Corso Professionalizzante di Specializzazione (3 CFU)
Ingegneria dell'Informazione o magistrale in Ingegneria Informatica Automatica, Ingegneria Elettronica, Ingegneria delle Telecomunicazioni

WSN and VANET Security

Course Intro

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About me

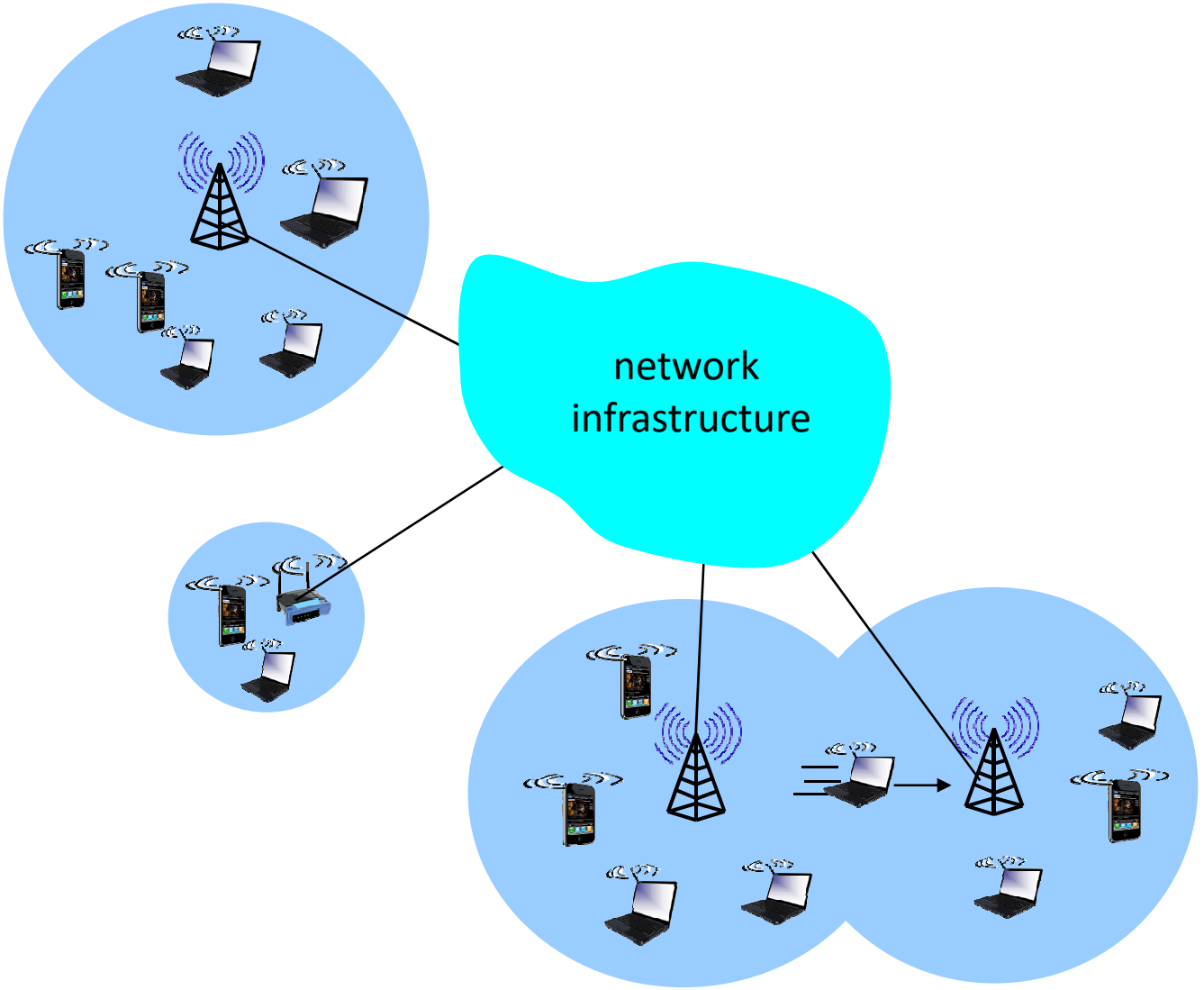
- Laurea degree in Electronics Engineering, University of Roma ”La Sapienza”
- Ph.D. degree in Electrical Engineering and Computer Science, University of L'Aquila
- Registered Civil and Industrial Engineer
- Qualified as Coordinator for Safety in Workplaces (CSP/CSE) according to D.lgs. 81/08.
- Qualified as Security Manager at CE.S.INT.E.S. (Centro Studi in Intelligence Economica e Security Management), University of Roma ”Tor Vergata”
- Certified UNI 10459:2017 “Senior Security Manager” cat. III
- ICMQ-CERSA Auditor for UNI 10459:2017 certification process
- Associated at the Center of Excellence EX-EMERGE, University of L’Aquila
- Member of the Board of Directors in A.I.PRO.S. (Associazione Italiana Professionisti della Sicurezza). Head of Department "Vehicular and Transport Network Security"
- Lecturer on “Wireless Sensor and Vehicular Networks Security”, Specialization Seminar, University of L’Aquila
- Lecturer on "Security Management applied to D.lgs. 231/01 and D.lgs. 81/08“, Course of Qualification in Security Management, Fondazione ICSA (Intelligence Culture and Strategic Analysis)
- IEEE Senior Member (SMIEEE)
- Over 25 years working on ICT and system security with leading industries and service operators, over 40 scientific contributions

