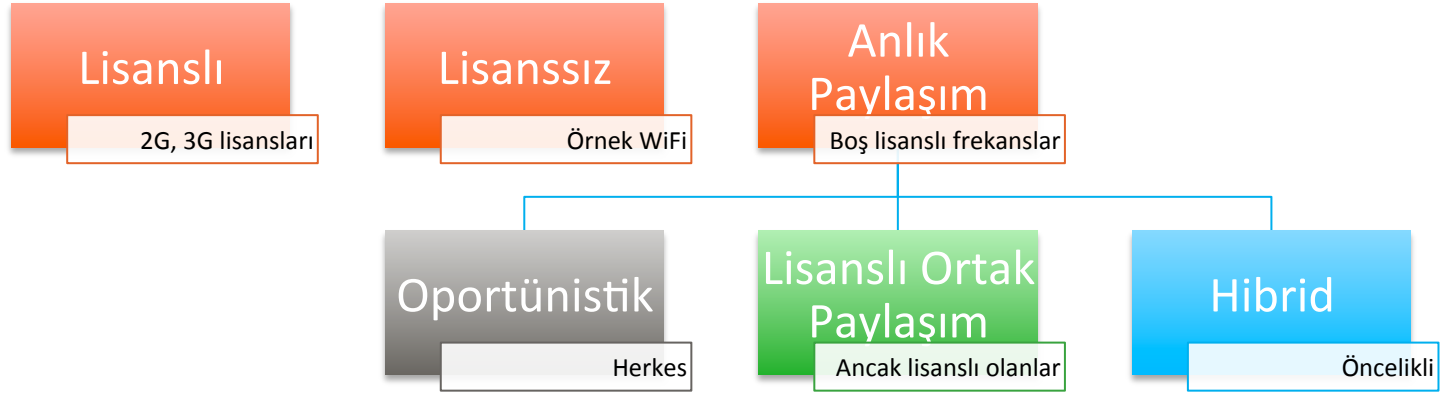
- Optical subsystems
- Analogue LED driver electronics
- ADC/DAC solutions
- Automatic gain control

3. Çoklu Erişim ve Üst Katmanlar

- Duplexing
- Diversity / link blockage
- MIMO / beamforming
- Interference mitigation
- Mobility support
- Relaying



Anlık Frekans Paylaşımı



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Teşekkürler!