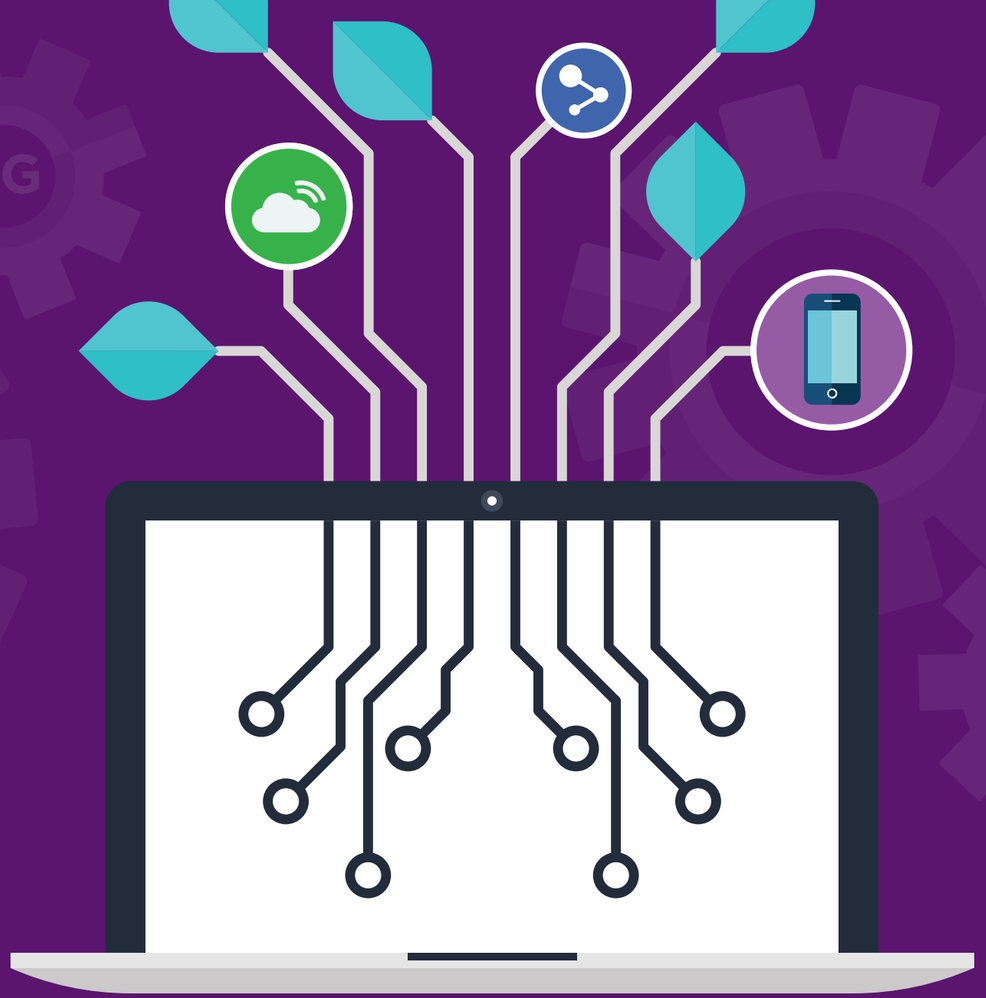
InterDigital®

Introduction

It won’t be long before we will begin seeing the first real world testing and deployment of 5G networks. While these early individual deployments are planned to be relatively narrow in scope, the full rollout of worldwide 5G will be a wide ranging, transformative global effort requiring significant collaboration between the engineering community, standards bodies, and wireless operators. Many questions have come up about this complexity in recent months, so we wanted to take a moment to address some of them and discuss the collaborations and integrations that will need to happen in order for this next transition to take place as smoothly as possible.

Q: What's the plan for the new 5G RAN - is it going to be designed from scratch for NR or will previous RAN design be re-used?

The 5G RAN will have some significant differences, but will have parts that are similar to the 4G RAN. When designing a new system like NR, 3GPP RAN will always look to reuse as much as possible. However, given the new requirements and use cases for NR, a number of significant changes will need to be made. For example, the 5G RAN will have very tight interworking with the LTE 4G radio/base stations, so there will be commonalities in how these systems work together.