See my website https://mpugliese.webnode.it

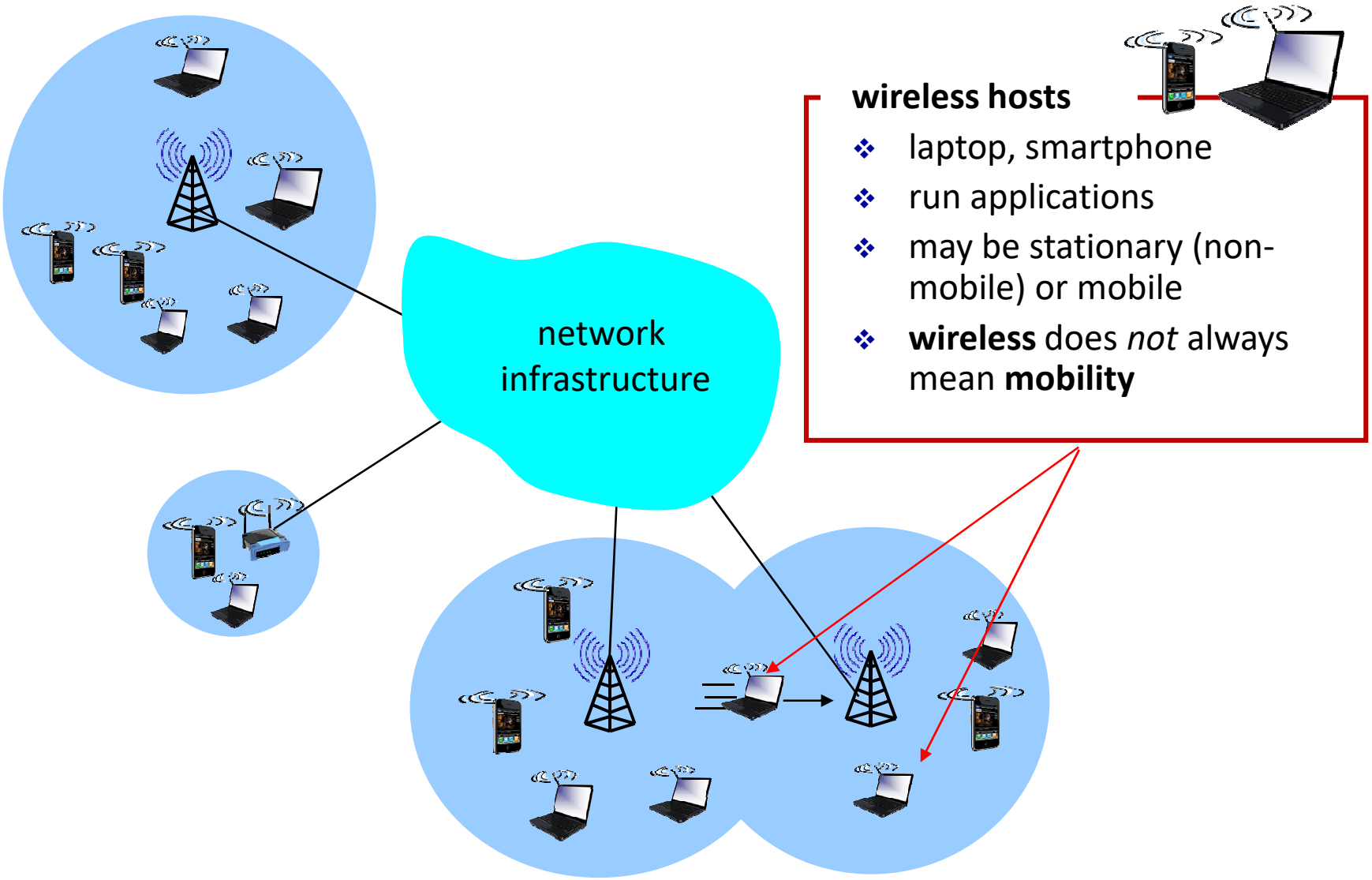
Outline

- Elements of a wireless network
- Wireless Network Taxonomy
- Adhoc Networks (ANET)
  - Mobile ANET (MANET)
  - Vehicular ANET (VANET)
  - Wireless Sensor Network (WSN)

