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5G e Sicurezza Nazionale

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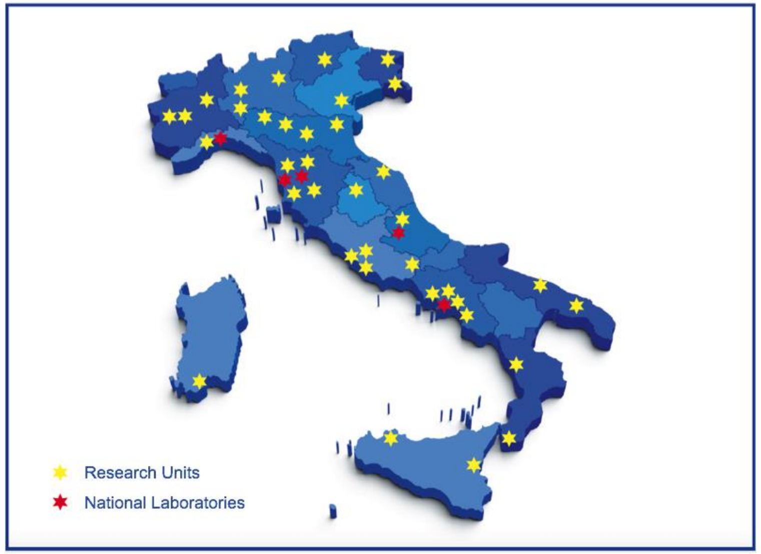
www.cnit.it

cnit
consorzio nazionale
interuniversitario
per le telecomunicazioni

What is CNIT? (www.cnit.it)

- National Inter-University Consortium for Telecommunications (**37 Italian Universities+8 CNR research units**)
- Mission: basic and applied research and advanced education in ICT
- 1300+ researchers; **100+ own employees**
- Funding from private companies and competitive programs only:
  - H2020: 48 projects, **11 of them coordinated by CNIT**
  - 2018: 124 projects (39 EU+37 Ntl+48 Industry), 19M€; Recent results: **5 EU projects on applications of ICT**; **3 EU projects on 5G ranked #1 in their calls**; 1 on cybersecurity (EU competence network); 1 on autonomous vehicles; Flagship Graphene, Flagship Quantum Information
  - Organizer of ECOC 2018 and 5G Italy 2018 and 2019 (https://www.5gitaly.eu/)



- No “structural” funding, a problem for overhead and labs equipment
  - e.g., Germany 30%, Spain 50%, Switzerland 50% of total budget

5G: Evolution

Better performance (speed, density, …)

Currently being deployed

Interest for private and temporary 5G networks (e.g. port, factory, campus, concert)

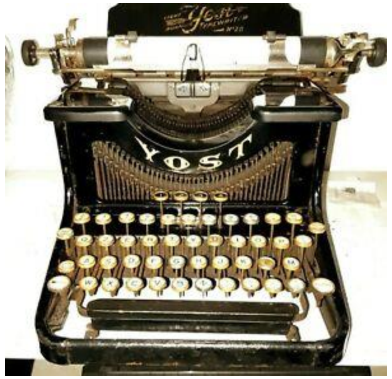
5G: Revolution

Diversified vertical services

Main novelties

- New usage scenarios and new (non-human users)
  - larger ecosystem, with more stakeholders, more heterogeneity
- End-to-End, including the whole network, not only the cellular section
  - Independence between RAN and CN
  - Control and user plane separation
- The software network
  - From a typewriter (HW) to a personal computer (SW)
    - Huge security implications!
  - Virtualization and Orchestration
  - Cloud (and edge cloud), SDN, NFV
  - Service-based Architecture in the CN

