Intuitive Device Configuration and Home Media Sharing with Content-Centric Networking

DISCUSSION DOCUMENT
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Executive Summary

With the explosion in consumer electronics devices and growth in digital content generated and consumed at home, there is an increasing need for easy access to and sharing of digital media at home. Despite many efforts for industry standardization, device configurability and management remains a barrier to an intuitive user experience and seamless content sharing between devices.

This document proposes a methodology for secure and intuitive device configuration and remote access service that enables sharing of media across mobile and home networking devices. The proposal outlines a phased methodology for easy and secure device configuration over Wi-Fi Direct, bootstrapping home network configuration, and enabling remote access and sharing of digital content. The document also highlights opportunities to drive growth for companies that operate in the consumer electronics devices or home media services sectors.

1. Introduction

In the past, the interaction of Wi-Fi equipped devices within the home has required a home router to broker any communication. The emergence of Wi-Fi Direct capability allows these devices to connect and communicate directly without the need for an infrastructure. However, the ability to seamlessly interconnect and share content securely is far from reality. Technologies such as the Wi-Fi Protected Setup (WPS) for secure pairing include PIN and Push Button methods that fail to deliver an intuitive end-user experience. The Digital Living Network Alliance (DLNA) specifies interoperability guidelines and certifies products for viewing and managing content over a range of devices. Many services and devices today use DLNA implementation to allow users to share content across devices that support such services.

This document provides a brief introduction to Content-Centric Networking (CCN), outlines a statement of work, and discusses use cases, along with addressable market and business potential for the current engagement. It outlines a proposal to enable intuitive, secure, seamless content sharing between multiple mobile and home networking devices. The functionality can exist alongside DLNA and allows for easy device discovery, configuration, and content access using Wi-Fi Direct. We outline features that enable easy and intuitive setup of home wireless networks, and remote and guest access of home media content.

2. About Content-Centric Networking (CCN)

CCN is an alternative approach to the networking architecture based on the principle that a communication network should allow a user to focus on the data he or she needs, rather than having to reference a specific, physical location, from where that data is to be retrieved. CCN enables content caching to reduce congestion and improve delivery speed, a simpler configuration of network devices, and security built into the network at the data level. The initiative has continued to gain momentum with an open source code release, Android implementation release, commercial engagements with prominent industrial partners, and the CCN community meeting recently hosted at PARC.
3. Strategic Vision

The intuitive user experience and connectivity across products that Apple customers enjoy is missing on platforms like Android due to the fragmentation in the device ecosystem. Our goal is to help industries operating in that ecosystem make a range of devices intuitive to configure and share data in the home to increase the application user base, and to generate intellectual property to help position a potential partner company as a strong player in the future.

We propose a four-step plan:

1. Leverage PARC’s secure two-device pairing for devices such as TV and phones.
2. Create a unified plug-and-play experience for multiple devices such as TV, smartphone, and PC.
3. Enable seamless infrastructure set-up for home Wi-Fi network.
4. Enable remote and guest access to home media services.

4. Work Plan Proposition

We propose the following work segments. Once goals and objectives are aligned, we will have further discussions to create a comprehensive work plan.

Device Configurability and Pairing
This work will focus on creating intuitive and secure device connectivity and usability in the home. PARC’s work on user-friendly, secure methods for device pairing between two devices will be leveraged for easy configuration of multiple consumer electronics and mobile devices within the home network. CCN’s content-based security models and novel association and enrollment methods will be used to make the experience of inter-device connectivity easy, intuitive, and secure. Prototyping can be done with a network of mobile phones, TV, and PC over Wi-Fi Direct in the presence of other untrusted devices.

Bootstrapping Home Wi-Fi Network Setup
The device pairing and authentication via Wi-Fi Direct can be leveraged to enable automatic home wireless router Wi-Fi setup for home devices. A smartphone that has been paired with a TV doesn’t need to be independently configured to securely access the home network, thus allowing for easy access to Wi-Fi at home. The goal is to enhance the capabilities of device connectedness within the home network.

Home Media Guest Access
Being able to securely provision home networking services guest access to a visitor builds a better community and user experience. A friend or family member can securely log in, access, and retrieve the host’s media content using their own device. CCN’s device pairing and data-centric security would allow for secure access to and retrieval of the host’s home content. The service, while capable of co-existing with a cloud offering, would offer a competitive advantage by enabling relatively lower access delay, a better user experience, lower CAPEX/OPEX for the provider, better security for private data, and lower backhaul bandwidth consumption. The service also leverages the home user’s computing, processing, and storage—which reduces expenses for the home media services provisioning company.
Home Media Remote Access
Home content can also be accessed remotely when a user is away from home. One use case is accessing pictures from a visitor's home media server, using the host's devices (e.g., TV or tablet) that run the service. The service, while capable of existing alongside a cloud service, does not have to rely on one. This reduces related costs of deployment and maintenance, leveraging CCN’s stronger security and the computing, processing, and storage capabilities of the home user’s devices.

5. Technology and Business Impact
For many years, the intuitive user experience and interconnectivity between Apple products has dominated the market. Our goal is to enhance the competitiveness of the offerings in other product ecosystems. Enhanced usability and security can be instrumental in increasing the user base for such devices and services. This initiative can help a player take a leadership role in providing intuitive connectivity between devices in the Android ecosystem. The guest and remote access capabilities can provide a competitive advantage and serve as add-on features that can help increase the customer base.