Elements of a wireless network



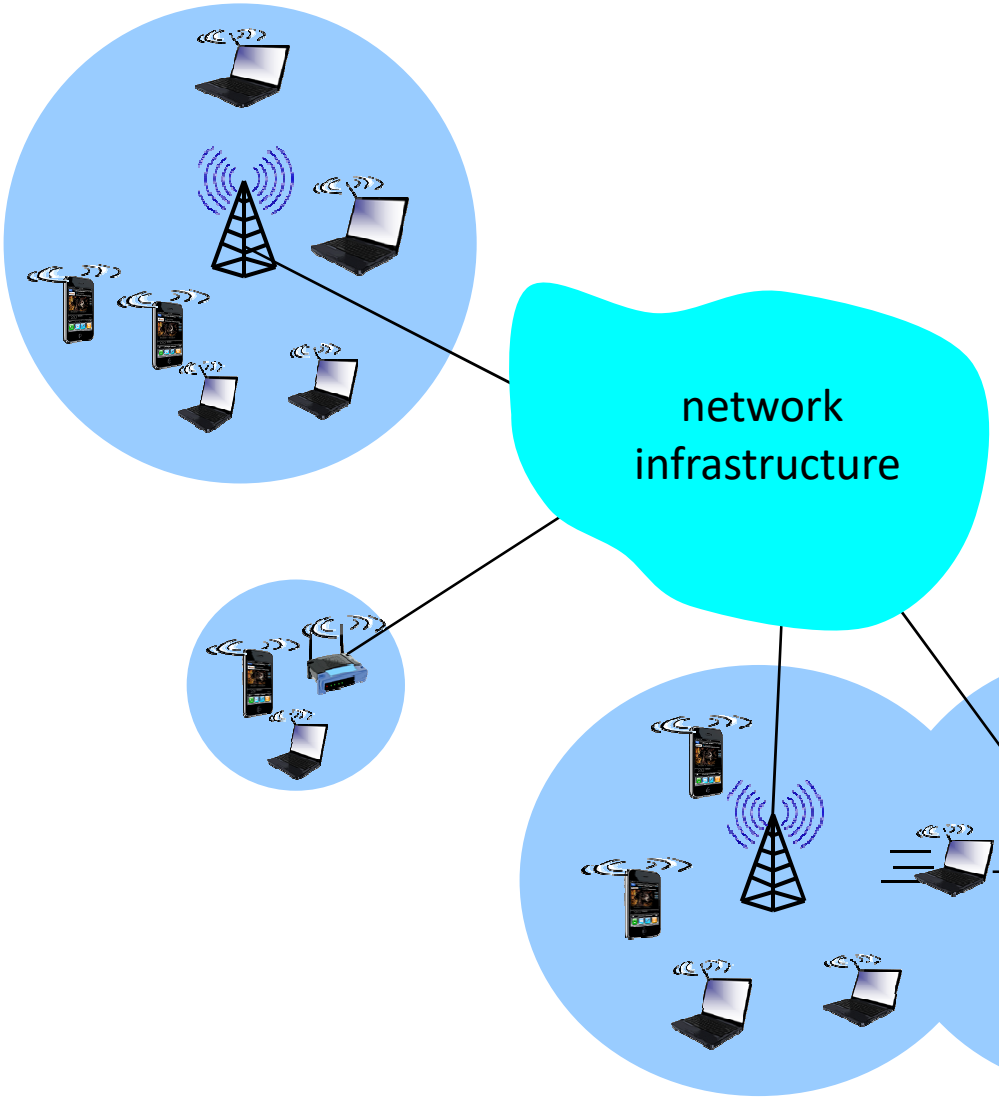
Elements of a wireless network



wireless hosts

- laptop, smartphone
- run applications
- may be stationary (non-mobile) or mobile
- **wireless** does *not* always mean **mobility**

