IEEE 802 EC 5G/IMT-2020 SC draft report

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5G SC report

Philosophy

- Include and describe all options
  - That are derivatives of the four requested cases
- Expand cost/benefit for each
  - In a prioritized manner based on contributions
    - starting with option 4, then option 1 *(per 78, 81)*
- SC conclusion recommended
  - Consensus preferred on preference
    - not required
    - Worst case straw poll preference
  - Recommend way forward for preference (s)

What are “costs and benefits”?

- This is a cost-benefit analysis
  - But without monetary cost, only relative costs
  - A quantitative pros vs cons
  - Strengths, Weaknesses, Opportunities and Threats
- Brainstorm all costs and benefits
  - E.g., resource cost, standards development cost, installation cost, operational cost, energy cost, etc.
  - Are the unexpected costs?
  - Are there unanticipated benefits?
- Estimate value relative to a baseline

Proposed Table of Contents

- Introduction
  - IEEE 802 5G related projects
- Options Considered
  1. IEEE 5G
     - Description
     - Benefits
     - Costs
  2. IMT-2020 – single technology
     - Description
     - Benefits
     - Costs
  3. IMT-2020 – set of technologies
     - Description
     - Benefits
     - Costs
  4. IMT-2020 – external proposal
     - Description
     - Benefits
     - Costs
- Conclusion

- 802.1
  - P802.1CF – OmniRAN architecture
  - P802.1CM – TSN for Fronthaul
- 802.3
- 802.11
  - P802.11ax – high aggregate throughput. High density of users.
  - IEEE Std 802.11ad – high individual throughput, short range.
  - P802.11ay – next generation of 802.11ad.
  - P802.11ah - <1 GHz for IoT requirements
- 802.15
  - P802.15.3d
  - 100Gb/s THz project
  - P802.15.7 REVa, Optical Wireless Communications,
  - P802.15.4 family.
- 802.16
  - 802.16.1
- 802.21
  - P802.21.1

Report format?

- Following Table of Contents
- Slide deck
  - Allowing for figures, tables, conclusions
    - Follow a template for SWOT summary
  - Will continue to progress content on calls
  - Easy presentation to EC
  - Chair could be editor
- Document
  - Allowing for more detailed wording
  - Contributions and offline editing required
  - Will need an overview presentation for EC
  - Would require editor

SWOT Template

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1.a.i – option name

Objective

Description

Strength	Weakness	Opportunity	Threat
1.	1.	1.	1.
2.	2.	2.	2.
3.	3.	3.	3.
4.	4.	4.	4.

