



# Current Benefits and Future Directions of NFC Services

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**International Conference on Education and  
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# Outline

- Introduction to Near Field Communication (NFC)
- NFC Operating Modes
- Discovered Benefits and Future Scenarios of NFC Services



# Outline

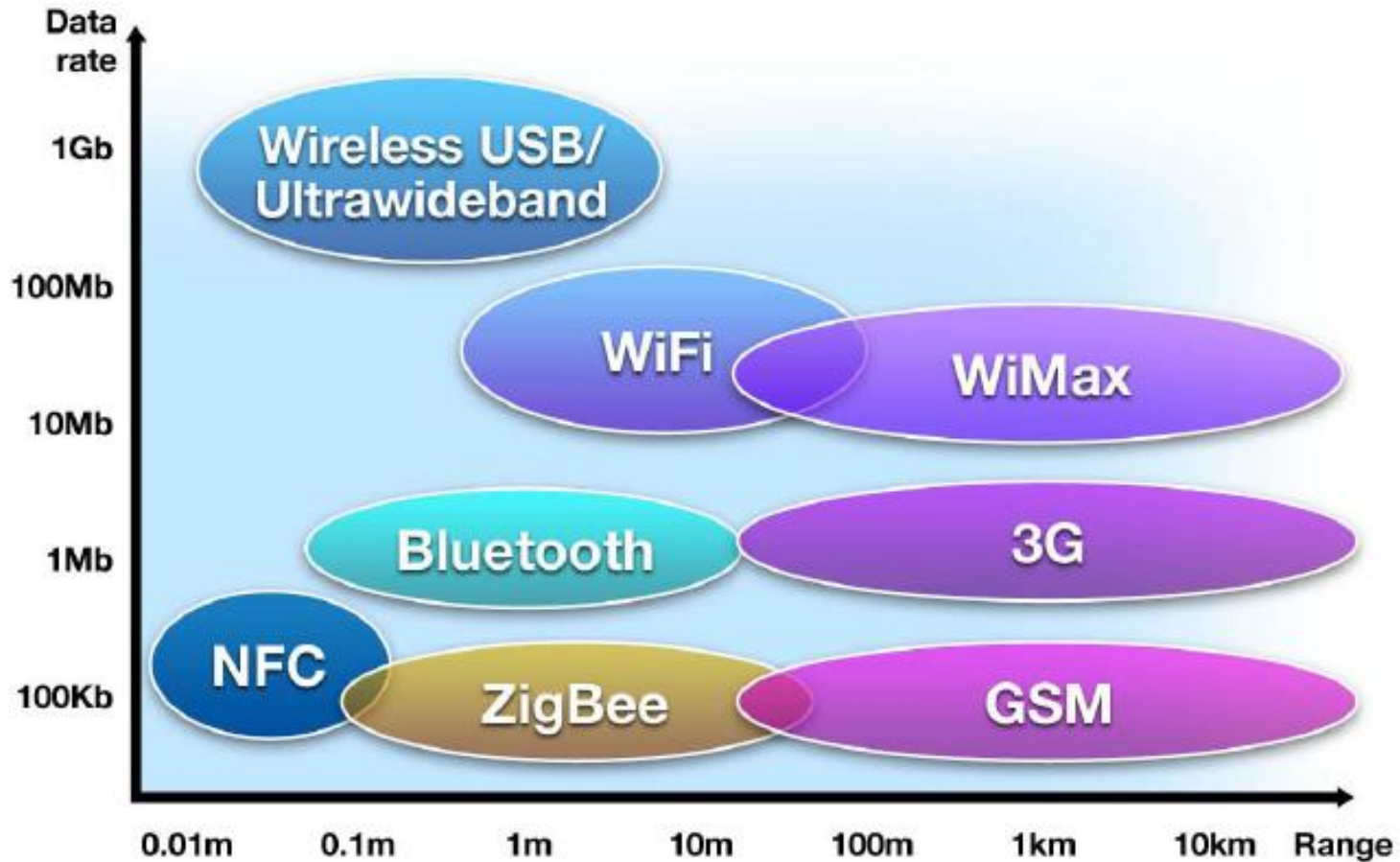
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# Near Field Communication

- Developed by Sony and Philips in late 2002
- Evolved from Radio Frequency Identification(RFID) technology
- Short Range Radio Communication Technology
- Frequency: 13.56 MHz.
- Max. Bandwidth: 424Kbits/sec
- Communication starts when two NFC-compatible devices brought together less then four centimeters
- NFC Forum is the leading organization that organizes the efforts

# NFC - Data Rate



# Advantages of NFC Technology

- NFC technology can benefit from mobile phones
- The technology is compatible with existing RFID structures, existing RFID tags and contactless smart cards
- Short range communication (up to 4 cm.)
  - Automatic coupling
  - Inherent security
- Ease of use (Very familiar to people, only touch)
- Mobile phones can be used both as an information storage devices or an NFC reader
  - They can read information from NFC tags
  - They can be used as a digital storage e.g. storing credit card information.