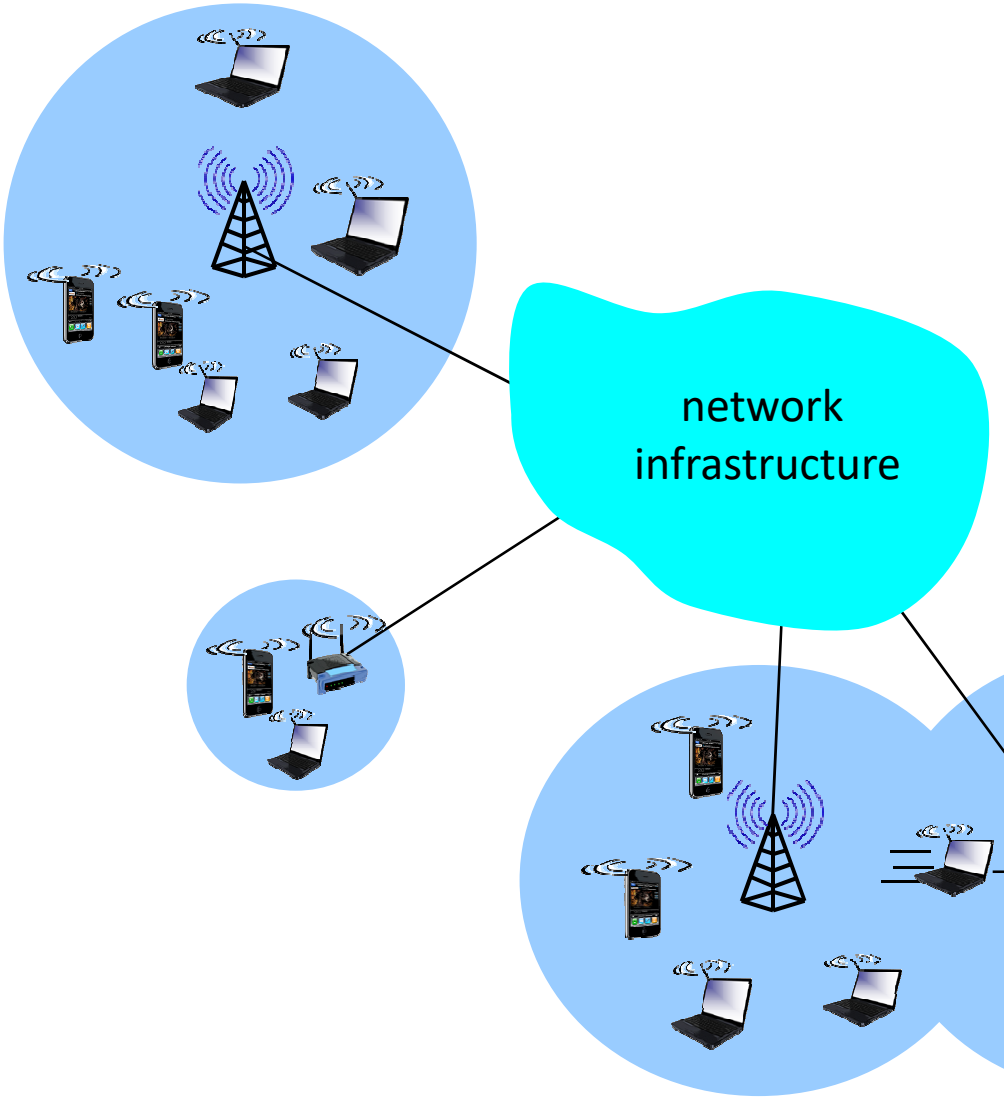
Elements of a wireless network



base station

- typically connected to wired network
- relay - responsible for sending packets between wired network and wireless hosts) in its "area"
  - e.g., cell towers, 802.11 access points