Q:

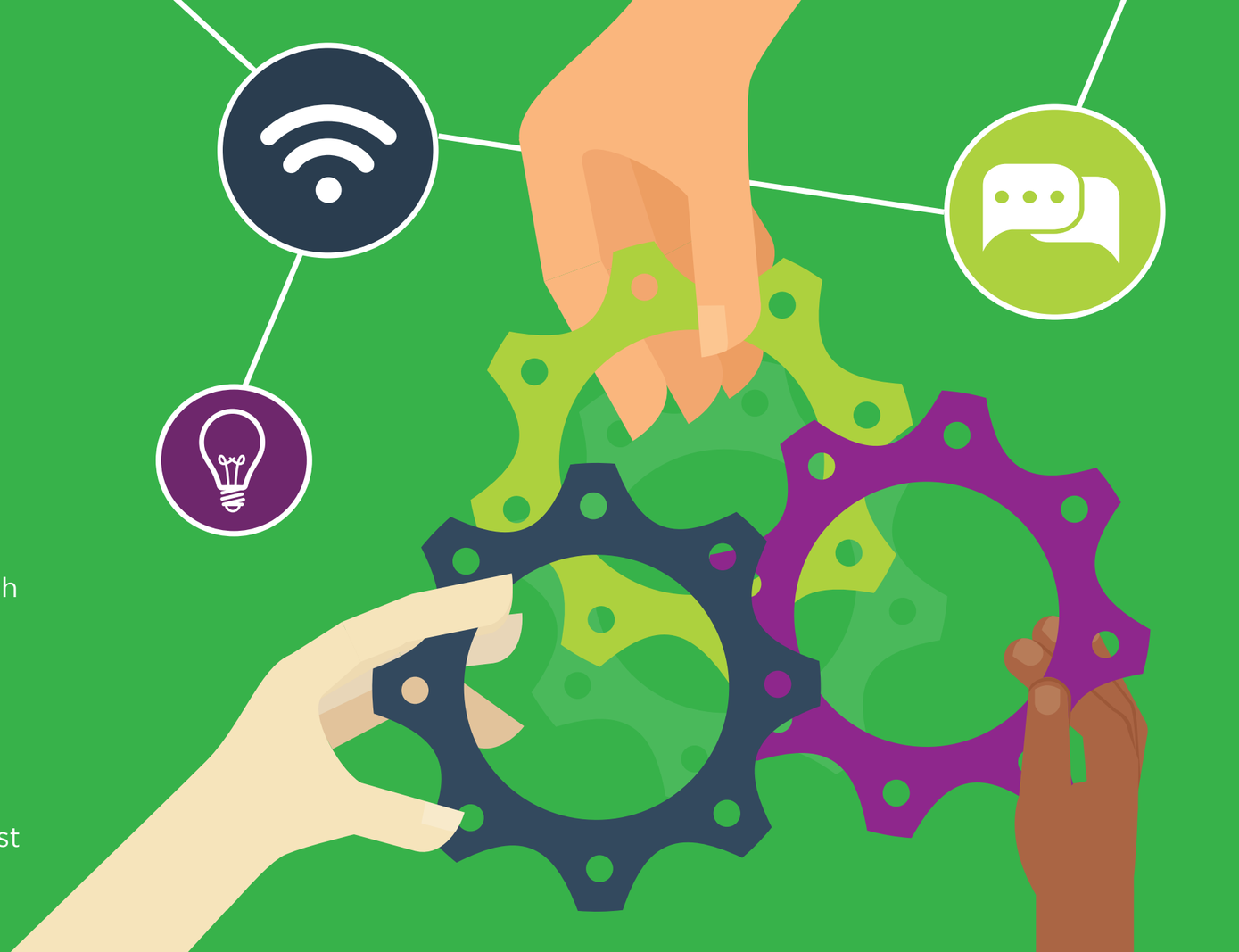
Can we leverage the current network architecture (network elements, hardware, access/ transport data, switches etc.) to support 5G/IMT-2020 or do we have to build it from scratch?