  - New Radio, new spectrum, massive MIMO, …



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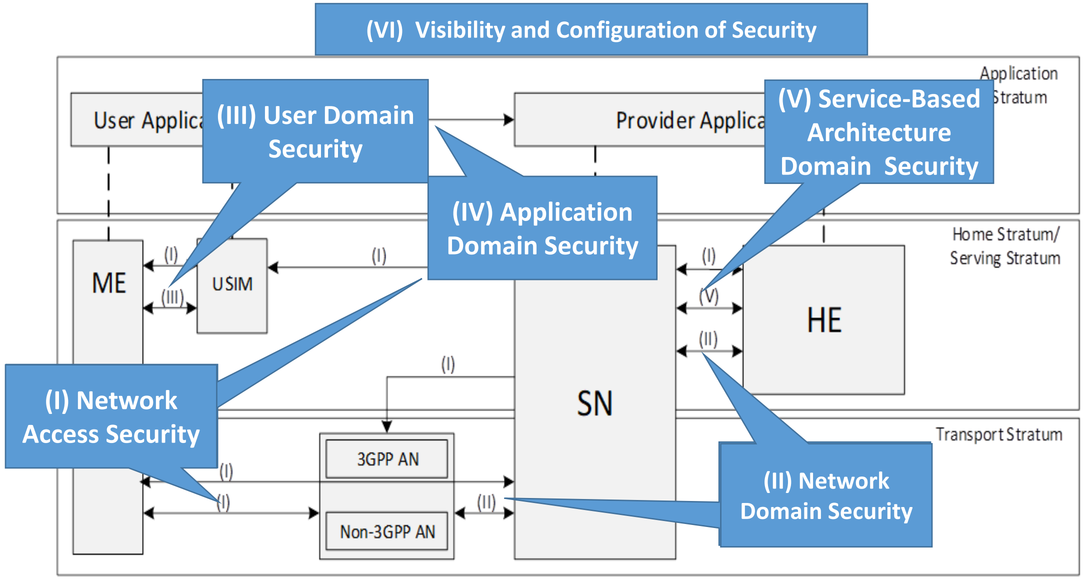
Generations and security

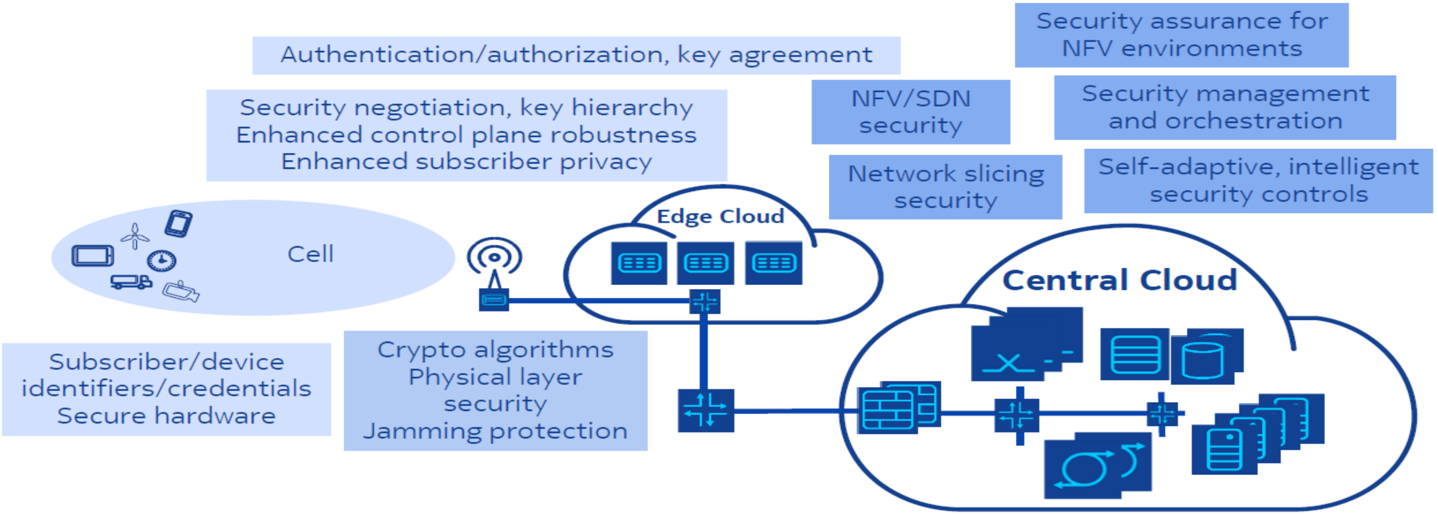
- 1G, 1980s, up to 2.4Kbps: portability
  - [virtually no security]
- 2G, 1990s, up to 64Kbps : from analog to digital, SMS, WAP
  - client authentication, encryption [Security by obscurity, no BS authentication, no core network security]
- 3G, 2000s, up to 10Mbps: data services
  - Encryption and (in part) Integrity, mutual authentication, core network security
- 4G, 2010s up to 300Mbps : Internet-integrated, video
  - Systematic approach, security architecture


