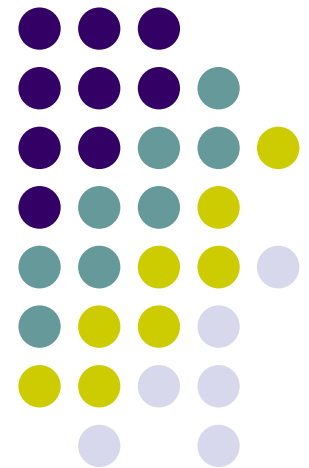


Mobile and Ubiquitous Computing

CS 525M: P2P Micro-Interactions with NFC-Enabled Mobile Phones

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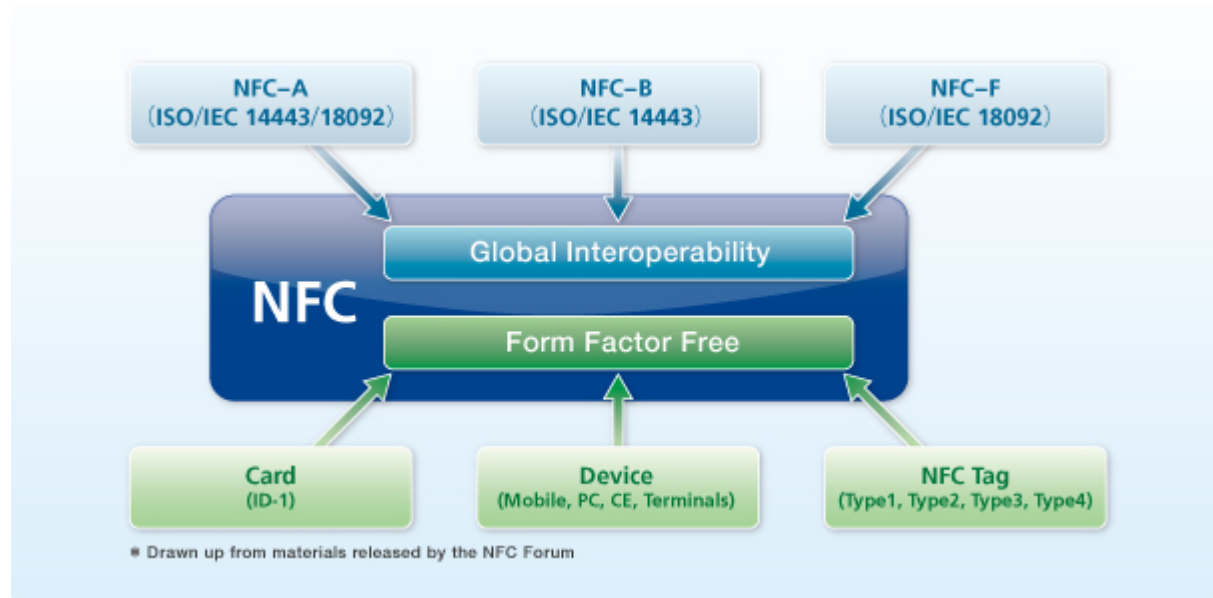
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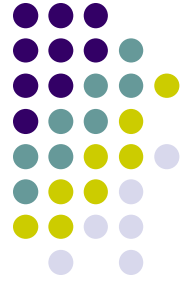




Introduction

- *Near-Field Communication*
 - Standardized in Dec. 2003 (ISO/IEC 18092)
 - Combination of three existing technologies





Introduction

- *“NFC is a short-range wireless technology to exchange data among various devices with various usages.” - SONY NFC Website*





Introduction

- *Frictionless* Micro-Interactions
 - Sharing information with other devices
- Bluetooth? -> Requires pairing
- Wi-Fi ad hoc? -> Requires settings
- IrDA? -> Requires Aiming and Steadiness
- NFC
 - No pre-configuration
 - Transaction in less than a second





Related Work

- Device to Phone Micro-Interaction
 - Reach Out and Touch: Using NFC and 2D Barcodes for Service Discovery and Interaction with Mobile Devices
 - Comparison between NFC and QR codes for posters
- Bump application
 - Phone to Phone
 - Computer to Phone
- ...and various other commercial products
 - Rice-cooker? Washing Machine?