The 5G core network will look much different than the 4G network. It will have some radical changes to allow for virtualization, network slicing and a new Quality of Service architecture. However, these changes will allow much more flexibility in how the network is deployed. Network hardware will be more generic, and will allow the network to evolve more easily. For the 5G RAN, more flexibility in deployment is also a consideration, and will result in architecture changes, but less so than on the core network side. There are significant hardware upgrades required on the RAN side in order to deploy NR. For example, the NR air interface physical layer, including RF and baseband processing, will require hardware upgrades from existing LTE deployments.

Q:

3GPP and IEEE are very different organizations. In what sense can they collaborate to produce 5G standards?

3GPP and IEEE are very different organizations with different structures and internal procedures, and currently they have a loose working arrangement that allows for each to be formally consulted at the proper time and informed when decisions are made that effect the other. Looking at the current market, there are a number of companies that have interests in each of the bodies. Therefore, there are a number of companies with a strong Wi-Fi interest within the 3GPP discussions, and companies with a cellular interest within the IEEE discussions.

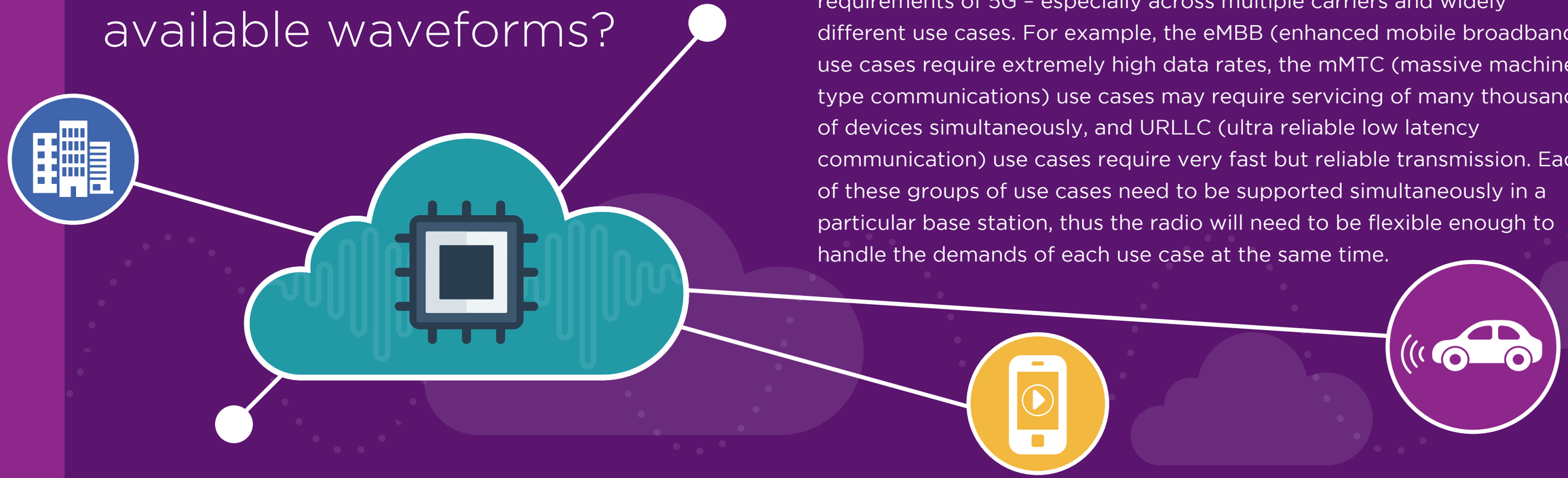


Q: Are there any specific new frequency bands for 5G?

In short, yes. In 4G the spectrum in use is below 6GHz, while for 5G, 3GPP is looking at frequencies up to 52GHz and in the future, based on spectrum decisions that will be made in 2019 by the ITU, the spectrum that will be considered may extend up to 100GHz. While it is widely acknowledged that it's important and beneficial to harmonize the use of frequency bands on a regional and global basis, this is not always possible. Ultimately, the decisions about what frequency bands will be allocated are left to national regulators within each country. However, those decisions are informed by recommendations and guidelines developed by the ITU through its World Radiocommunication Conference (WRC).

