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4/14/11

Rule your digital world with the mobile Hot Potato

NFC (Near Field Communication)

- NFC is a wireless technology for interacting with devices with a touch.
  - ~ 5cm range, ~424 kbit/s bandwidth.
- Supports Active and Passive devices
  - Active: powered devices; phones, PC readers, etc
  - Passive: unpowered. Stickers, ID badges, credit card.

Interactions at a Touch

- Why do people care about NFC?
  - "It's coming." Payments, coupons, ticketing.
  - Finally reaching the latest generation of mobile devices.

- Why do *we* care about NFC?
  - Is short-ranged, intention-oriented, quick setup.
  - Bidirectional, symmetric communication.
  - NFC is low-power, can be always on.
  - Lives "behind the screen", in the background.

We like our phones.

- Phones
  - Powerful.
  - Connected.
  - Always with us.
  - Personal.
- Phones have a sense of **identity**.

We like our other devices, too.

NFC helps us bring them together

- Phone is your digital personality, which it brings to other devices.

What is Hot Potato?

- Instant transfer of the one thing in my hand
- Instant trigger of the appropriate reaction upon receipt of the thing

Hot Potato is useful (demos)

- Phone-to-Phone, Phone-to-PC, Phone-to-TV
- Sharing links
- Sharing files
- Running applications

Hot Potato Paradigm

- Foreground application "owns" the radio.
- Designate the "hot potato" in advance
  - mNfc.share(object);
- Specify the handler
  - Foreground app: mNfc.addNdefHandler(handler)
  - Otherwise: Intent filters, protocol handlers

- NFC touch issues bidirectional exchange

Context-Aware NFC

- One touch, many interactions
  - Phone-to-Phone
    - Two people exchanging data.
    - Links, files, contact information, applications
  - Phone-to-PC
    - User-to-self interactions
    - Authenticated links, personal utilities, files, payments
  - Phone-to-TV
    - User-to-device
    - Multimedia, applications
    - Handle content with no further action

Challenges of Sharing with NFC

1. What if the device doesn't have NFC?
2. How do we share more than just data?
   - Cross-platform applications
3. How to keep an ongoing interaction?
   - Multi-partied, real-time communication

Key Concept: Virtual NFC

- Standardize on NDEF (language of NFC)
- Standardize on single-packet exchange
- Implement across devices without NFC

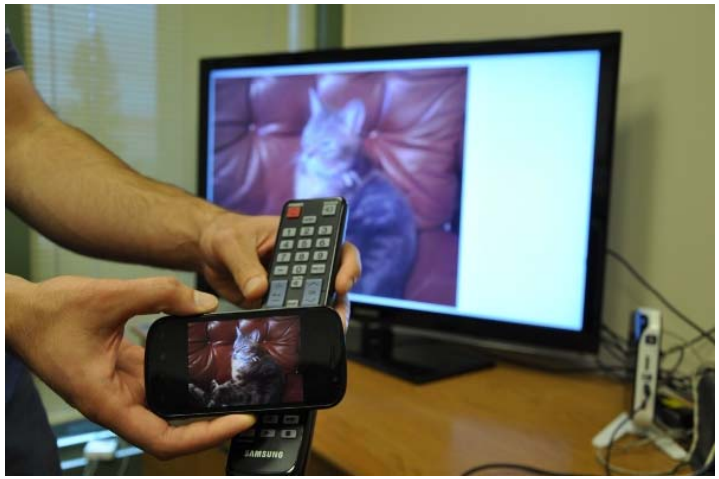
NDEF: The language of NFC

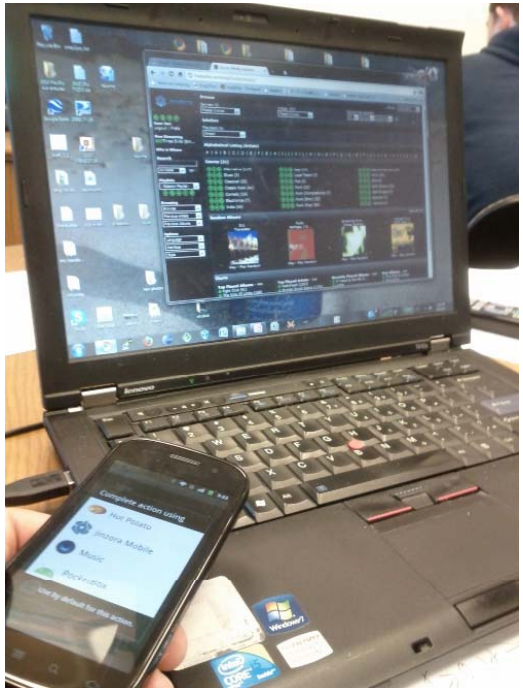
- NFC Forum defines a data format called NDEF (NFC Data Exchange Format)
- NDEF is at the same level as HTTP, OBEX
  - Can be run over any link layer
  - But is designed for use with NFC
- NDEF Exchange is not request/response
  - Especially when dealing with passive NFC devices.
  - Requires a packet structure that contextualizes its content.