Types of Micro-Interactions

- Multi-Party (e.g. Phone to Phone)
 - By touching two phones, user can share files, contact information, and application
 - Can download application on the fly
- Self across interactive devices (e.g. Phone to PC)
 - Borrow keyboard on PC for phone
 - Using password manager on phone
 - Confirmation is not required, possible white-list for security

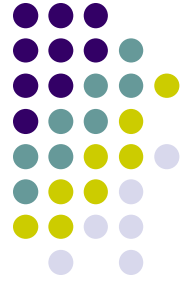


Types of Micro-Interactions

- Remote Control (e.g. Phone to TV or Car)
 - Displaying a photo on TV
 - Loading music preferences and seat position for a car
 - Phone initiated interaction



From NFC & Smart WORLD 2013 – *Kakaku.com Magazine*



Methodology - Junction

- Dodson et al. constructed multiple libraries for NFC and a platform *Junction*
- *Junction* was inspired by Android's NFC implementation, using NDEF_[1] messages
- *Junction* allows establishing a session (Wi-Fi, Bluetooth) across devices after a NFC “touch”



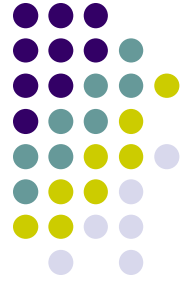
Methodology - Junction

- Junction uses a Interaction Manifest to represent dispatching application
 - One way communication, avoiding request/response
- Contains:
 - Platform Identifier (e.g. Android, iOS, Web)
 - Platform-specific application reference (installed and installable programs)
 - Application arguments
 - (Optional) Device modality for different devices



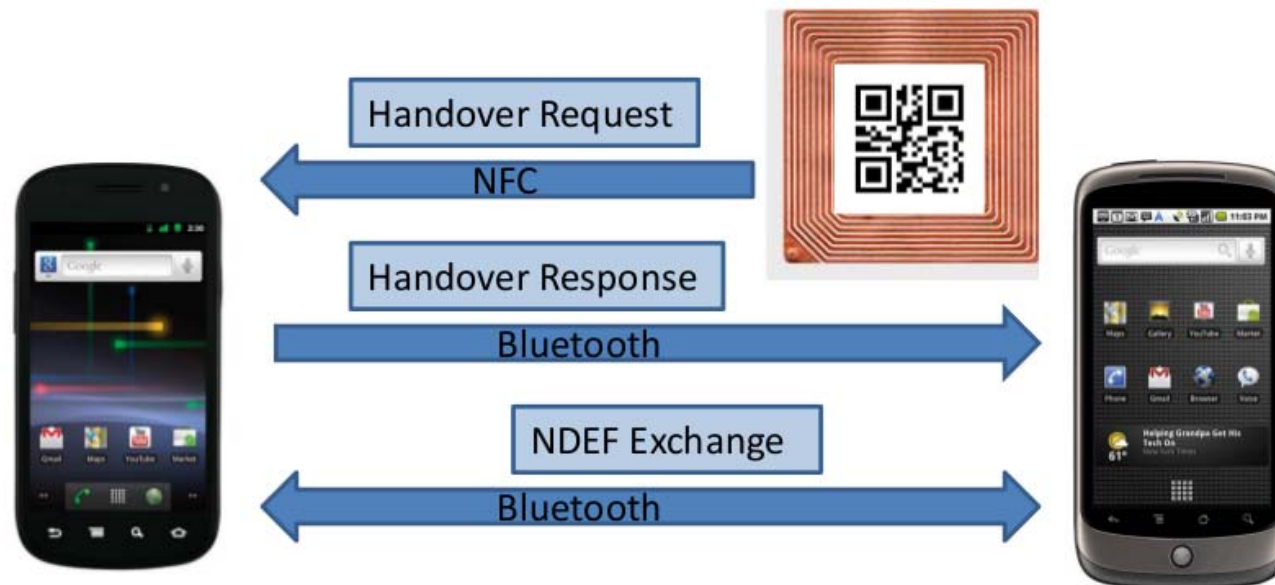
Methodology - Junction

- *Context-rich*
 - Application on foreground wishes to use NDEF
- *Context-bare*
 - Application cannot or does not use NDEF
- Two context-rich applications?
 - Exchanges the applications' Interaction Manifest
- Two context-bare applications?
 - Exchanges handover address and device type
 - Prompts user what to do



Methodology - Handover

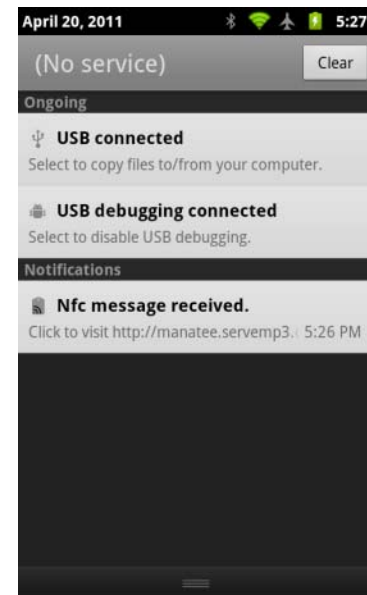
- What about phones that does not have NFC?
 - Affix a *passive* NFC/QR tag, and initiate a handover
- After handover, exchanges NDEF messages