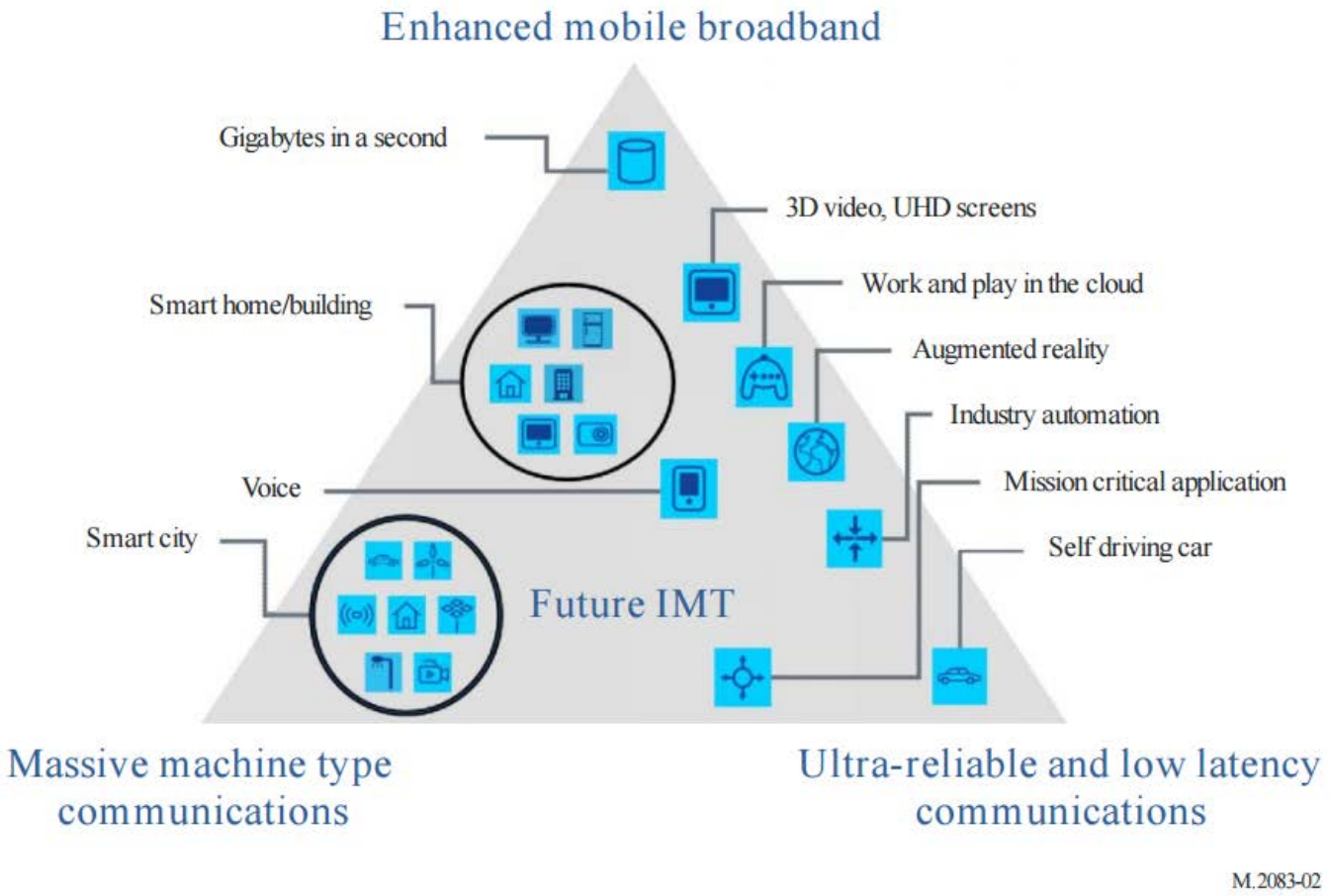
Cost	Benefit

What is 5G?

There are two contexts for 5G

- IEEE 5G
  - Some sort of description will be required
  - This may include use cases and requirements
- IMT-2020
  - Usage scenarios (as defined by ITU-R M.2083)
    - Enhanced Mobile Broadband (eMBB)
    - Ultra-reliable and low latency communications (UrLLC)
    - Massive machine type communications (mMTC)
  - Capabilities (as defined by ITU-R M.2083)
    - Peak Data rate, User experienced data rate, Latency, Mobility, Connection density, Energy efficiency, Spectrum efficiency, Area traffic capacity

IMT-2020 *(per ITU-R M.2083 – Figure 2)*



IEEE 5G architecture

... simplified

There are also two contexts for 3GPP

- IEEE 5G
  - There is no focus on the ITU-R IMT-2020 submission
    - 3GPP defines solely, or jointly with IEEE 802, the requirements and use cases for IEEE 802 technology
    - This could be equivalent to, or a subset of, 3GPP 5G
- IMT-2020 5G
  - There is an ITU-R IMT-2020 submission
    - By either 3GPP or IEEE 802
    - The requirements placed on IEEE 802 are based on the usage scenarios and capabilities defined by ITU-R M.2083

What are all the derivatives of options?

1. IEEE 5G

- Description
  - Cost/benefit analysis does not include submission to IMT-2020
  - At least simplified architecture , but likely more
  - A combination of multiple IEEE standard technologies, profiled in a single standard

a) IEEE 802 wireless 5G

i. 802.11 only

a. P802.11ax – high aggregate throughput. High density of users.

b. P802.11ay , IEEE Std 802.11ad – high individual throughput, short range.

c. P802.11ah - <1 GHz for IoT requirements

d. 802.11p - wireless access in vehicular environments

ii. 802.15 only

a. P802.15.3d

b. 100Gb/s THz project

c. P802.15.7 REVa, Optical Wireless Communications,

d. P802.15.4 family.

b) "All IEEE 802" 5G

i. And submit to ITU-R as non-IMT (i.e., WAS/RLAN) and complementary to IMT-2020

c) IEEE 802 5G plus others

i. 3GPP 5G

ii. IETF

d) "All IEEE" 5G

i. IEEE 802 and ComSoc projects

e) IEEE 5G plus others

2. IMT-2020 – single technology

- Description
  - Just radio interface of simplified architecture . Single or multiple singles...
  - IMT-2020 proposal by IEEE

a) eMBB(<6GHz)
   i. IEEE 802.11ax
   ii. IEEE 802.11ac
   iii. IEEE 802.11n

b) eMBB (>6GHz)
   i. IEEE 802.11ay
   ii. IEEE 802.11aj
   iii. IEEE 802.11ad

c) UrLLC– IEEE 802.11p

d) mMTC – IEEE 802.11ah

e) eMBB
   a) P802.15.3d
   b) 100Gb/s THz project
   c) P802.15.7 REVa, Optical Wireless Communications,

f) mMTC - P802.15.4 family.

