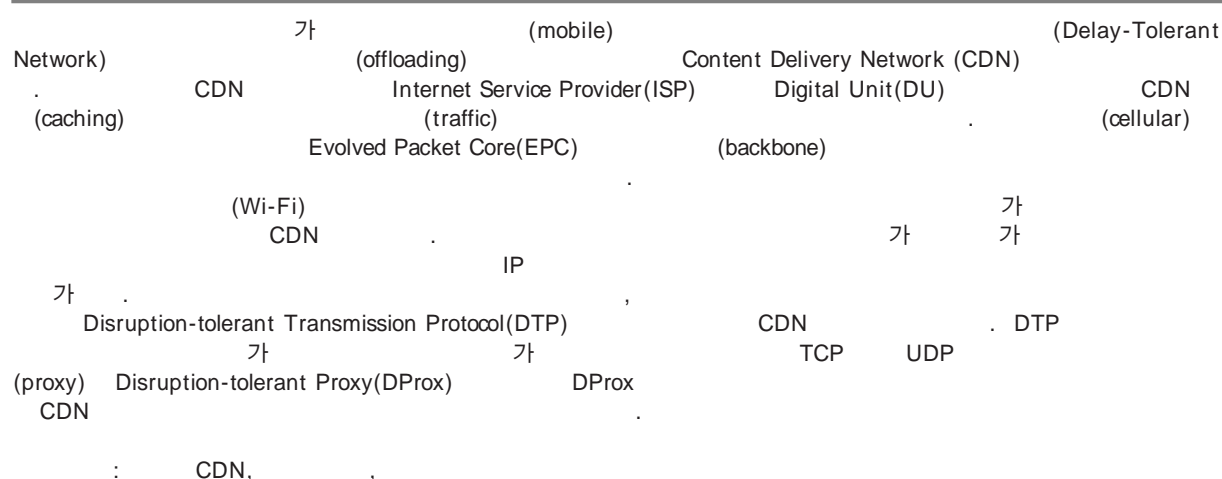


CDN

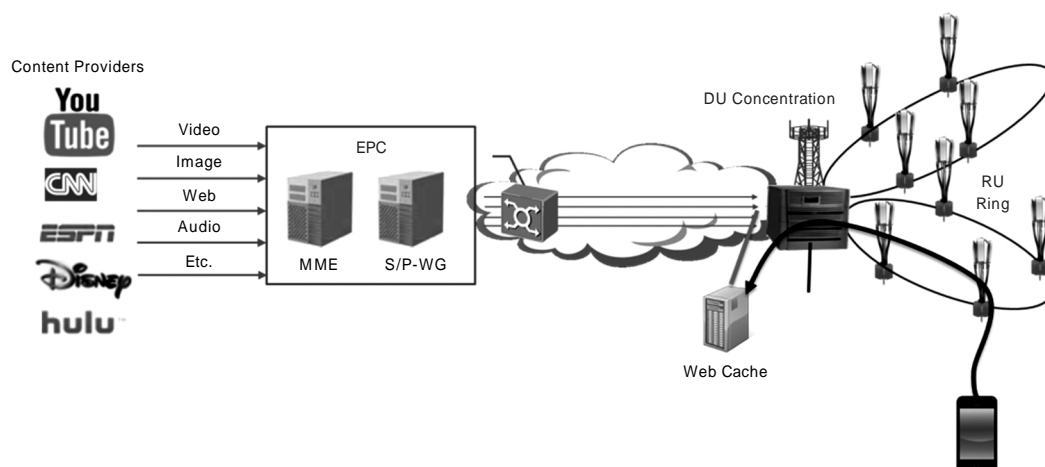
Deploying a Practical Mobile CDN System with Delay-tolerant Data Offloading

Younghwan Go · YoungGyoun Moon · KyoungSoo Park



In this paper, we propose a practical mobile Content Delivery Network (CDN) framework, which employs Delay-Tolerant Network (DTN)-based data offloading to allow mobile users to utilize the mobile network efficiently. Traditional mobile CDN operates to reduce the traffic congestion or bottleneck between the servers by inserting the CDN caching servers in cellular Internet Service Provider (ISP) network such as at the Digital Unit (DU) concentration. Although this can reduce the load on the backbone network, including the Evolved Packet Core (EPC) where the cellular data traffic finally gathers, there is a fundamental problem that it is unable to mitigate the mobile network data usage. In this research, we envision a new CDN framework, which can significantly reduce the overall mobile data communication by offloading the mobile traffic to a wired network via Wi-Fi by delaying the transfer until a Wi-Fi hotspot is found. However, we need to handle the network disruptions and delays from mobile user's IP address changes due to the network switching between cellular network and Wi-Fi. In this paper, we propose a mobile CDN system, which applies Disruption-tolerant Transmission Protocol (DTP) that maintains the connection in the transport layer even at physical network disconnection or switching. We first develop a caching proxy, Disruption-tolerant Proxy (DProx), which enables mobile clients to communicate with the servers that do not support DTP by transferring data to/from the server via TCP or UDP on behalf of them, present the overall architecture of the DTN-based data offloading mobile CDN, and finally conclude with the future work.