Methodology - Handover

- EasyNFC library for Android
 - Requires Internet and Bluetooth permissions
 - Simplifies connection between phones using NDEF
- LegacyNFC service for Android
 - Listens on Bluetooth for NDEF handover responses
 - Acts like a NFC chip for non-NFC phones





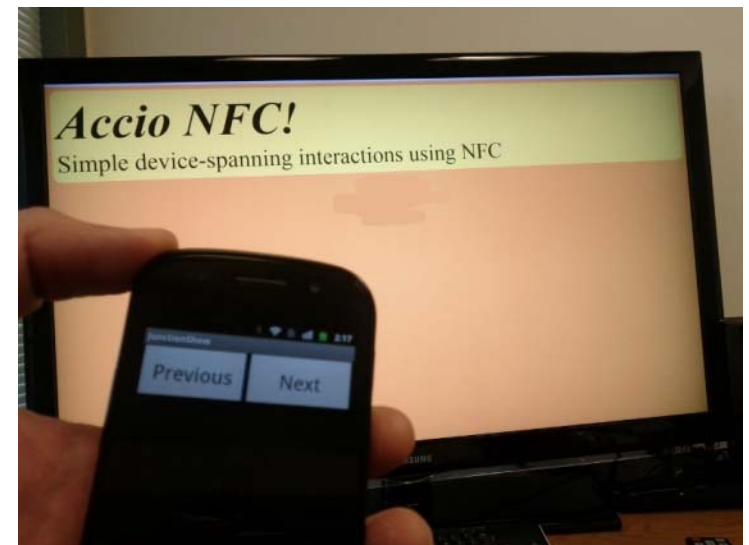
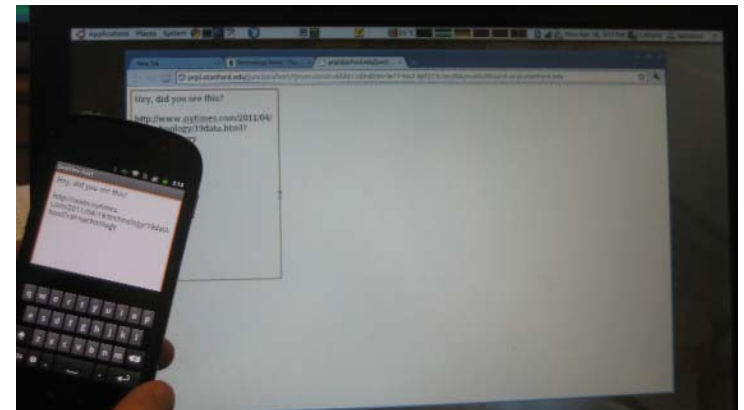
Methodology - Handover

- DesktopNFC service for PCs and TVs
 - Supports Bluetooth and TCP/IP handovers
 - Similar to LegacyNFC
- Activity Director
 - Supporting application for previous libraries
 - Upon receiving NDEF message
 - If supporting application is installed, launch it
 - If not, prompts to install application on Google Play



Results - Applications

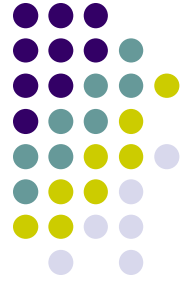
- TapBoard
 - Can use PC keyboard to input text
 - Uses connection handover to share a URL
- PocketSlides
 - Scan NFC/QR tag for a display
 - Phone is a remote control for display
 - Uses connection handover for sharing a URL





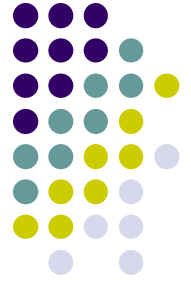
Results - Applications

- Hot Potato
 - Application that can share files from existing apps
 - Larger files can be transferred with handover
 - Supports “copy and paste” by handing a reference
- weHold’Em
 - Uses Junction, JavaScript and HTML
 - Touching phone invites player to game
 - Touching the TV shows the chips and community cards



Future Work

- Security for NFC transactions
 - Eavesdropping, Man-in-the-middle attacks, losing the phone
- More devices with NFC support
 - Train route information, Air conditioners?
- Micro-Payments and Tickets
 - Buying coffee with NFC prepaid card
 - Train ticket, Airline ticket, Hotel check-in, etc....
- User Study???



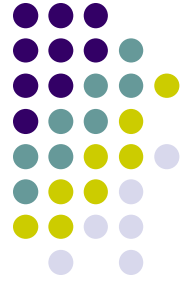
Conclusion

- Junction allows a simple method for micro-interactions using NFC
- Not only for phones, but for any device with Internet or Bluetooth capabilities
- Libraries allow abstraction of NFC hardware from the application programmer
- Infinite possibilities of applications using NFC technology

Thank You!

- Questions?





References

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