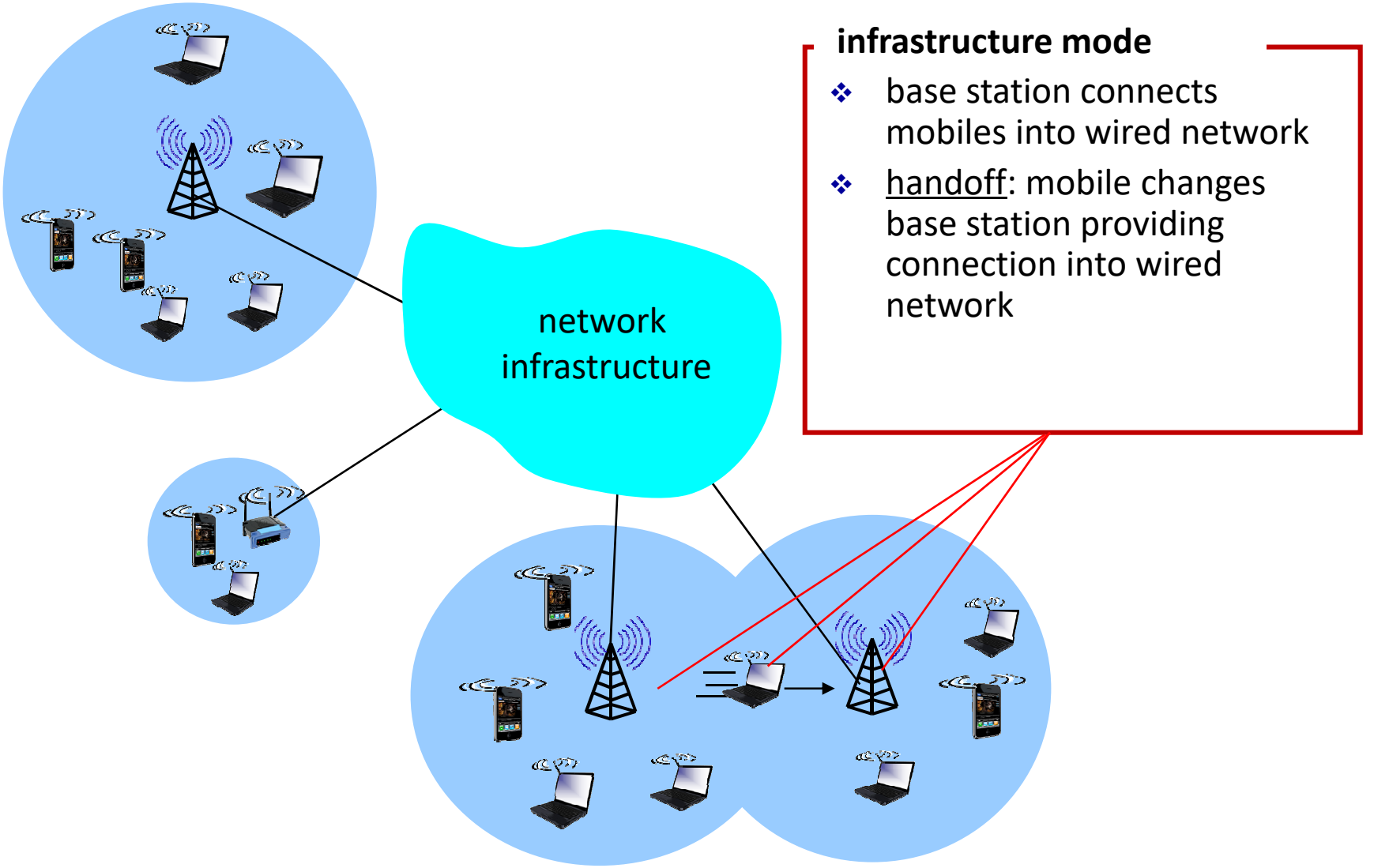
Elements of a wireless network



wireless link

- typically used to connect mobile(s) to base station
- also used as backbone link
- multiple access control (MAC) protocol coordinates link access
- various data rates, transmission distance