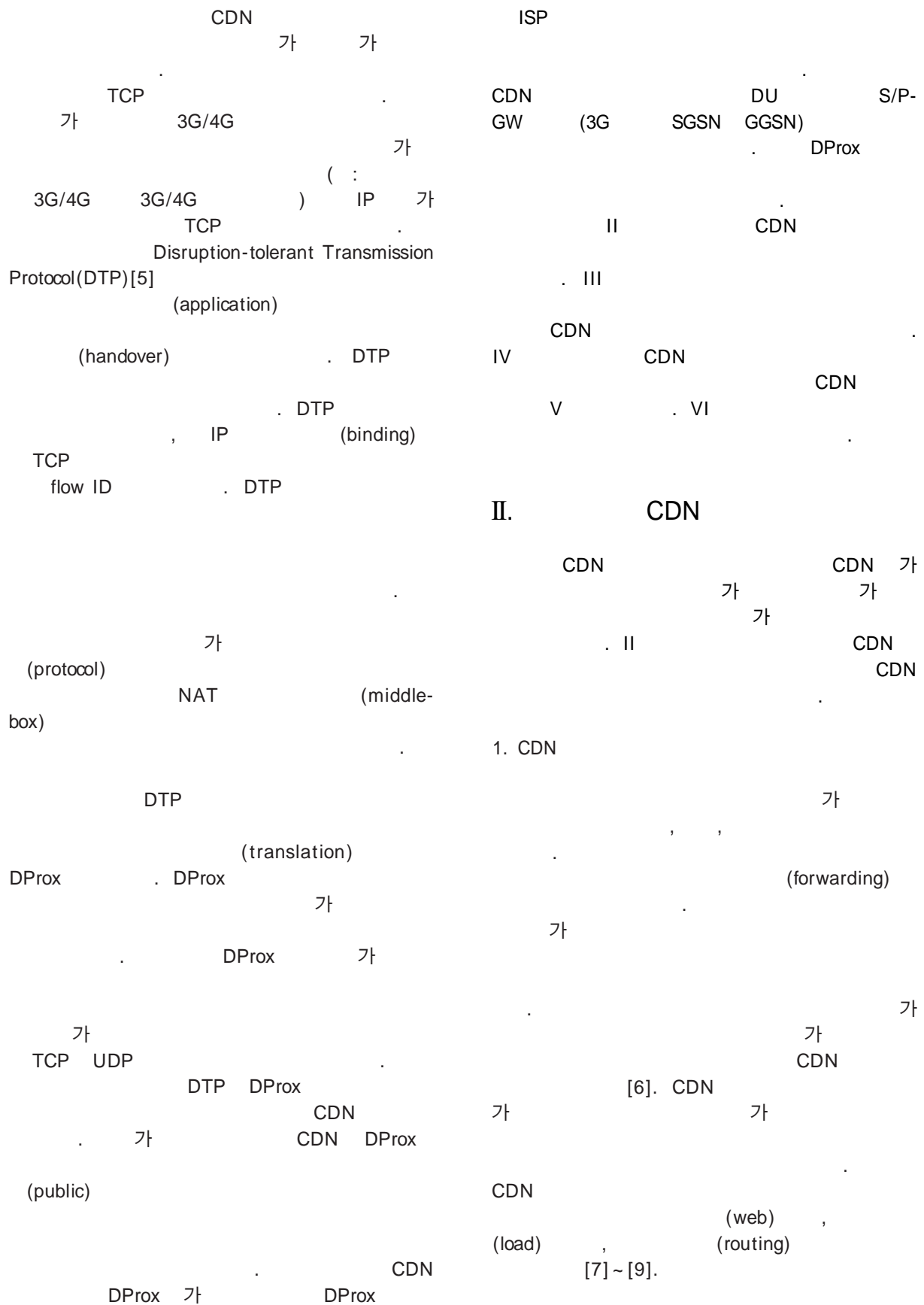
Keywords: Mobile CDN, Delay-tolerant network, Data offloading



DU 1. CDN
S/P-GW

I.

