

An Empirical Study of Backend Infrastructure in Leading Pakistani Mobile Apps

Sana Habib^{†¶}, Mohammad Taha Khan[‡], Jedidiah R. Crandall^{†§}

Arizona State University[†], Washington and Lee University[¶],
Breakpointing Bad[§], Carnegie Mellon University[‡]

Free and Open Communication on the Internet (FOCI), July 20, 2026



Outline

Motivation: Why Study Backend Infrastructure?

Study Dataset

Methodology

Findings

Implications for Users and Researchers

Thank you!

Motivation: Why Study Backend Infrastructure?

Motivation: Why Study Backend Infrastructure?



Motivation: Why Study Backend Infrastructure?



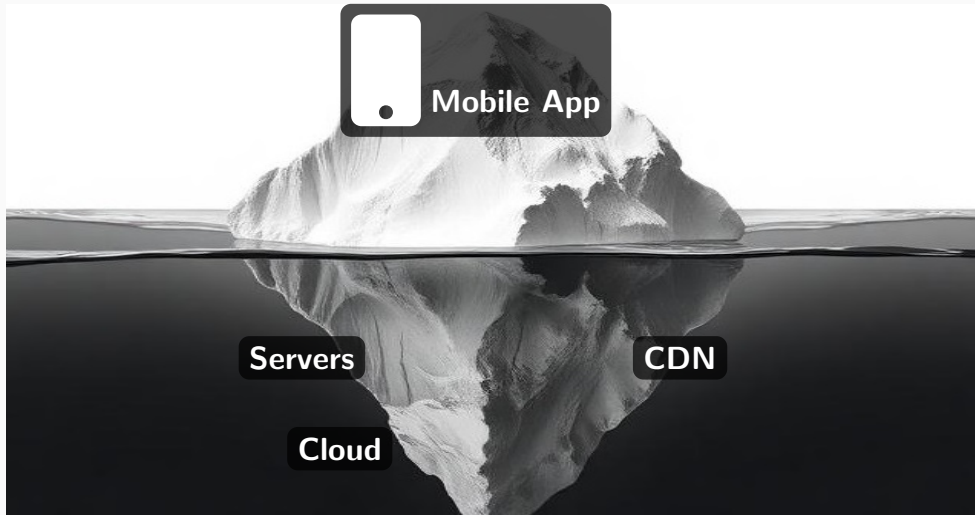
Motivation: Why Study Backend Infrastructure?



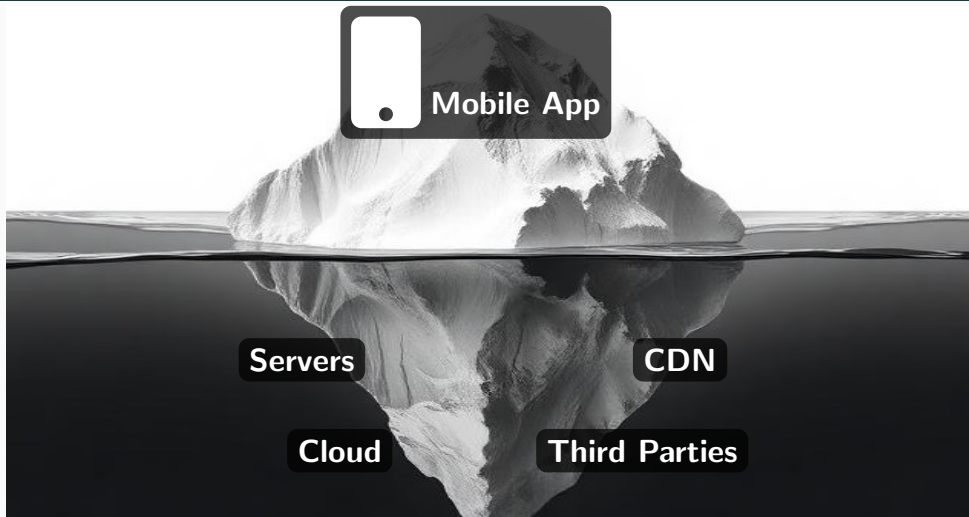
Motivation: Why Study Backend Infrastructure?