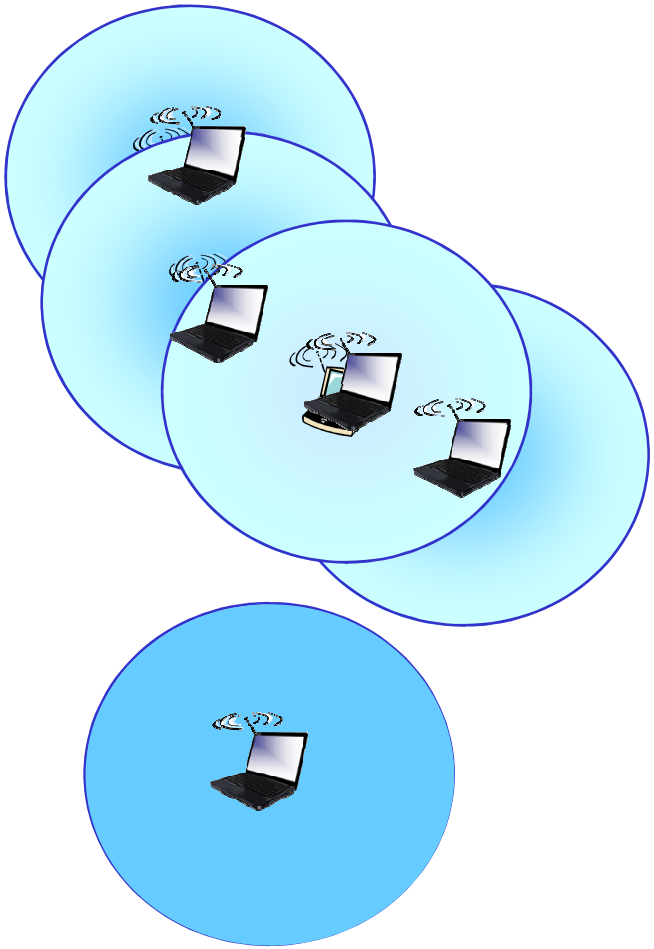
Elements of a wireless network



infrastructure mode

- base station connects mobiles into wired network
- handoff: mobile changes base station providing connection into wired network

Elements of a wireless network



(pure) ad hoc mode

- **no base stations –only peer to peer communications**
- nodes can only transmit to other nodes within link coverage
- nodes organize themselves into a network: route among themselves

(hybrid) ad hoc mode

- **An Access Point is foreseen**
- nodes can only transmit to other nodes within link coverage
- nodes organize themselves into a network: route among themselves

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Wireless network taxonomy

	single hop	multiple hops
Infrastructured (cellular / hybrid ad hoc)	host directly connects to base stations which connects to larger Internet: **WiFi, WiMAX, cellular**	host may have to relay through other wireless nodes to connect to larger Internet: **WSN, VANET 3GPP-LTE**
Infrastructureless (pure ad hoc)	no base station which connects to larger Internet: **Bluetooth, PTT Radio Terminals**	no base station, no connection to larger Internet. May have to relay to reach other wireless nodes: **MANET, VANET 802.11p**

- Mobile Ad-hoc Network (MANET): e.g. Vehicular Ad-hoc Network (VANET)
- Nomadic Ad-hoc Network: e.g. Wireless Sensor Network

Where intelligence is

- Infrastructured networks: **intelligence into the core**
  - centralized operation services.
  - coverage services, e.g. hand-off, athe edges of the backbone
  - adoption of mature conventional passive / active security functions.

- Infrastructure-less networks: **intelligence into the nodes**
  - self-organizing functions for resilience management (dynamical recovery management, topology management, dynamical function assignment).
  - adoption of challenging passive / active security functions.

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WSN vs. MANET vs. VANET

- **Ad hoc network (ANET):** continuously self-configuring, self-organizing, infrastructure-less network of radio connected devices (nodes). It is sometimes known as “on-the-fly” network or “spontaneous network”.
  - **Wireless Sensor Network (WSN):** nodes are fixed or nomadic sensor units with TX/RX and with energy-constrained processing and storage capabilities. Hierarchical network topology (clusterwise), convergecast data communication patterns.
  - **Mobile Ad hoc NETwork (MANET):** nodes are mobile not necessarily energy-constrained as sensor nodes. Mobile nodes are routers (multihop network) and hosts. Random topology changes rapidly and unpredictably. No hierarchies among nodes (peer-to-peer networks).
  - **Vehicular Ad hoc NETwork (VANET):** class of MANET where mobile nodes (i.e. vehicles) are constrained into predefined paths (roads). However VANET can be also considered infrastructured (3GPP approach to V2X through new V2V interfaces).

    V2I: communications nearby fixed equipment (Road Side Units, RSU).

    V2V: communications among vehicles for fast delivery of real time information (typically traffic, accident and in general alarm info).

    Intra-vehicle: communications among internal devices (ECU) and the edge device (On Board Unit, OBU).

    VANET security management include privacy preservation (GDPR in UE).