NDEF: The language of NFC

- NDEF Format
  - NDEF Message has 1 or more NDEF Records.
  - NDEF Record has:
    - Type Name Format (TNF)
    - URI, Mime-Type, Well-Known-Type, External
    - RTD (Record Type Format)
    - "uri", "application/jpeg", "connection handover" …
    - And a payload of arbitrary bytes.

1. Devices without NFC





Connection Handover

- Connection Handover is a specially formatted NDEF message
  - Generic framework defined by NFC Forum
  - Negotiated handover, or static handover
- libhotpotato recognizes "NDEF Exchange" handover
  - Runs bidirectional NDEF exchange protocol over bluetooth or tcp
  - Invisible to developer.

Preparing a non-NFC device

0. Associate NFC tag with a “touchless”phone

Preparing a non-NFC device

1. Run Hot Potato daemon.

QR code encodes Bluetooth address and public key.

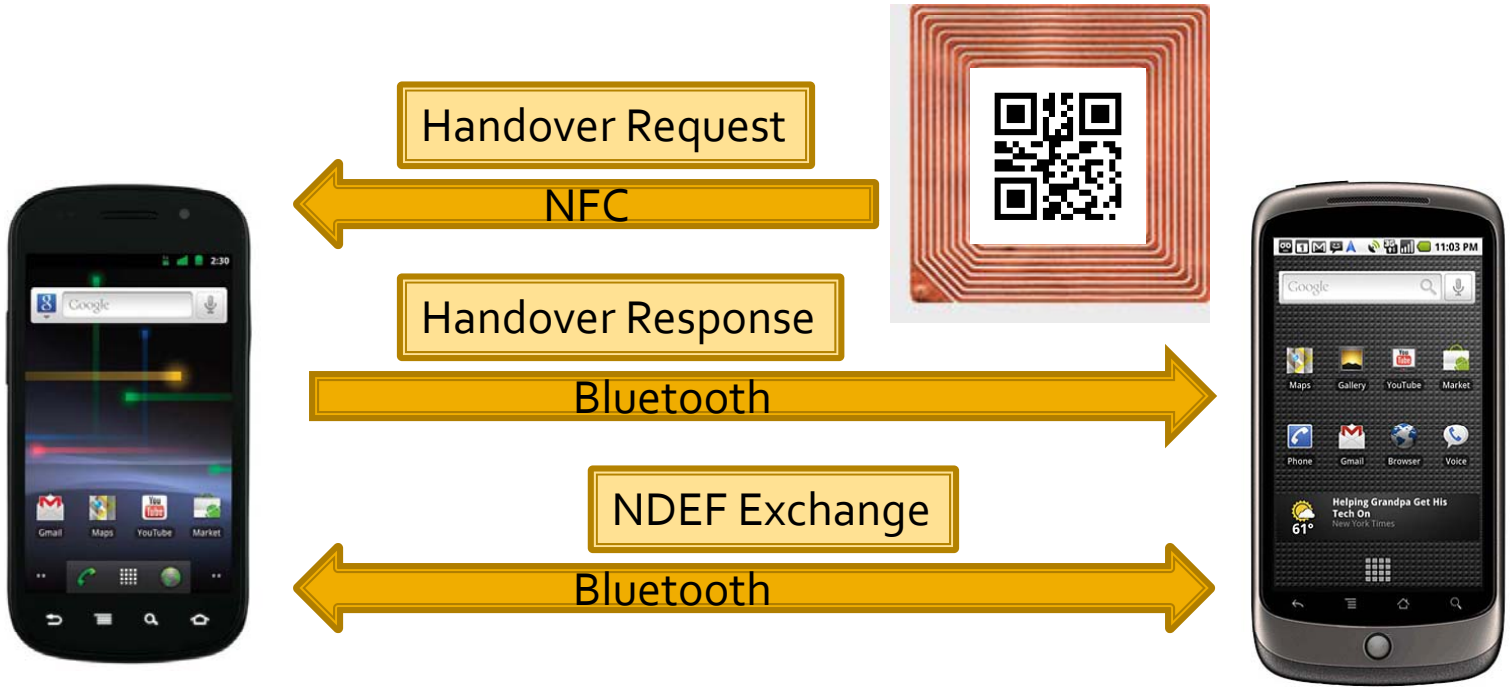
Preparing a non-NFC device

2. A friend with NFC helps out

Preparing a non-NFC device

3. Writes request to tag

Connection Handover



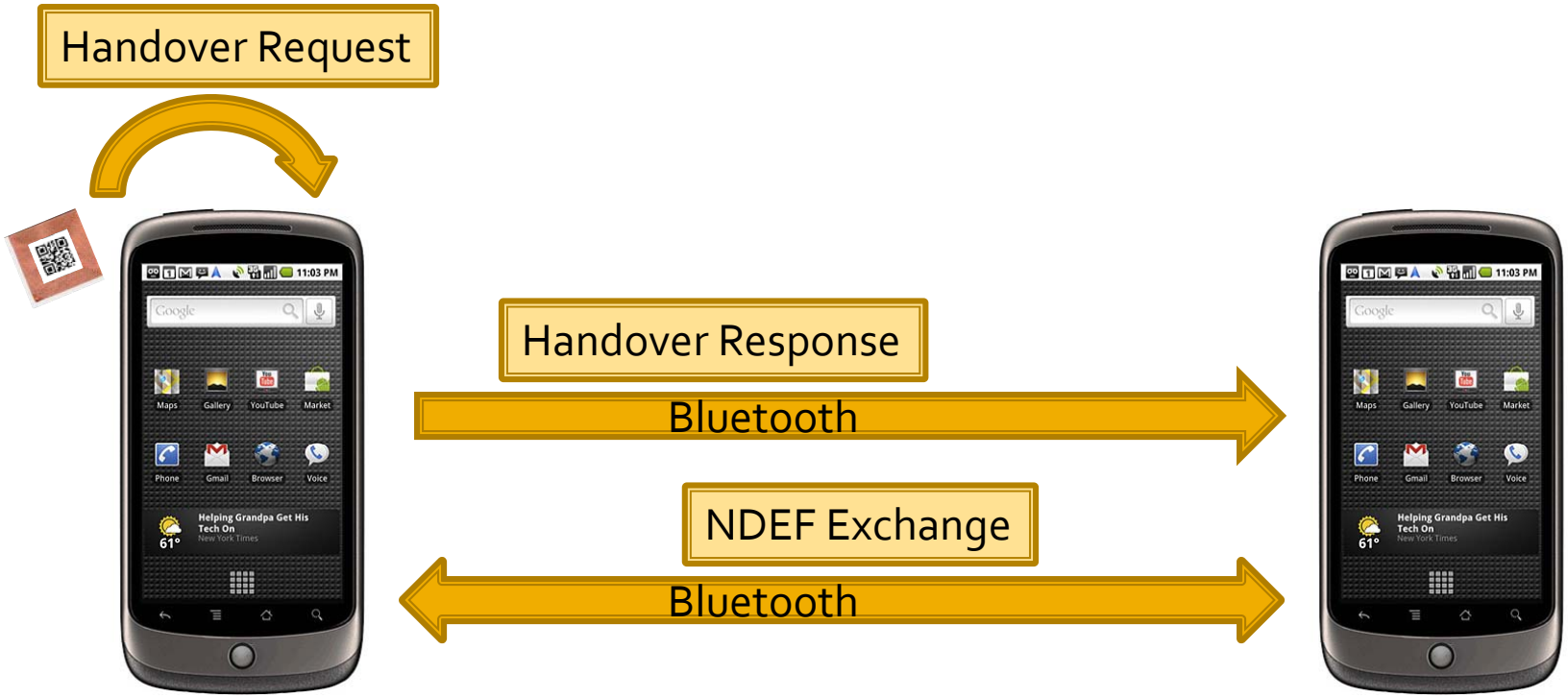
- All hidden from the developer

NDEF Exchange as First Class Object

- An NDEF Exchange request is representable as a data structure
- Can pass it between devices, store it for later

- Virtualized NFC: Can use the NFC interaction without the NFC radio

Virtual NFC (Ndef Exchange)



Virtual NFC


11:25
NfcLinks
Choose a link then touch your phone to share it.
Nfc-TV Demo (Video)
GMail
MobiSocial
The Manatee
Engadget
Slashdot
Now sharing: The Manatee.
11:26
NfcLinks
Choose a link then touch your phone to share it.
Nfc-TV Demo (Video)
GMail
MobiSocial
The Manatee
Engadget
Slashdot
Now sharing: The Manatee.
April 9, 2011
11:26
(No service)
Clear
Ongoing
USB connected
Select to copy files to/from your computer.
USB debugging connected
Select to disable USB debugging.
Notifications
Share current activity.
Click to send to another device.
11:26 AM

2. Sharing applications

- Application shares itself over NDEF Exchange
  - May be received by
    - Same application
    - Different application
    - Some Platform
- How do we represent an application so it can be understood in any context?