3. IMT-2020 – set of technologies

- Description
  - At least radio interface of simplified architecture , but likely more
  - A combination of multiple IEEE 802 standard technologies, profiled in a single standard
  - IMT-2020 proposal by IEEE

a) IEEE 802.11
   i. eMBB (<6GHz) – IEEE 802.11 ax,ac,n
   ii. eMBB (>6GHz) – IEEE 802.11 ay,aj,ad
   iii. UrLLC– IEEE 802.11p
   iv. mMTC – IEEE 802.11ah

b) IEEE 802.11 with 802.1/3

c) IEEE 802.15
   a) eMBB
      a) P802.15.3d
      b) 100Gb/s THz project
      c) P802.15.7 REVa, Optical Wireless Communications,
   b) mMTC - P802.15.4 family.

d) IEEE 802.11 with 3GPP 5G
   i. LWA
   ii. LWIP
   iii. eLWA
   iv. New?

4. IMT-2020 – external proposal

- Description
  - Part of a complete architecture
  - A combination of IEEE 802 standard technologies with other technologies (e.g., 3GPP)
  - IMT-2020 proposal by external party (e.g., 3GPP)

a) IEEE 802.11 with 3GPP 5G
(no IMT-2020 spectrum requested for 802.11)

i. LWA
ii. LWIP
iii. eLWA (Release 14)
iv. Release 16?

b) IEEE 802.11 with 3GPP 5G
(IMT-2020 spectrum requested for 802.11)

i. New IEEE 802.11 standard for appropriate spectrum band

What are all the initial cost/benefits?

Approach Analysis (4.a)

- **IMT 2020 – external party (i.e., 3GPP)**
  - IEEE802 is as a part of 5G radio and networks of other technologies.
    - Radio interface
      - IEEE802.11 using (e)LWA or LWIP
    - Network management, control, etc.
      - under external party's submission.
  - Benefits:
    - IEEE802.11 is a component in ITU-R/3GPP 5G architecture
      - Align with industry 5G branding momentum
    - Align with the current scope of IEEE802.11: PHY and MAC
    - Help ITU-R to study the need of new spectrum for IMT-2020
    - The least effort among four approaches
      - IEEE 802 could just let 3GPP include IEEE 802 technology autonomously
  - Costs:
    - IEEE 802 needs to coordinate with 3GPP for their submission of IMT-2020 proposal in ITU-R.

4.a – IMT-2020 – 3GPP proposal

Objective

- Inclusion of IEEE 802.11 technologies in 3GPP IMT-2020 proposal
- No IMT-2020 spectrum for 802.11 RAT

Description

- IEEE802 is a part of 5G radio and networks as specified by 3GPP
  - Radio interface: IEEE 802.11 using (e)LWA or LWIP
  - Network management, control, etc.: per 3GPP submission.

Strength	Weakness	Opportunity	Threat
1. Align with the current scope of IEEE802.11: PHY and MAC	1. IEEE 802 has no input on how technology included	1. IEEE802.11 as a component	1. Help ITU-R to study the need of new spectrum for IMT-2020
2. Aligns with industry 5G branding momentum	2. No new spectrum	2. 3GPP includes IEEE 802 technology autonomously	2. 3GPP changes IEEE 802 functionality
3. The least effort	3.	3.	3.

Cost	Benefit
IEEE 802 needs to coordinate with 3GPP for their submission of IMT-2020 proposal in ITU-R.	IEEE 802.11 is a component in ITU-R/3GPP 5G architecture, aligning with industry 5G branding momentum

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4.b – IMT-2020 – 3GPP proposal with spectrum

Objective

- Inclusion of IEEE 802.11 technologies in 3GPP IMT-2020 proposal
- Inclusion of IMT-2020 spectrum for 802.11 RAT

Description

- IEEE802 is a part of 5G radio and networks as specified by 3GPP
  - Radio interface: IEEE 802.11 using (e)LWA or LWIP
  - Network management, control, etc.: per 3GPP submission.

Strength	Weakness	Opportunity	Threat
1. Align with the current scope of IEEE802.11: PHY and MAC	1. IEEE 802 has no input on how technology included	1. IEEE802.11 as a component	1. Help ITU-R to study the need of new spectrum for IMT-2020
2. Aligns with industry 5G branding momentum	2. 802.11 RAT simulation modelling required by ITU-R	2. 3GPP includes IEEE 802 technology autonomously	2. 3GPP changes IEEE 802 functionality
3.	3. Significant 3GPP coordination	3.	3. 3GPP reluctant to add RAT

Cost	Benefit
IEEE 802 needs to coordinate significantly with 3GPP for their submission of IMT-2020 proposal in ITU-R.	IEEE 802.11 is a component in ITU-R/3GPP 5G architecture, with IMT spectrum, aligning with industry 5G branding momentum