Risk Based Thinking

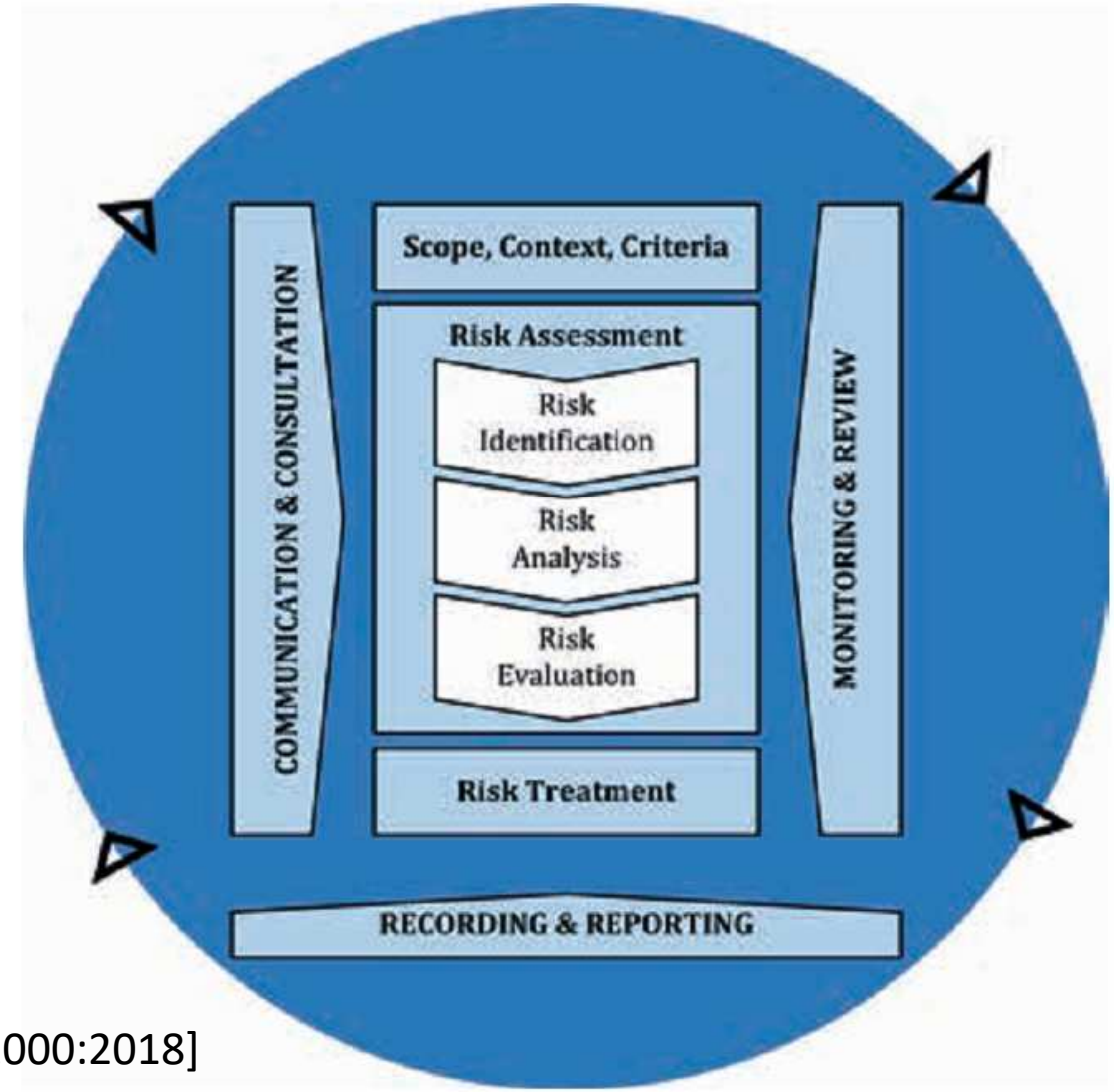
This course will be methodologically based on **risk management principles**:

- **Risk** is defined as the "***effect of uncertainty on objectives***" (ISO 31000:2018).
  - An **effect** is a deviation from the expected positive and / or negative.
  - **Objectives** can have different aspects (financial, health, safety, environmental) and can apply at different levels (strategic, organization-wide, project, product, process).
- **Risk Management** are the "*coordinated activities to direct and control an organization with regard to risk*" (ISO 31000:2018).
- **Risk Magnitude:** the estimated value of a risk.
- **Acceptable Risk:** risk correspondent to the acceptable damage ("TO BE" risk).
- **Inherent Risk:** risk magnitude before treatment ("AS IS" risk).