Application Manifest for Cross-Platform Apps

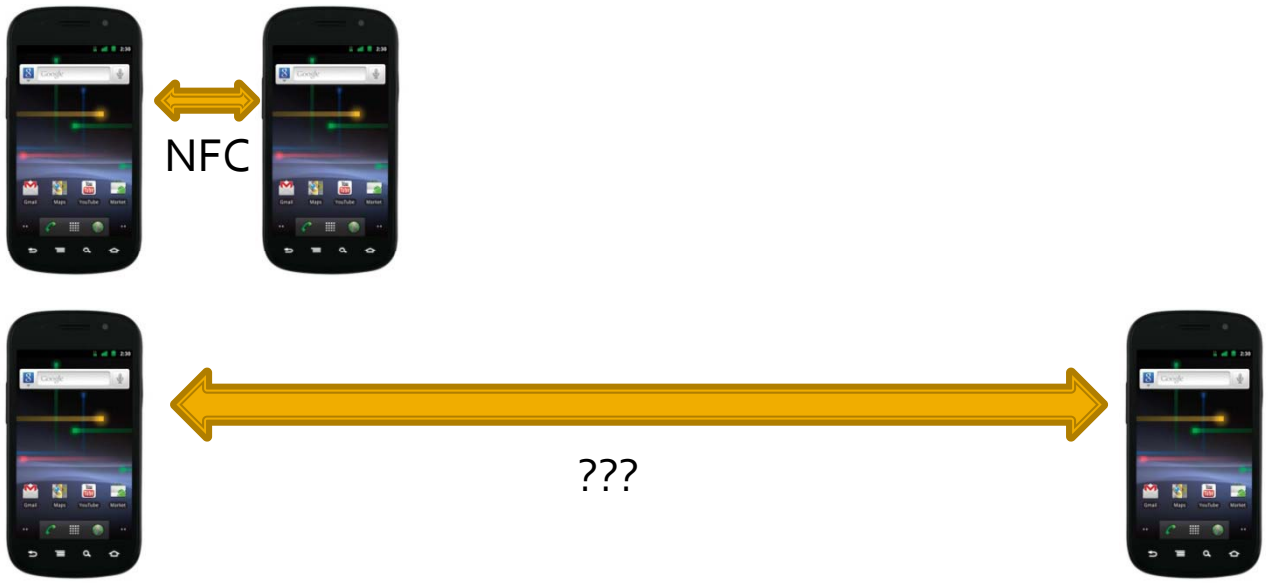
Application Manifest for Cross-Platform Apps

- Encodes a list of:
  - (platform, app-reference, app-argument)
  - Whiteboard:

Platform	App reference	App argument
Android+Market	mobisocial.whiteboard	junction://sb/m48727f
iPhone+Store	mobisocial.whiteboard	whiteboard:// junction://sb/m48727f
Web	mobisocial.stanford.edu /whiteboard	{jxuri : junction://sb/m48727f}

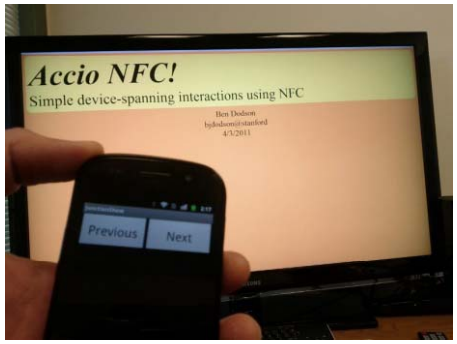
3. On-Going Interaction

- If NDEF exchange is a single-packet transaction, how do we have an ongoing interaction?



Junction

- Cross-platform framework for device-spanning applications.
  - Provides real-time communication across devices
  - Running session represented as URI, separate from code URL.



Why not Bump?

- Biggest differences between NFC and Bump
  - Requires user interaction to bring up
  - Blocks current activity
  - Receiver must launch special program
  - All data passes through Bump cloud service

  - NFC is always on
  - Lives behind the screen

What can we do?

- NFC Forum specifies radio and "firmware"
  - Large consortium good for base standards, not suited for rapid software evolution
- Platform vendors need higher level standards
  - NDEF Exchange protocol
  - Handover protocols
  - App Manifest

Conclusions

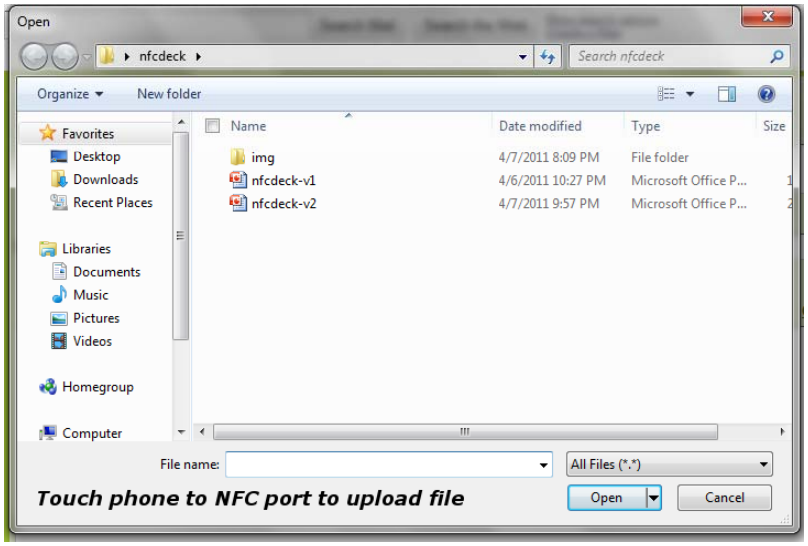
- NFC enables 0-click interactions
  - What's in front of the screen represented behind the screen
- "NDEF exchange" as interesting as NFC
  - NFC as a *system*, not just a radio.
  - Open standard around this exchange.
- Right abstraction lets us extend the experience of NFC for users, without burdening developers