Figure 1: Comparison of the network architecture of the current mobile network and the proposed network architecture. The figure is divided into two parts: (a) Current mobile network architecture and (b) Proposed network architecture. Part (a) shows a traditional 4G/LTE network with a User Equipment (UE) connected to an E-UTRAN (radio access network), which is connected to an EPC (Evolved Packet Core). The EPC includes an MME (Mobility Management Entity), HSS (Home Subscriber System), and S-GW (Serving Gateway). The S-GW is connected to an S/P-GW (Serving/Proxy Gateway) and an ISP (Internet Service Provider). Part (b) shows a proposed network architecture with a UE connected to an E-UTRAN, which is connected to an EPC. The EPC includes an MME, HSS, and S-GW. The S-GW is connected to an S/P-GW, which is connected to an ISP. The proposed architecture also includes a CDN (Content Delivery Network) and a DU (Data User) connected to the S/P-GW. The figure includes a legend for the components: UE (User Equipment), E-UTRAN (Evolved-UTRAN), EPC (Evolved Packet Core), MME (Mobility Management Entity), HSS (Home Subscriber System), S-GW (Serving Gateway), S/P-GW (Serving/Proxy Gateway), ISP (Internet Service Provider), CDN (Content Delivery Network), and DU (Data User).



1. 3G [4]

| Category | 3G | Wi-Fi |
|--------------|-----------|------------------------|
| Availability | 100% | 45%(Vehicle)/53%(Walk) |
| Latency | 130 ms | 80ms |
| Bandwidth | 1 ~ 2Mbps | 2.6 ~ 5Mbps |

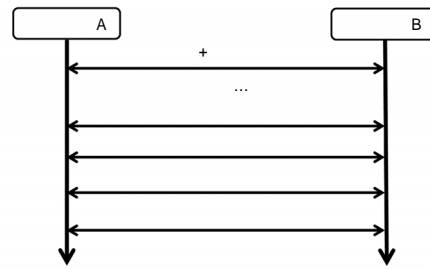
2. CDN [10].

가
CDN (: ,) transfer) CDN (reliable data 가
[8]. CDN 가 ISP 가 가
가 가 가
가 (ubiquitous) (interface)
가
3G/4G DU 가
EPC S/P-GW 3G/4G 가
S/P-GW S/P-GW가 III
CDN 3G/4G
가 1 \ 가
DU 가
가 3G 4G (delay) 가
[11]. 가
(access point)
가
가 70% [4]
가 DU S/P-GW 50% 2011 11 ,
/ 가
[5].
가

III. 가

(streaming)

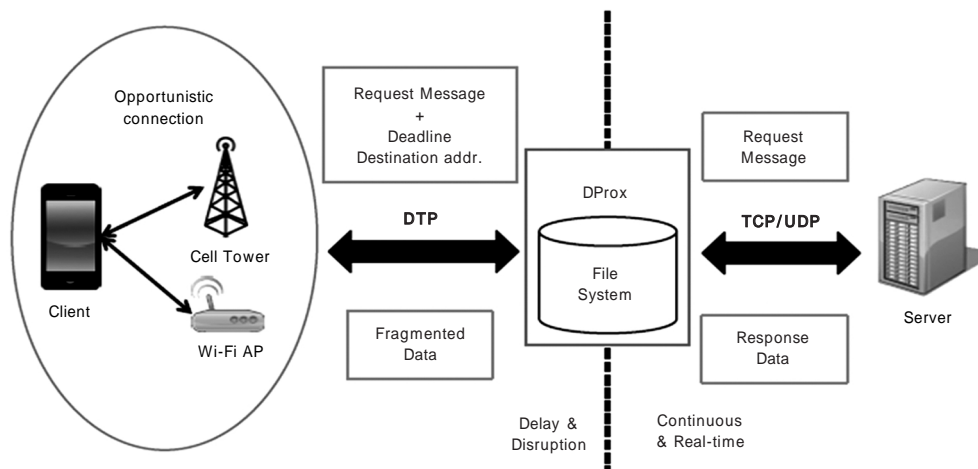
3G/4G



2. DTP [4]

3G/4G (hybrid) CDN 100% 가 3G/4G 가 [12]. 가 3G/4G 가 CDN 가 , 3G/4G 가 가 IV. IV IP 가 DTP DProx 1. TCP 가 TCP (connection) 가 IP 가 TCP IP 가 HIP[13]