(VI) Visibility and Configuration of Security
Application Stratum
User Applic
(III) User Domain Security
Provider Applica
(V) Service-Based Architecture Domain Security
(IV) Application Domain Security
Home Stratum/ Serving Stratum
ME
USIM
(I)
(III)
(I)
(I)
(V)
(II)
HE
SN
(I)
(I) Network Access Security
Transport Stratum
3GPP AN
Non-3GPP AN
(I)
(I)
(II)
(II) Network Domain Security

Generations and security

- 5G, 2020: new services, whole network, softwarization, cloud
  - Many (small and not-so small) tailored/chirurgic improvements
    - Proof of Presence
    - Unified Flexible Authentication / Support for multiple protocols (also non 3GPP)
    - No more transmission of IMSI (SUPI) in clear; SUCI = Public key (ECIES) encryption of SUPI
    - L2 message integrity
    - Security Edge Protection Proxy
    - Rogue base stations
      - downgrading

Elements of a 5G Security Architecture


Security assurance for NFV environments
Authentication/authorization, key agreement
Security negotiation, key hierarchy
Enhanced control plane robustness
Enhanced subscriber privacy
NFV/SDN security
Security management and orchestration
Network slicing security
Self-adaptive, intelligent security controls
Edge Cloud
Cell
Central Cloud
Subscriber/device identifiers/credentials
Secure hardware
Crypto algorithms
Physical layer security
Jamming protection

Source: Nokia Bell labs, P. Schneider, 2018

Security: high-level challenges

- More realms of applications: increase in attack surface
  - Ultra Reliable and Low Latency scenarios -> more critical situations
  - IoT scenarios -> more and widespread applications, heterogeneous terminals
  - Multiplication of both types of stakeholders and numbers of tenants and third-party suppliers
  - Distribution of responsibilities also more complex
- Softwarization and slicing
  - Inherently more risky
- Signalling traffic
  - Increasing share of total; need of specific protection

- Flexible security, tailored to specific scenarios
  - Security-as-a-Service: more complex but also more powerful and effective

Credits to Giuseppe Bianchi

Security: specific issues

- Softwarization and slicing
  - Slice isolation
  - Programmability platform (e.g. P4) security
  - Network management and orchestration security-aware
  - Software modules implementing security services (e.g. monitoring)
- IoT
  - Massive coordinated IoT attacks
  - Lightweight cryptographic solutions, integrated within communication protocols
  - Multi-tenant, heterogeneous, flexible, large scale access-control
  - Scalable monitoring techniques
- New communication technologies
  - Specific security solutions for dense networks, MIMO networks
  - New (e.g. quantum) physical layer cryptographic techniques
  - Radio waves designed for security purposes

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Security: new requirements

- Beyond confidentiality, integrity and availability, need to address:
  - location security (www.locus-project.eu) and privacy
  - trustworthiness of information/integrity of remote platforms
  - contextual correctness
  - proof of possession
  - support for highly limited devices such as sensors
  - tailored security at the service and device level: differentiated security services on request
  - dynamic composition of services -> modular security guarantees within the system
- Not only systems' security but also implementation security
  - Not nearly a new 5G concern → remember Greek Wiretapping case, 2004/05
  - Which approach for vulnerability assessment process?

Antennas and Engineers

- Network deployment
  - Investments
  - Thresholds, regulations, rules, bureaucracy and red tape (“antennas”)

- People (“engineers”)
  - 208k people aged 20-34 left Italy in the last ten years
  - Italy has the lowest percentage of people with a university degree in Europe
  - Italy has the third lowest percentage of STEM degrees in Europe