Q:

5. Do you think that the 5G waveform will be a composite of the available waveforms?



Although we know that the 5G waveform is based on an older technology known as orthogonal frequency-division multiplexing (OFDM), significant design decisions have yet to be made within the standardization process. Different channel coding schemes and other variations will be made so that the physical layer will be able to handle the very divergent requirements of 5G – especially across multiple carriers and widely different use cases. For example, the eMBB (enhanced mobile broadband) use cases require extremely high data rates, the mMTC (massive machine type communications) use cases may require servicing of many thousands of devices simultaneously, and URLLC (ultra reliable low latency communication) use cases require very fast but reliable transmission. Each of these groups of use cases need to be supported simultaneously in a particular base station, thus the radio will need to be flexible enough to handle the demands of each use case at the same time.

Q:

Will the various 5G technologies using unlicensed 5 GHz spectrum continue to have their own market segments, or will there necessarily be winners and losers? Also, 70% of traffic is on Wi-Fi. Will this continue up to 2020 and beyond? Why or why not?

There will be a significant amount of traffic in unlicensed spectrum for the foreseeable future. Wi-Fi provides a way for cheap, basic and nomadic coverage, while cellular focuses on guarantees for quality of service for mobile users. Certain use cases will naturally be solved by cellular approaches using licensed spectrum, while others will be solved with unlicensed approaches in the 5GHz band and elsewhere. For example, internet access within the home will continue to be done most cost effectively by Wi-Fi. However, there will continue to be a use by cellular operators to enhance the data rates by using License Assisted Access (LAA) service in 5G, or a service like LTE-WLAN Aggregation (LWA) with Wi-Fi access points.

Q: Is there any ITU-R study to allow mobile operators to share spectrum dynamically on demand?

ITU-R working party 1B is working on two new reports: "*Regulatory tools to support enhanced shared use of the spectrum*" and "*Spectrum management principles, challenges and issues related to dynamic access to frequency bands.*" When completed, these reports will provide operators with more tools and principles to share spectrum more dynamically in a regulated manner. Additionally, ITU-R working party 5A is writing a report specific to sharing with Wi-Fi in the 5 GHz band called "*Study of proposed additional mitigation techniques to facilitate sharing between RLAN systems and incumbent services.*"

Q:

If a mobile operator has a green field deployment opportunity, would they use LAA, LWA or Multefire to complement a 4G/5G macro strategy?

Mobile operators will use different strategies depending on their existing deployments and spectrum availability. For example, an aspiring mobile operator that does not have any licensed spectrum would need to deploy either Multefire or Wi-Fi to serve its customers in unlicensed spectrum. For operators having existing 4G deployments and licensed spectrum, they can choose between LAA or LWA for incorporating unlicensed spectrum. The choice between these two technologies may depend on a number of factors, such as whether or not the operator has an existing Wi-Fi network deployment.

Q:

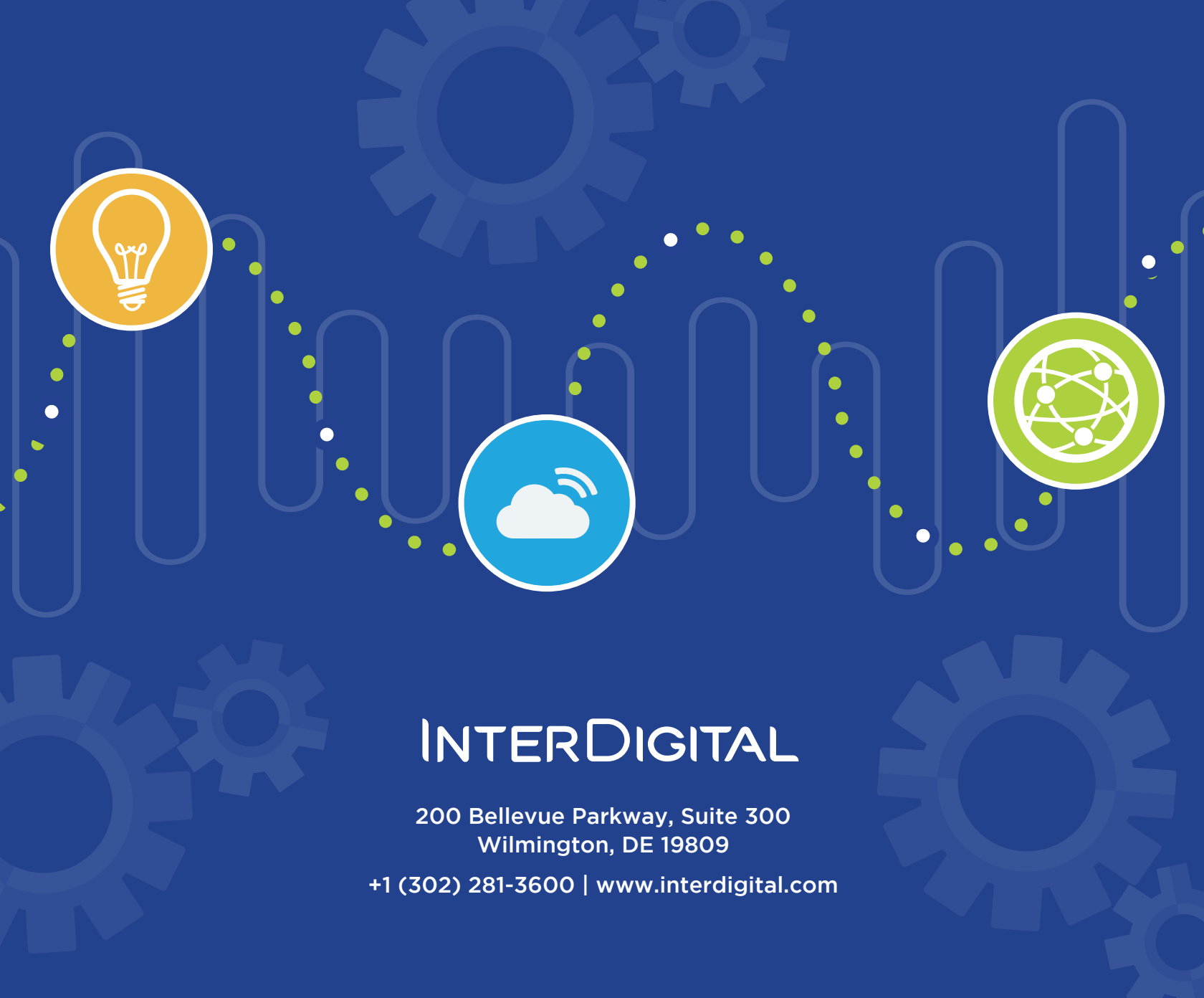
Different RATs have different benefits that satisfy the different use cases and requirements outlined in IMT-2020. When deciding which RAT each user equipment/station (UE/STA) will utilize, where do you think that network handoff will take place?

A number of decisions in this area haven't been made yet since we are early in development of 5G, but one of the aspects of the new core network is that the interfaces between the core network and the RAN are planned to be RAT agnostic. This means that the interface between the core network and RAN for Wi-Fi data and regular cellular data will be the same. If fully envisioned, this will allow for RAN network control of all of the connections and which RATs are best to be utilized for a particular UE/STA. In 4G, the coordination of Wi-Fi and LTE evolved over time with some UE/STA involvement and some with RAN network involvement. We believe that all networks in 5G cellular systems will function this way.

Q: How will interference avoidance be implemented in Wi-Fi with LTE? What is the progress on defining test cases so that LTE in unlicensed band does not degrade Wi-Fi?

Coexistence between LTE eNB and Wi-Fi AP has been studied by both 3GPP and IEEE/Wi-Fi proponents. The LBT (listen before talk) mechanism/procedure has been adapted and implemented in a physical layer for LTE operation as a means for coexistence in unlicensed spectrum, complying as well with the power density limits by implementing an appropriate interlaced radio block allocation rule.

In 3GPP RAN4 radio and base station requirements, a specific study is ongoing for defining appropriate test cases for coexistence of LTE Base stations with Wi-Fi Access points. The study is scheduled to finish in late 2017 and will lead to a set of agreed test cases.



InterDigital

200 Bellevue Parkway, Suite 300
Wilmington, DE 19809

+1 (302) 281-3600 | www.interdigital.com