NID[14] Public Key Infrastructure(PKI) (host identity) (node ID) DNS NBS[15] (router) DOA[16] DNS 가 DOA 가 ILNP[17] LISP IP (identifier) (locator) (namespace) 가 가 DTP 2 2. Disruption-tolerant Transmission Protocol DTP “flow ID” 가 Flow ID 가 flow ID (2). CDN CDN



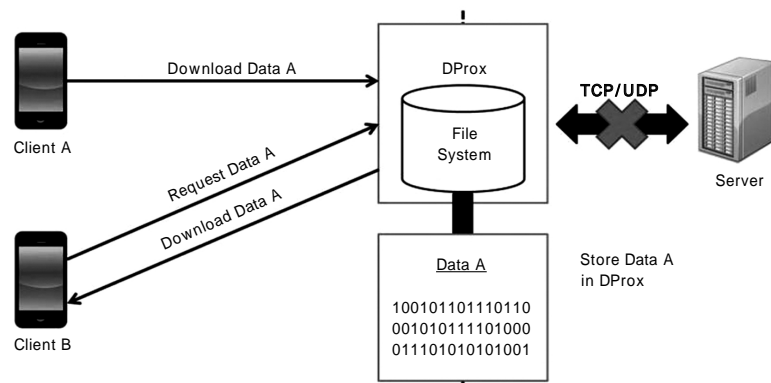
3. DProx

()

TCP (header) flow ID, DTP host ID, TCP 가 DProx Lookup 가 DProx DProx (request) 가 DProx DProx 가 , (context) DProx 가 DProx (offset) DProx ISP IP 가 DProx DNS Lookup 가 DTP TCP UDP 가 DProx 가

3.1. DProx

3 DProx DProx DProx DProx 가 DProx DProx DProx



4.

CDN

가

[19].

가
log-based disk writing

가

DProx

가

DTP

seek

가

DProx

가

가

DProx
가

가

3G/4G

DProx
DProx
(free)

3.3. DProx

3.2. DProx

DProx가

DProx
가

(privacy)
DProx
DProx가

(token)

DProx

가

DProx가

가 DProx
public key

(certificate)

DProx

DProx가

가

가
Secure Socket Layer(SSL)

DTP

가

가

2. CDN

| Implemented Code | | LOC |
|------------------|-------------|-------|
| DTP | | 5,975 |
| DProx | | 2,248 |
| Android | Application | 1,011 |
| | Network | 280 |
| | JNI Wrapper | 134 |

V. CDN

V III, IV DTP DProx CDN CDN

CDN . 4 . DProx

가 DProx CDN

(reverse proxy) CDN

DProx (forward proxy)

가 DProx CDN

가 DTP TCP DProx

가 DTP

DProx i7-2620M 4GB

(ram) 가 linux 2.6.40 (kernel)

2. CDN

CDN

DProx

가

3G/4G

2 .

DProx select() -

DTP

TCP DProx

가 DTP

DProx

i7-2620M 4GB

(ram) 가 linux 2.6.40 (kernel)

1. CDN

CDN

(4).

A (: (podcast)) A

CDN DProx DProx

A B가

DProx

(: Cache-Control)

RDF Site Summary (RSS)
(metadata)