6. Application Market Description
This work covers consumer electronics and mobile user device configuration, pairing, and digital media exchange for a home networking scenario. More specifically, it covers home networking and mobile device and services offering and Wi-Fi Direct-based pairing. The work can also be an enabler for new applications in the Android Marketplace or new app stores.

The value and strategic importance of the work is supported by several prevailing trends in consumer electronics and connected and mobile device segments. According to Gartner, mobile device hardware design is no longer a differentiator. Increasingly, sales are won or lost on the supporting ecosystems, including applications, services, and content.

Widespread adoption of mobile phones has pushed many consumers to expect to be "always on" — always connected to the Internet for gaming, social networking, or simply surfing. The proliferation of Wi-Fi, as well as faster cellular networks, has allowed many gadgets that were originally developed with no access to the Internet to reach the next level. Consumers will not want to manage one individual plan for each device that they connect to the network.

Sharing content between devices will also be important, as consumers will not want to pay for the same content more than once. According to Gartner, low attach rate numbers in the early years in embedded connected devices are expected. Every embedded connected device, such as an embedded notebook, is not expected to have its embedded modem connected to a cellular network during its lifetime. The attachment rate refers to end users that activate their cellular data modem by signing up for cellular data service from a content service provider.

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7. Use Case Scenarios

There are several use case scenarios including:

- A user having a TV with Wi-Fi connectivity can now pair it with her phone more easily and securely, in the presence of other TVs and Wi-Fi devices.
- Pairing of a phone with a PC can be done in the same way as above.
- Pairing between TV and PC can be done easily and securely using a phone, which is already paired with one of these devices.
- A user who is travelling can access her media content remotely and securely.
- A user visiting her family is able to show pictures that are stored in her digital media server via remote access.
- A user can get guest access to her friend’s digital media server while visiting.

8. Existing Technologies and Present Work Positioning

**Bonjour** is a component of Apple applications (e.g., iTunes, iPhoto), services (e.g., MobileMe), and devices (e.g., Apple TV and Airport) that enables automatic discovery of computers, devices, and services on IP networks using industry standard IP protocols. The Windows implementation is being used for installation and configuration of network printers. Our work proposition targets alternative device ecosystems (e.g., Android) and a suite of home networking and mobile devices.

**Digital Living Network Alliance (DLNA)** is a standardized technology that has been adopted by several major players in consumer electronics, mobile, and service provider sectors to make it easier for users to use and share digital media content. Several emerging and existing content sharing services use DLNA. The current work proposition exists alongside DLNA for intuitive device configuration and pairing.

**Universal Plug and Play (UPnP)**, promoted by the UPnP Forum, enables networked devices to discover presence and establish services for sharing and communications. Some DLNA-based services run in conjunction with UPnP in home media sharing services. The present proposition enhances the usability and security of device association and paring.

**Wi-Fi Protected Setup (WPS)** employs methods like PIN and Push Button pairing to securely allow pairing of wireless devices. Wi-Fi Direct is emerging as a strong potential technology for devices such as mobile phones, cameras, printers, PCs, and gaming devices to connect to each other directly without the need of an infrastructure to transfer content and share applications. Devices can make a one-to-one connection, or a group of several devices can connect simultaneously. This work is designed to simplify and enhance the usability of device association over Wi-Fi Direct, or over that enabled by WPS-like mechanisms, for media content that is then shared using DLNA. Services like remote access and cloud storage can be built as wrappers to enhance and extend the home media sharing user experience.

**Various cloud offerings** by start-ups and established players have the capability to provision remote access to content, but also come with the associated overhead of deployment and maintenance, and concerns about security and privacy of personal content.
Next Steps

Over the years, PARC has developed a roadmap for defining projects in a way that maximizes the likelihood of success.

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<tr>
<th>Status</th>
<th>Step</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>☐</td>
<td>PARC Introductions - Business Model - Technology Opportunities</td>
<td>If Client believes further exploration is warranted, select one to three areas to focus on for further exploration</td>
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<tr>
<td>☐</td>
<td>Overview of Client’s Strategic Interests and Current Capabilities</td>
<td>Client provides overview of strategic priorities, internal capabilities/resources. PARC and Client determine areas for further investigation.</td>
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<tr>
<td>☐</td>
<td>Project Formulation</td>
<td>PARC and Client’s internal stakeholders design ways to address Client’s strategic priorities. Usually includes technical and business case development.</td>
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<td>☐</td>
<td>Validation</td>
<td>Executives at both Client and PARC agree that the direction outlined is of mutual interest. Although there is no commitment to enter into a contract, each company’s executives have reviewed the high-level project and commit to further development of the proposal.</td>
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<tr>
<td>☐</td>
<td>Detailed Proposal Development</td>
<td>Client and PARC team members refine a detailed Statement of Work to achieve desired business results. This includes development of mutually acceptable terms and conditions.</td>
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<td>☐</td>
<td>Contract Development</td>
<td>After the business and technical parameters have been established, PARC translates these into a Project Agreement for legal review.</td>
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<td>☐</td>
<td>Program Delivery</td>
<td>Once both parties have signed the Project Agreement, senior technical staff of each organization will lead the work at PARC and at the Client.</td>
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