- Hot Potato and libhotpotato available now
  - http://github.com/mobisocial

- Thanks!

Looking Forward

- Nfc.js
  - Allow web pages to interact with NFC directly
- OAUTH2-based mobile bookmarks
- Better desktop integration
- Handover environments



Establish a Bluetooth Connection

```
onBluetoothConnected
        (BluetoothSocket s) {

    // Your code here
};
```

Roadmap

- Observations on our digital world
- Augmenting interactions with NFC
- Defining the Hot Potato
- Context-Sensitive Interactions with NFC
- Virtual NFC
- Conclusions

Contributions

- Vision: Phones makes our digital experience coherent
  - Centralized management of identities & personal assets.
  - Hot Potato connects them to friends and surrounding physical devices
- Hot Potato abstraction: user and application layer
  - Uniform experience of sharing with an NFC tap.
  - Virtual NFC: NDEF Exchange Connection Handover
    - For transferring large data types
    - Inter-operability across devices without NFC
  - Compatibility across platforms
    - Apple unlikely to adopt "Android NDEF Push Protocol"
- Open-source Android library → standard across platforms?

Distributed Applications

- Require three problems be solved:
  - **Naming.** How to refer to another device
  - **Communication.** How to send messages
  - **Contextualization.** How to interpret messages
- NFC solves all three with a tap.

What is the Hot Potato?

- Model: Two devices touch, "want" to interact
  - Intentional Initiations
  - Focus on one object at a time
- Exploit NFC's 0-click potential
  - Enable *Spontaneous Interactions*
- Contextually-aware message exchange

Enabling the Digital Hot Potato

- Question: How do you represent what's on screen to a random visitor?

Programming Paradigm

- Two devices touch triggering an interaction.
  - Simultaneous event between two devices
    - Developer prepares data in advance.
      - makeDataAvailable(…), not sendDataNow(…)
      - onDataReceived(…), not data = waitForData(…)

NDEF: Why it Matters

- NDEF defines the "hot potato"
  - Self-contained, well-typed data structure
  - Contain contextual invocation information
- NDEF Exchange
  - Make a single object available, provide as much context as possible up front.

What is Hot Potato?

NFC-inspired user interaction

- Based on the technique we call virtual NFC

With one tap

- Activity you are working with is shared (hot potato)
  - URL, text
  - Large data types: Photos, videos, data streams
  - Multi-party games being played
- The sharing device launches the right operation
  - Devices include phones
  - PCs, TVs with no built-in NFC

Context-Sensitive Interactions: Phone-to-Phone

- *Share my identity with others*

- Phones will have active NFC radios
- Phones are always associated with people
  - *Two phones touch, two people interact.*

Context-Sensitive Interactions: Phone-to-PC

- *Use my identity across devices*

- Typically, PC and Phone are owned by the same user.
  - *User-to-self interaction*
- Authentication, bookmarks, settings, payments, …

Context-Sensitive Interactions: Phone-to-TV

- *My digital assets to any device.*

- TVs are typically lacking in input devices.
  - *User-to-device interaction*
  - *Couch Potato*
- NFC lets us bring our phone personalization to our TV.
  - Our photos, music, videos with a touch
  - Our apps

Why not QR?

- Biggest differences between NFC and QR
  - QR code must be displayed on screen
  - Requires user interaction to bring up
  - Blocks current activity
  - Receiver must launch special program

  - NFC is always on
  - Lives behind the screen

NFC is for Sharing!