The generic Risk Management Process instance is the following:

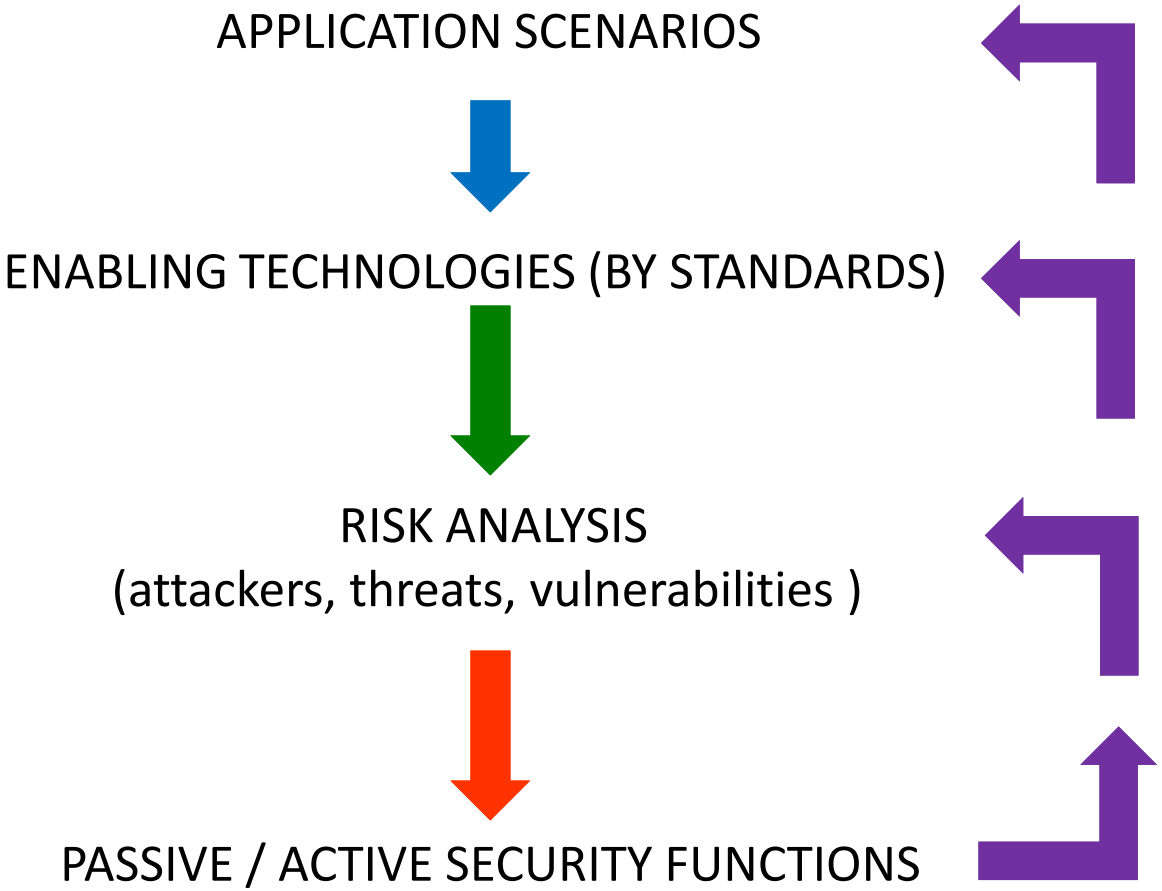
- **Risk Assessment**
  - **Risk Identification**: process of finding, recognizing and describing risks
  - **Risk Analysis**: process of comprehending the nature of risk
  - **Risk Evaluation**: process of estimation of risk magnitude to determine whether the risk magnitude is acceptable .
- **Risk Treatment**: process to reduce risks if not acceptable.

Risk Based Thinking



[Source: ISO 31000:2018]

Risk Based Thinking



Course Schedule

Part I. Generalities on WSN and VANET Security

05.04.24: Lecture I.1 WSN Architectures and Application Scenarios

12.04.24: Lecture I.2 VANET Architectures and Application Scenarios

19.04.24: Lecture I.3 Security Management

19.04.24: Lecture I.4 Cyber Attackers and Attacks

Part II. Techniques for WSN and VANET Security

26.04.24: Lecture II.1 Passive Security Functions

03.05.24: Lecture II.2 Active Security Functions

10.05.24: Lecture II.3 WSN Security

17.05.24: Lecture II.4 VANET Security and Privacy