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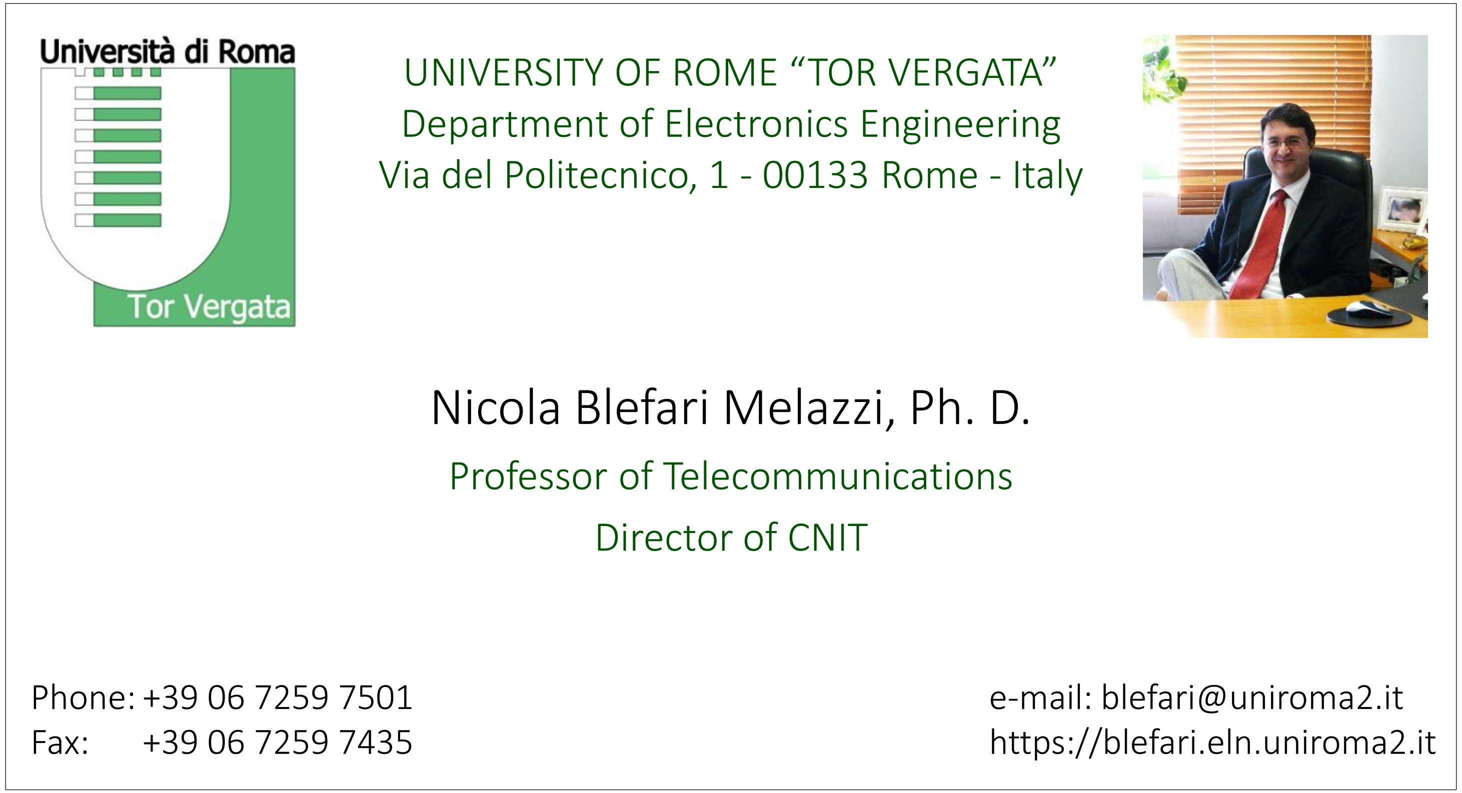
Thank you