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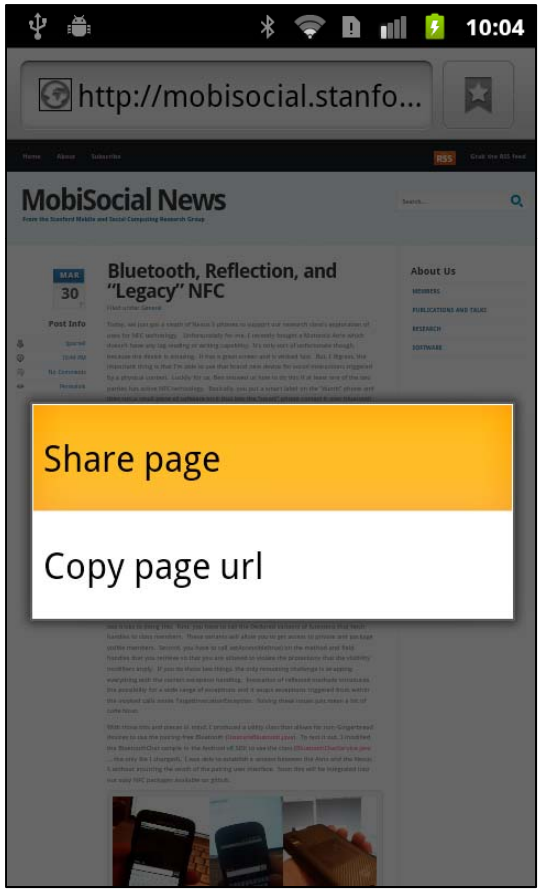
1

NFC is for Sharing!

2



NFC is for Sharing!

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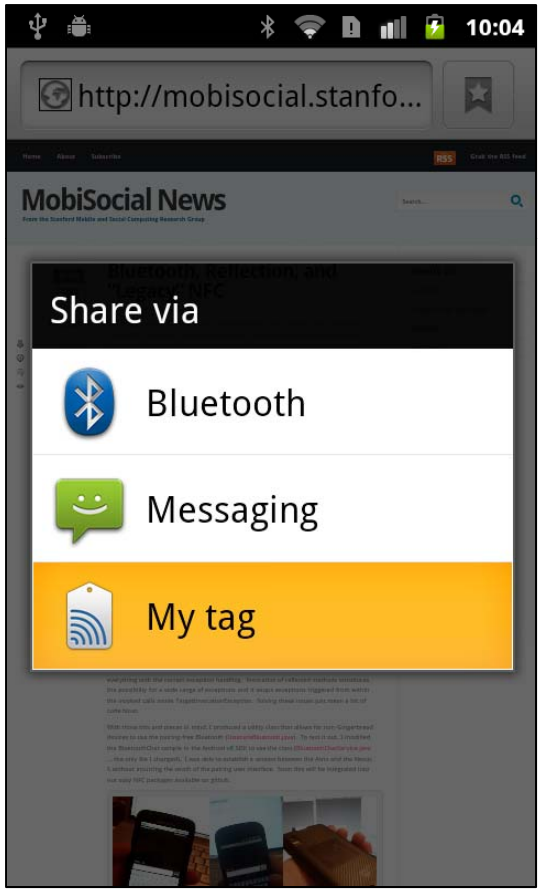

NFC is for Sharing!

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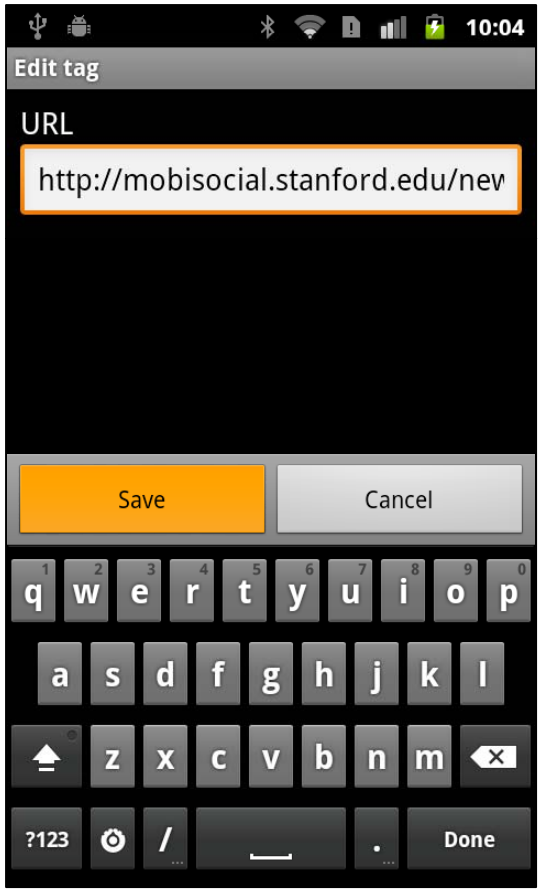