1.c.i – IEEE 802 5G – with 3GPP

Objective

- Describe inclusion of IEEE 802 technologies with 3GPP for 5G
- No ITU-R submissions

Description

- IEEE 5G is 802 complementing 5G radio and networks as specified by 3GPP
  - Radio interface: IEEE 802.11 using (e)LWA or LWIP
  - Network management, control, etc.: per 3GPP submission.
  - Back haul and front haul: IEEE 802.1/3, etc

Strength	Weakness	Opportunity	Threat
1. Align with the current scope of IEEE802.11: PHY and MAC	1. IEEE 802 not in IMT-2020, no new spectrum	1. IEEE802.11 as a component	1. 3GPP specification diverts from IEEE
2. Aligns with industry 5G branding momentum	2. Develop IEEE 5G uses cases & requirements	2. Drive market to equate 5G = 3GPP + 802	2. IEEE 802 resources not interested
3. Inclusion of 802.3 & 802.1	3. 3GPP coordination required to ensure alignment	3. Highlight 802.3 & 802.1 in 5G	3.

Cost	Benefit
IEEE 802 needs to develop a 5G description	IEEE 802 complements 3GPP to be the 5G architecture, aligning with industry 5G branding momentum

Approach Analysis (1.b.i)

- **IEEE802 5G as ITU-R non-IMT**
  - Submit 5G proposals to ITU-R WP5A WAS/RLAN as a complementary solution of IMT-2020
  - Possible IEEE802 technology for component of 5G
    - Radio interface
      - IEEE802.11, IEEE802.15, etc
    - Network management and control (TBD)
    - Back haul and front haul
      - IEEE 802.1/3, IEEE 802.11, etc
  - Benefits:
    - Align ITU-R WP5A scope for non-IMT systems: WAS/RLAN
    - May identify some use cases and requirements for non-IMT 5G services.
    - Support new spectrum sharing mechanism with other technologies
    - Promote IEEE802 in ITU-R 5G branding as non-IMT and complementary to IMT-2020
  - Costs:
    - Requires more work than the approach 4.

1.b.i – IEEE 802 5G – complement

Objective

- Describe a complementary IEEE 5G for license exempt spectrum
- Submit to ITU-R for non-IMT spectrum

Description

- Submit 5G proposals to ITU-R WP5A WAS/RLAN as IMT-2020 complementary solution
  - Radio interface: IEEE 802.11, 802.15, ...
  - Back haul and front haul: IEEE 802.1/3, etc
  - Network management, control, etc.: TBD

Strength	Weakness	Opportunity	Threat
1. Align ITU-R WP5A scope for non-IMT systems: WAS/RLAN	1. IEEE 802 5G may be dismissed by market	1. May identify some use cases and requirements for non-IMT 5G services.	1. Coordination effort required – may not be resourced
2. Promote 802 in ITU-R 5G branding as non-IMT	2. No IMT spectrum	2. Support new spectrum sharing mechanism with other technologies	2. 3GPP views approach as non-complementary
3. Complementary to IMT-2020	3.	3. Increase license exempt spectrum	3.

Cost	Benefit
IEEE 802 needs to coordinate with ITU-R WP5A.	Promote 802 in ITU-R 5G branding as non-IMT and complementary to IMT-2020

1.b – IEEE 802 5G – complement without ITU-R

Objective

- Describe a complementary IEEE 5G for license exempt spectrum
- No ITU-R submissions

Description

- Describe a complete IEEE 802 5G as an IMT-2020 complementary solution
  - Radio interface: IEEE 802.11, 802.15, ...
  - Back haul and front haul: IEEE 802.1/3, IEEE 802.11, etc
  - Network management, control, etc.: TBD

Strength	Weakness	Opportunity	Threat
1. Unite IEEE 802 with a 5G solution	1. IEEE 802 5G may be dismissed by market	1. May identify new use cases and requirements for 5G services.	1. 3GPP views approach as non-complementary
2. Promote 802 in 5G branding	2. No spectrum	2. Complementary to IMT-2020 / 3GPP	2. IEEE 802 resources not interested
3. No coordination effort required	3. Develop IEEE 5G uses cases & requirements	3. Highlight 802.3 & 802.1 in 5G	3.

Cost	Benefit
IEEE 802 needs to develop a 5G solution	Promote 802 in 5G branding as complementary to IMT-2020 / 3GPP

Next Steps

Contributions requested

- IEEE 5G
  - Use cases and Requirements
    - Endorse others, subset others, develop new
  - Describe architecture and/or technology

- Derivative options
  - Expand list
  - Prioritize list

- Report content
  - Agree on template and format
  - Expand costs and benefits of all options
  - Conclude on which option