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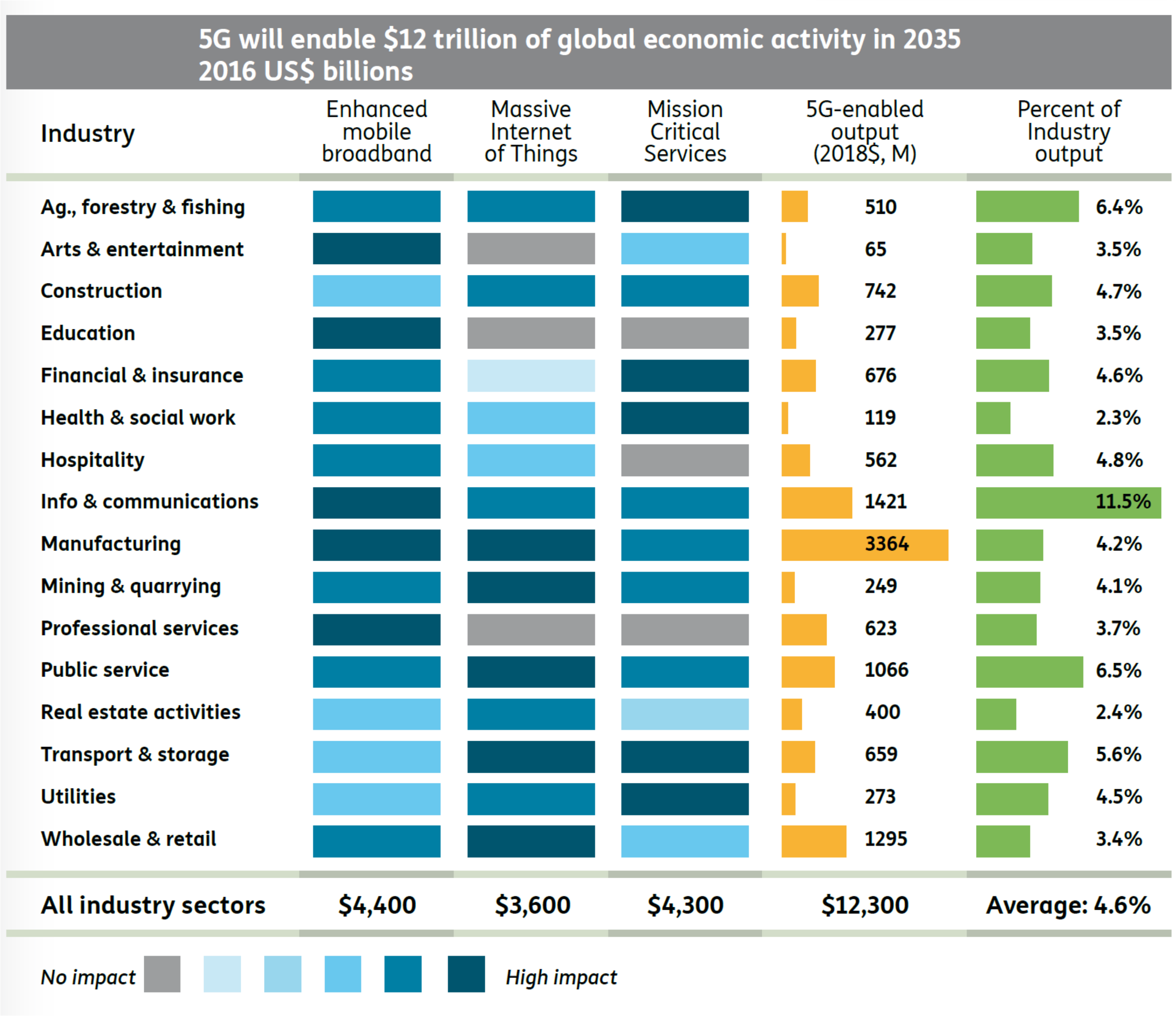
Economical Impact



5G will enable $12 trillion of global economic activity in 2035
2016 US$ billions

Industry	Enhanced mobile broadband	Massive Internet of Things	Mission Critical Services	5G-enabled output (2018$, M)	Percent of Industry output
Ag., forestry & fishing	◉	◉	●	510	6.4%
Arts & entertainment	●	○	◕	65	3.5%
Construction	◕	◉	◉	742	4.7%
Education	●	○	○	277	3.5%
Financial & insurance	◉	◔	●	676	4.6%
Health & social work	◉	◕	●	119	2.3%
Hospitality	◉	◕	○	562	4.8%
Info & communications	●	◉	◉	1421	11.5%
Manufacturing	●	●	◉	3364	4.2%
Mining & quarrying	◉	●	◉	249	4.1%
Professional services	●	○	○	623	3.7%
Public service	◉	●	◉	1066	6.5%
Real estate activities	◕	◉	◑	400	2.4%
Transport & storage	◕	●	●	659	5.6%
Utilities	◕	◉	●	273	4.5%
Wholesale & retail	◉	●	◕	1295	3.4%
All industry sectors	**$4,400**	**$3,600**	**$4,300**	**$12,300**	**Average: 4.6%**

No impact ○ ◔ ◑ ◕ ◉ ● *High impact*