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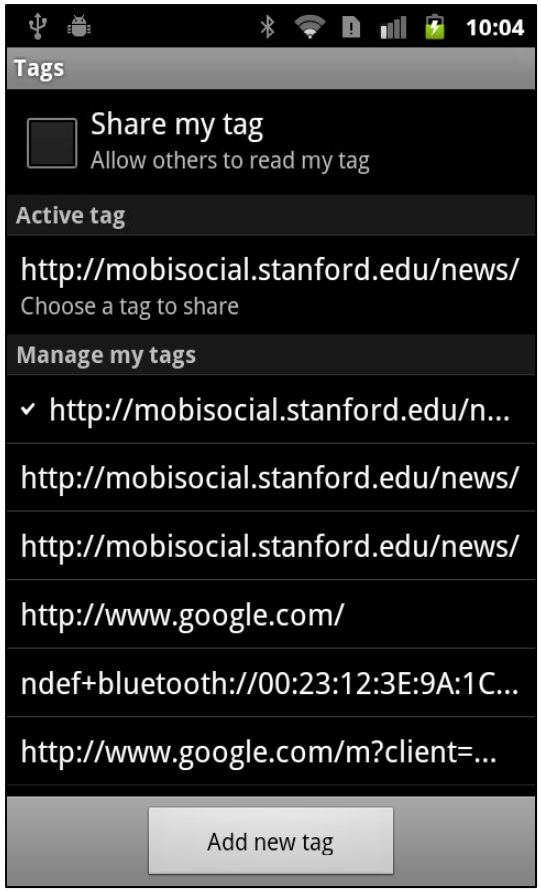

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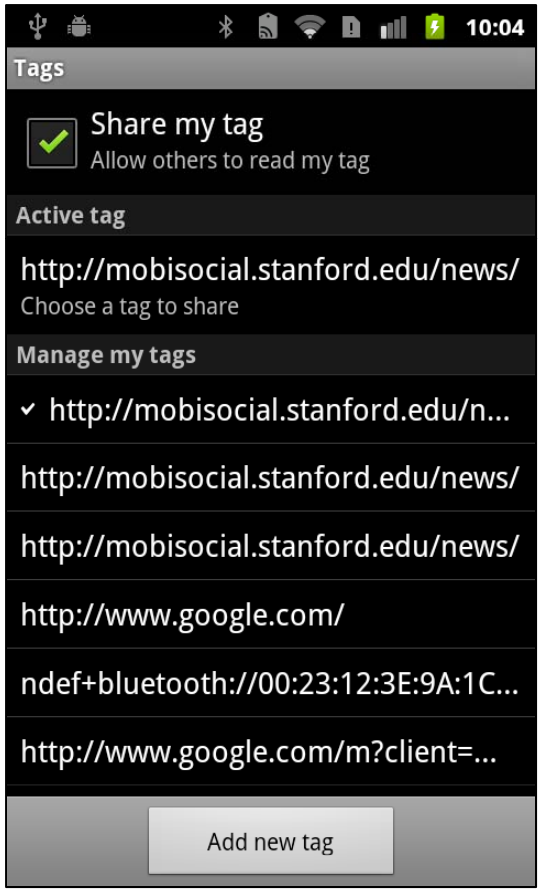

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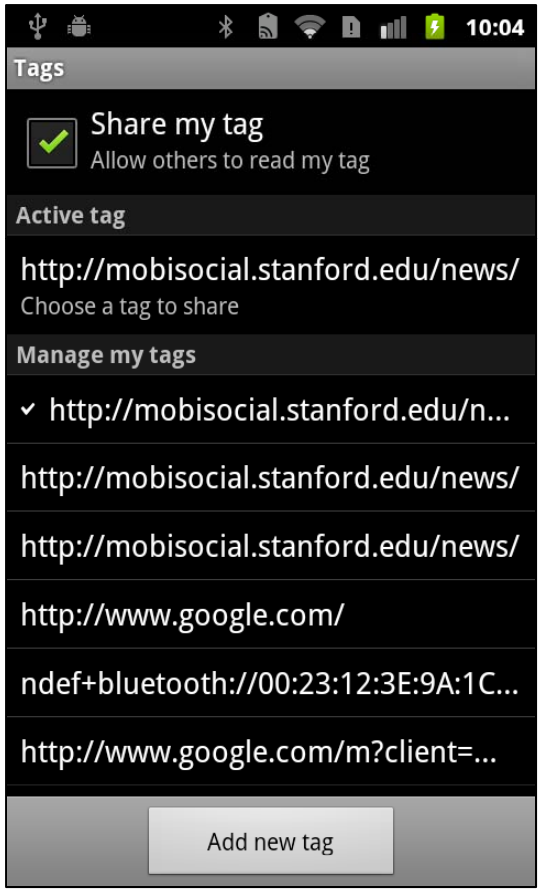

NFC is for Sharing?

