Smartphone Applications Using Bytewalla Protocol in Delay Tolerant Network

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Abstract: In Android platform, the Delay Tolerant Network (DTN) service and protocol stack and these presents an implementation of it that technique is called "Bytewalla". This technique allows the use of Android phones for the physical carriage of data or information between the network nodes in which where there are no other communication between network nodes are available, for certain security issues the existing links need to be avoided or in some case the internet is blocked by a government authority like it happened in some countries eg. Arab country during the spring of 2011. This technique deals with an implementation of two applications that runs on top of Bytewalla, are addressed together with some usage scenarios and those two applications are store and forward messaging application (SFMA) and a Sentinel Surveillance health-care application (SSA). We concluded that the combination of DTN links in the wide-ranging IP-network architecture on mobile phone platform is feasible and it will make this easier to integrate DTN applications into communication-delayed areas. To best of our knowledge the implementation of the bundle protocol on the Android platform is the first in DTN application.

Key words: Delay-tolerant network (DTN); Android platform; Bytewalla; Bundle protocol; Sentinel surveillance health-care application (SSA).

1. Introduction

An environmental area where there is always a demand for communication services between the various network nodes but no sufficient supply is provided for their communication. For communication organizational structures in both wired or wireless connections and continuous power supply such frequent challenges are arised. In addition, technical telecommunication operators always avoid spending resources in such type of areas because the operators return back only with low earnings, more costs, high risks factors, and no gain or profit. The paper, we converse about the Delay Tolerant Networking (DTN) approach (Fall K., and Farrell S., 2008) (K. Scott and S. Burleigh, 2007) (International telecommunication union) to face with this issues or challenges: The mobile devices for transportation of data between nodes are physically transported by extending the Internet Protocol group with the Bundle Protocol (ICT4RD) on the Android OS platform. This technique in certain areas, it does not consume lot of money, in the shorter term view (i.e) only to arrange a simple transport of data rather than to arrange for an overall network infrastructure, included optical fiber cables or broadband wireless links. In addition, this technique could attract local entrepreneurs and provides business opportunities for the operators. The number of mobile phone subscriptions in the year of 2011 is about more than six billions (Pentland, 2004) by International Telecommunication Union (ITU). Additionally, smartphones are currently experiencing sensor networks for all over the world.

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2. Related works

2.1 Internet layer

1. Application layer: Everything at this layer is application-specific. This layer provides application services for file transfers, e-mail, and other network software services. The protocols used in internet layer are HTTP – Hyper Text Transfer Protocol, FTP – File Transfer Protocol, POP – Post Office Protocol, SMTP – Simple Mail Transfer Protocol, SSL – Secure Socket Layer, Telnet – for remote computer access.

2. Transmission Control Protocol (TCP): One-to-one and connection-oriented reliable protocol. Used in the accurate transmission of large amount of data. Slower compared to UDP because of additional error checking being performed. Some core protocols are HTTP, FTP, Telnet, SMTP, POP3, IMAP, SNMP etc.

3. Network (IP): Concerned with getting packets from source to destination. The network layer must know the topology of the subnet and choose appropriate paths through it. When source and destination are in different networks, the network layer (IP) must deal with these differences.

4. Link Layer: Provide service interface to the network layer. Dealing with transmission error. Regulating data flow. Slow receivers not swamped by fast senders. The design issues in link layer are Network Layer, Framing, Error Control, and Flow Control.

5. Physical layer: The physical layer is responsible for transmitting a bit stream over a physical medium. It encodes and decodes bits into groups of bits. It then transforms a stream of bits into a signal. The protocols used in physical layer are TCP: Transmission control protocol, UDP: User datagram protocol, IP: Internet protocol, FTP: File transfer protocol, SMTP: Simple mail transfer protocol, POP: Post office protocol, HTTP: Hypertext transfer protocol.