# University Smart Poster\*



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\* G. M. Miraz, I. L. Ruiz, M. A. Gomez-Nieto, "How NFC can be used for the Compliance of European Higher Education Area Guidelines in European Universities", Proc. 1st International Workshop on Near Field Communication, Hagenberg, AUSTRIA, IEEE, 2009, pp. 3-8.

# NFC Ticketing\*



\* Peter Preuss, NFC Forum and NFC Use Cases presentation, <http://www.nfc-forum.org/>



# NFC Payment\*



\* Peter Preuss, NFC Forum and NFC Use Cases presentation, <http://www.nfc-forum.org/>

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# Active vs. Passive Device

- Devices containing power sources are called as active; In NFC model active device options are:
  - Mobile phone
  - NFC reader
- Devices without any available power sources are called as passive; In NFC model there exists only one passive device:
  - RFID tag

# NFC Model

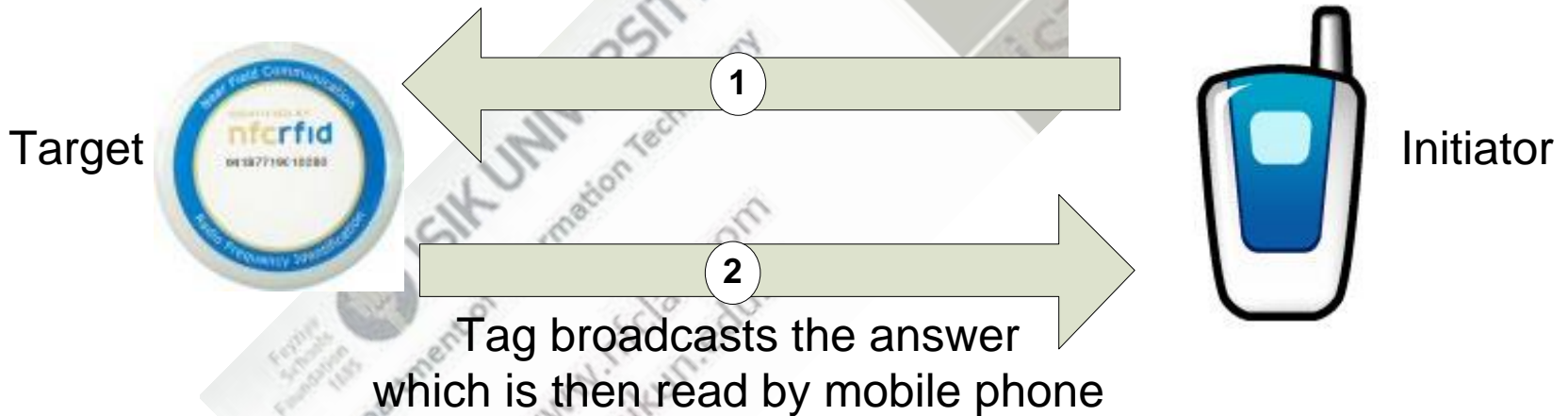
- In an NFC model two devices are involved in the communication
- **Initiator:**
  - Initiator starts the communication
  - Can be either a mobile phone or an NFC reader both of which are active devices
- **Target:**
  - Responds the initiator's requests
  - Can be either a RFID tag or a mobile phone
- Single RF band is used; communication is half-duplex

# NFC Operating Modes

- NFC has three operating modes as defined by NFC forum:
  1. Reader/Writer mode
  2. Card Emulation Mode
  3. Peer-to-Peer mode

# Reader Mode

NFC-enabled mobile phone creates magnetic field and powers the NFC tag within 4 cm



# Writer Mode

NFC-enabled mobile phone  
sends a query which also  
creates magnetic field and  
powers the NFC tag in 4 cm.  
NFC tag then saves the data to  
its internal memory