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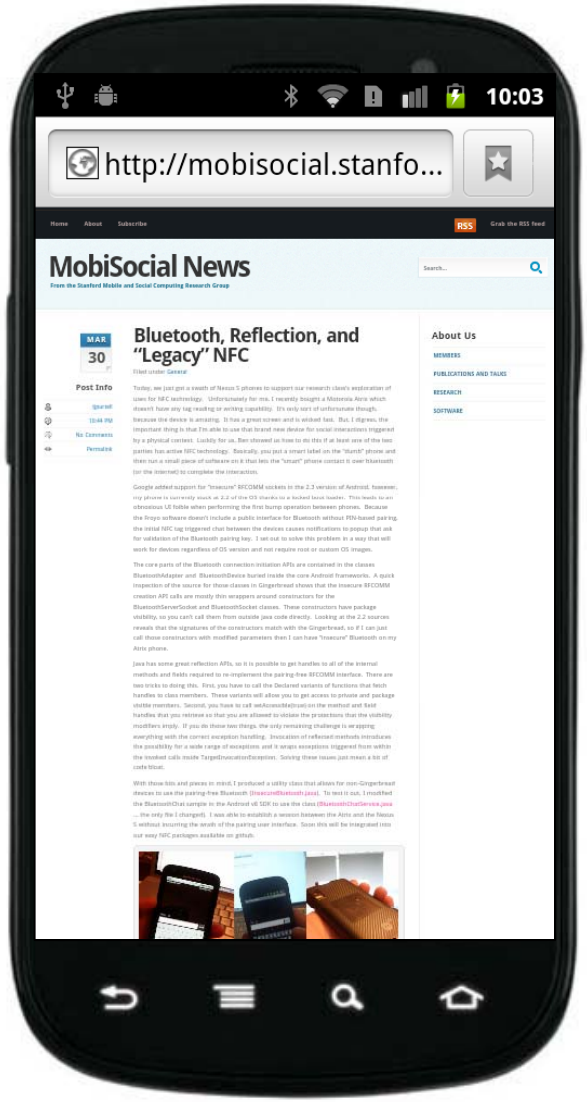
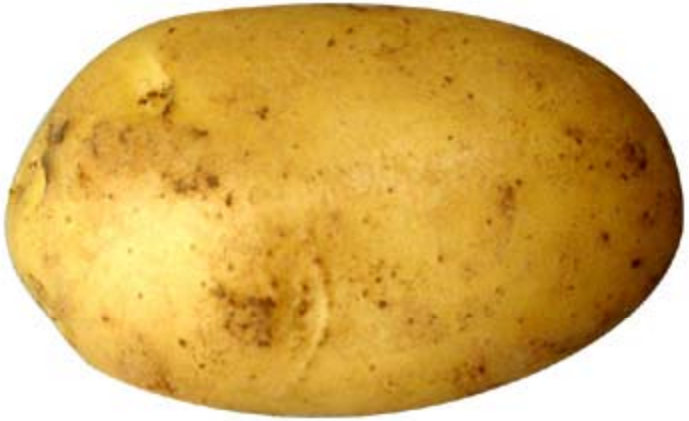


NFC is for Sharing!

Can we do better?



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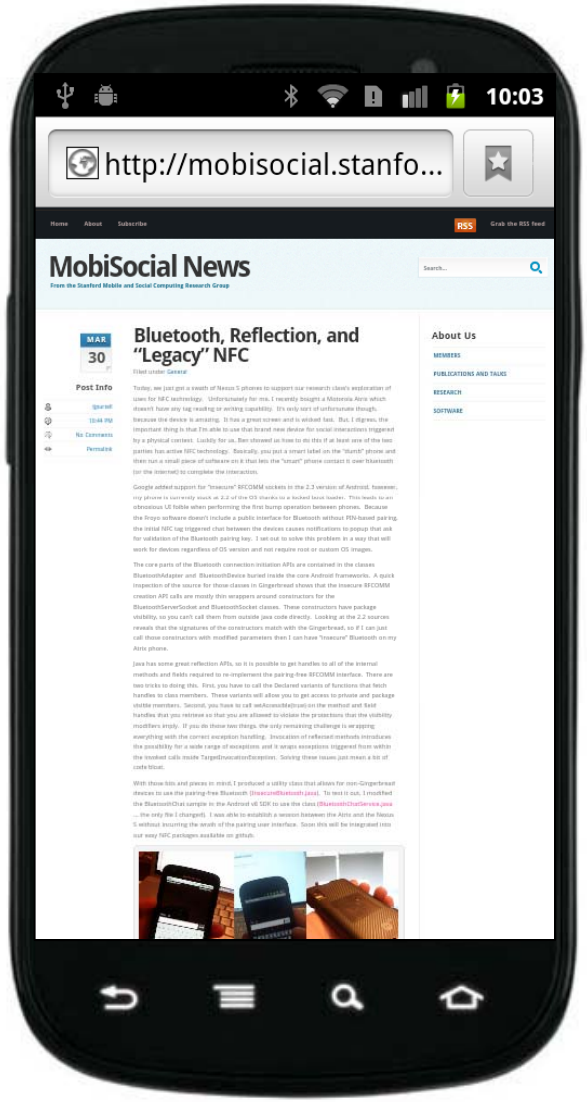

0-Click Sharing

Context-Aware NFC

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  - Phone-to-PC
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    - User-to-device
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    - Handle content with no further action