![Diagram of Internet Layer and DTN Layer](image)

**Figure 1:** Android phone application examples

2.2 DTN layer (Bundle layer)
Bundle protocol is an experimental disruption-tolerant networking (DTN) protocol designed for unstable communications networks. It groups data blocks into bundles and transmits them using a store-and-forward technique. Bundle protocols connect multiple subnets into a single network. They provide a custody-based retransmission service and store data for long periods. The signal retransmitter guarantees packet delivery. As such, they can easily cope with Internet connectivity issues such as bandwidth delays and breakups.

1. The capabilities of bundle protocols include

   1. Custody-based retransmission.
   2. Late binding of network endpoint identifiers to a constituent Internet address.
   3. Ability to take advantage of scheduled, predicted and opportunistic connectivity.
   4. Ability to interoperate with intermittent connectivity.

2. Services Offered by Bundle Protocol Agents

   1. Commencing a registration (registering a node in an endpoint);
   2. Terminating a registration;
   3. Switching a registration between Active and Passive states;
   4. Transmitting a bundle to an identified bundle endpoint;
   5. Canceling a transmission;
   6. Polling a registration that is in the passive state;
   7. Delivering a received bundle.

3. Implementation

3.1 Network Simulator

The network setup is designed in four main steps. They are

   1. Install the required software on the two remote servers: Ubuntu Linux and Oracle Berkeley DB
      (i) OASYS software (Object-oriented Adaptors to SYStem interfaces)
      (ii) DHCP server and The DTN2 software.
   2. Install the Bytewalla application on the Android phone (20).
   3. Install and configure WIFI access points on the two servers.
   4. Configure the three nodes to send and receive DTN Bundles.

3.2 The android mobile phone application

   1. Storage section: In configuration portion, the section has user can define the type of the service to be used for storing the bundles which could be the SD card of the phone. Moreover, the amount of memory to be used can be set.
   2. Interfaces section: This section consists of listener interface of the application. It has three fields: ID, type of convergence layer and local port. The type of convergence layer used is TCP.
   3. Link section: This section involves the information needed to start a connection to the DTN servers.
   4. Routing section: Bytewalla provides support for both the static and dynamic storage.
3.3 E-MAIL application

The servers receive emails from the clients and convert the emails into bundles and vice versa. The bundles are forwarded to the Android phones and transported physically from one location to another. They are delivered on the DTN server when phone enter in contact with it.

3.4 Sentinel surveillance application

The goal of the SSA is to provide a facility to report medical related data such as the level of the stock of medical drugs or number of patients in a village to a healthcare authority located in another remote region such as a city by using the Bytewalla DTN network. The SSA needs to reside on both sites; the city and the village, as records are maintained in the databases. It provides access to authorize the user to avoid illegal data manipulation while sending and receiving sites access to authenticated users to avoid illegal data manipulation at both sending and receiving sites. It is a server side web based application which uses a set of basic open source services and software. The list below describes the services and software required in order to run the SSA.
1. DTN Daemon: It is based on DTN2 software.
2. Database: MySQL is used to store patient’s records.

![Sentinel surveillance application examples](image)

**Figure 4** Sentinel surveillance application examples

### 4. Performance evaluation

The test environment consists of two Ubuntu desktop servers which runs DTN2 and an HTC Tattoo Android phone as described in figure 6.

![DTN servers at android phone](image)

**Figure 5:** DTN servers at android phone

105 DTN bundles were generated to be routed between the two servers. 35 different sizes of bundles were generated with the initial bundle size measuring 100KB. Each of the remaining bundle size was incremented by 100KB. So the size of the last 3 bundles was 3.5MB.

### 5. Conclusion and future works

The approach allows the integration of DTN in the general mobile IP-network architecture which make it easier to extend delay-tolerant applications into communication- challenged areas. The implementation follows the Bundle Protocol Specification – RFC 5050.
The future work will include adding more tools and applications on top of the Bytewalla network. Hence, we plan to integrate popular social networking applications such as Twitter and YouTube. A subscription service on top of which educational materials can be exchanged between communication challenged areas would be of great benefit to local communities. Moreover, we plan to use Bytewalla to tap up and transport sensor data from remotely located wireless sensor network for monitoring the quality of drinking water (7). Finally, a business model could be elaborated to help local entrepreneurs to setup some businesses on top of the Bytewalla system.

6. References