URL , , , DProx DTP

HTTP . DTP

3G/4G

가 DTP

UI 807 (XML

251),

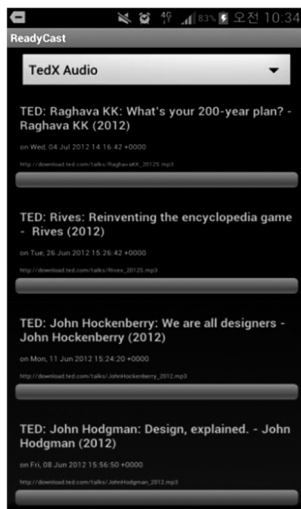
280 , RSS 204

DTP

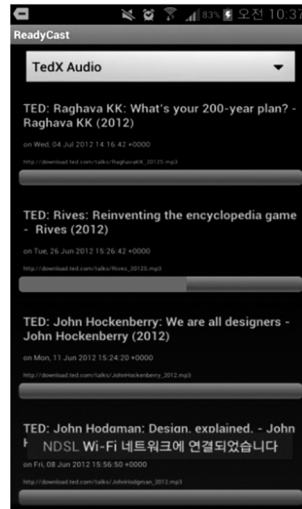
ISP JAVA

Interface(JNI) JAVA Native

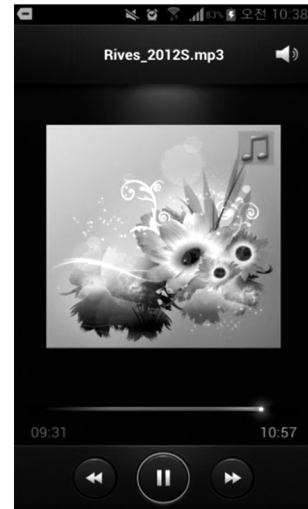
(wrapper) 134 JNI



(a) RSS

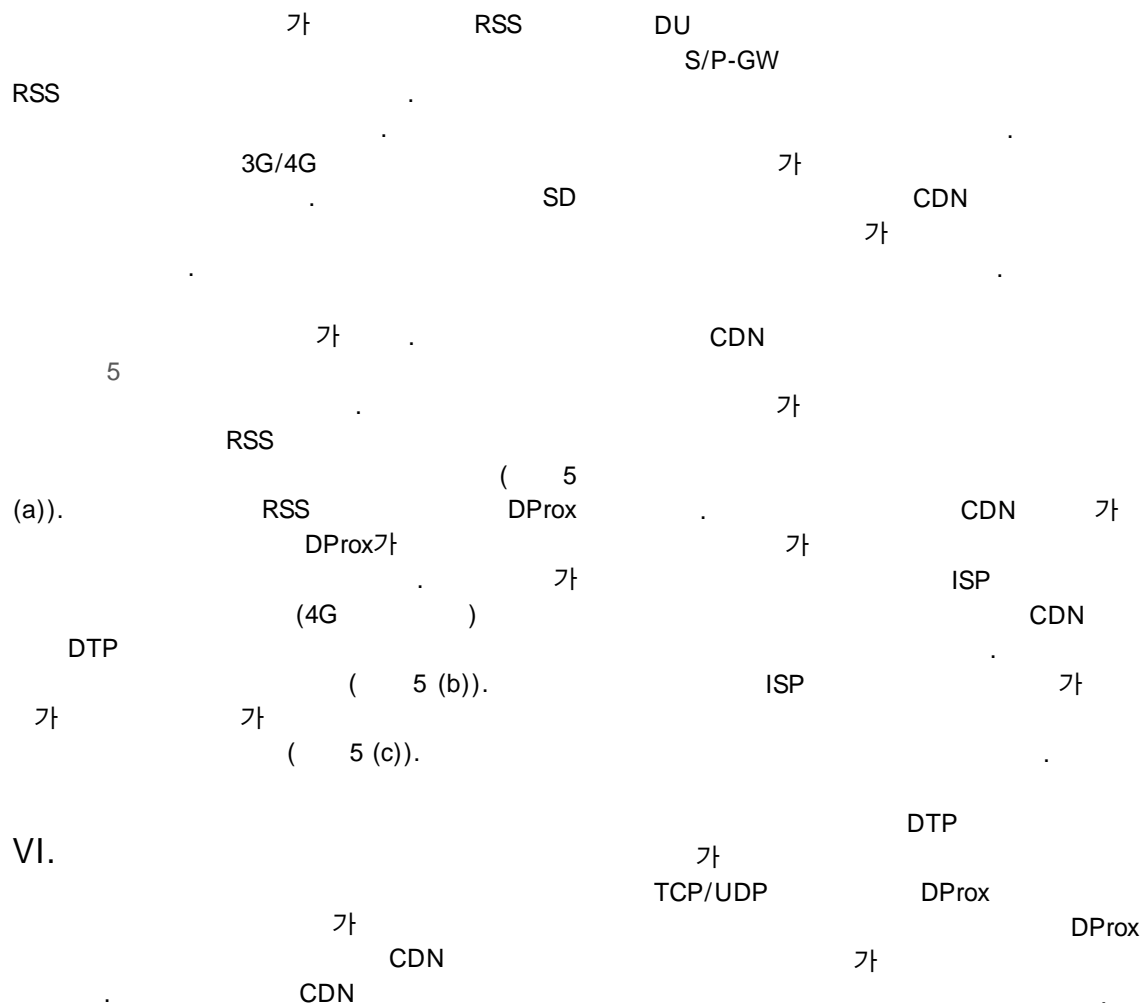


(b) 4G



(c)

5. CDN ()



CDN

CDN 가

가

CDN

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