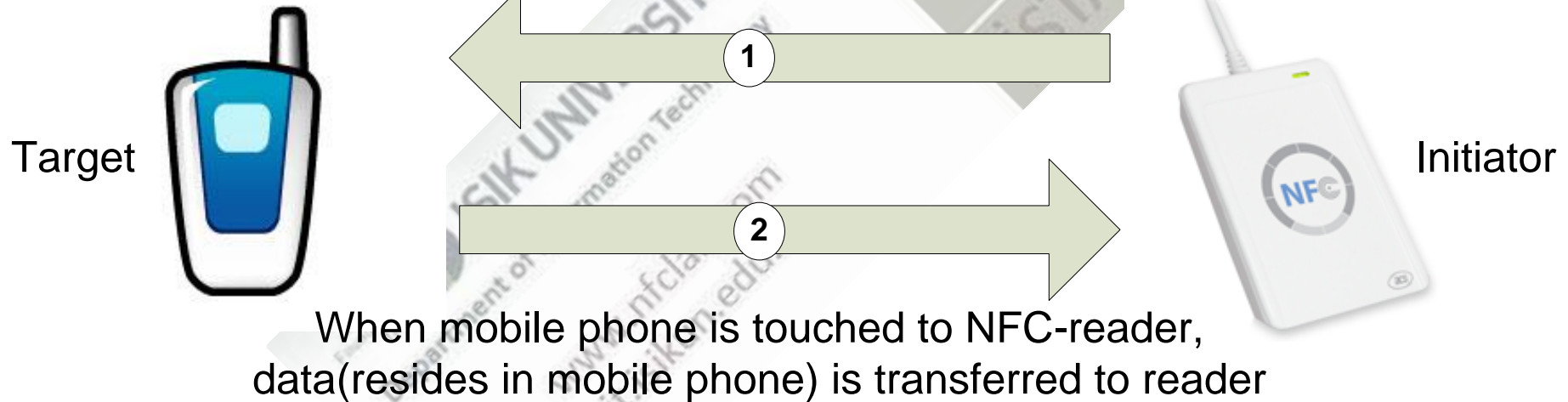
Target



Initiator

# Card Emulation Mode

NFC-reader generates 13.56 MHz magnetic field

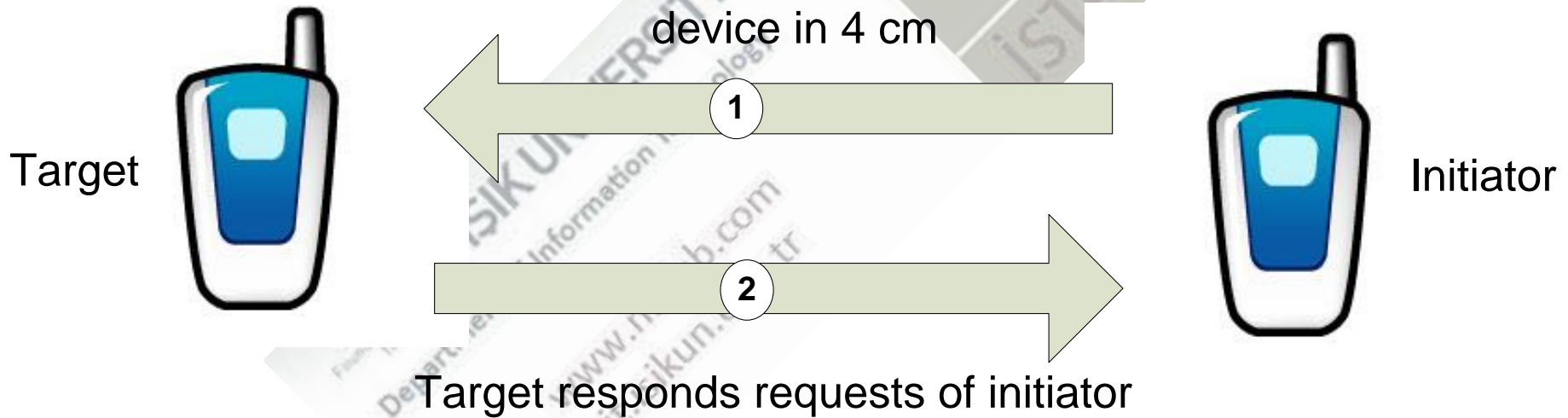


When mobile phone is touched to NFC-reader,  
data(resides in mobile phone) is transferred to reader



# Peer-to-Peer Mode

Initiator sends or requests data from target device in 4 cm



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# Our Research

- Research Questions:
  - What are the benefits of currently developed NFC applications?
  - Which possible applications can be implemented in the future, and what benefits can we expect from them?
- 42 NFC applications are reviewed from 50 research papers
- All applications are grouped according to their operating modes

	<b>R/W Mode</b>	<b>CE Mode</b>	<b>P2P Mode</b>
Reviewed applications based on operating modes	35 apps.	9 apps.	4 apps.

# Discovered Benefits

	R/W Mode	CE Mode	P2P Mode
Benefits	<ul style="list-style-type: none"><li>• Increases mobility</li><li>• Decreases physical effort</li><li>• Ability to be adapted by many scenarios</li><li>• Easy to implement</li></ul>	<ul style="list-style-type: none"><li>• Physical Object Elimination</li><li>• Access Control</li></ul>	<ul style="list-style-type: none"><li>• Easy data exchange between devices</li><li>• Device pairing</li></ul>

# Future Scenarios

	R/W Mode	CE Mode	P2P Mode
Future Scenarios	<ul style="list-style-type: none"><li>Many real-life scenarios can be adapted to NFC in this mode.</li></ul>	<ul style="list-style-type: none"><li>Integration of id-cards, passports, finger-prints, driver-license</li><li>Storage area for critical information to provide user's privacy and authorizing people to access those information</li></ul>	<ul style="list-style-type: none"><li>Secure exchange of critical data</li><li>Gossiping</li></ul>

# Conclusion

- Integration of NFC technology with mobile phones (mobility, relatively high processing power, Internet access) has a great potential to bring new opportunities to our lives
- Benefits of NFC applications had not been compared since this study
- We have clearly indicated that each NFC operating mode provides different kinds of benefits to users
- We also derived future usage scenarios based on each operating mode which can be used for further developments
- NFC technology is promoting a new market for both mobile phone producers/chip manufacturers/sellers... and NFC service developers
- Developing and promoting NFC enabled services will play an important role for companies in the near future
- Marketing NFC enabled mobile phones will be crucial (1.211 billion mobile terminal sales in 2009 - Gartner)



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