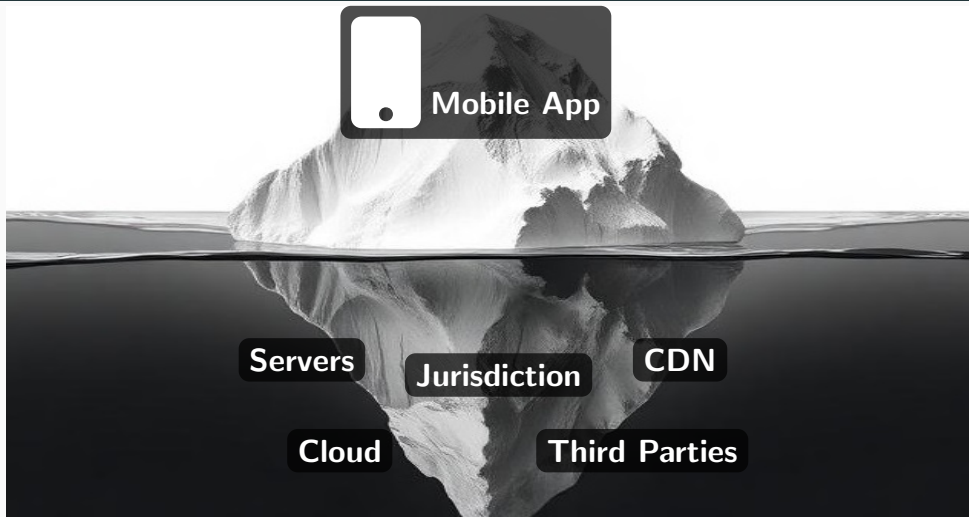
Motivation: Why Study Backend Infrastructure?



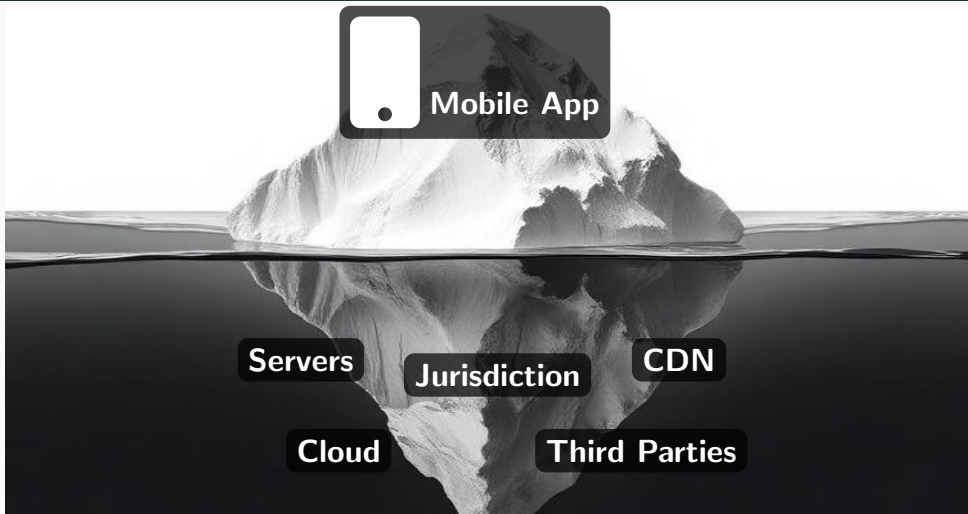
Motivation: Why Study Backend Infrastructure?



Motivation: Why Study Backend Infrastructure?



Motivation: Why Study Backend Infrastructure?



The app is only the visible tip of a much larger system.

**What lies beneath
the mobile app?**

What lies beneath the mobile app?

Who operates the backend infrastructure?

Where is it hosted?

How does it shape user privacy?

Study Dataset

Government



Pak Identity



Pakistan Citizen
Portal

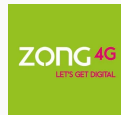


Qeemat Punjab

Telecommunications



SIMOSA



My Zong



My Telenor



UPTCL

Government



Pak Identity



Pakistan Citizen
Portal

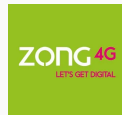


Qeemat Punjab

Telecommunications



SIMOSA



My Zong



My Telenor



UPTCL

7 widely-used applications spanning **government** and **telecommunications**— two sectors that routinely handle **sensitive user data**.

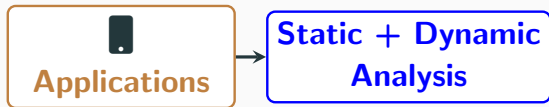
Methodology

Methodology: Backend Infrastructure Discovery

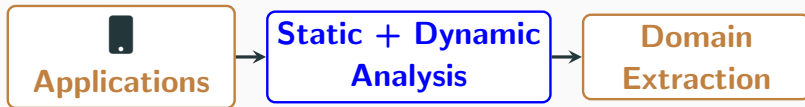


Applications

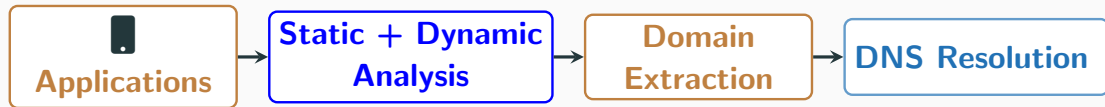
Methodology: Backend Infrastructure Discovery



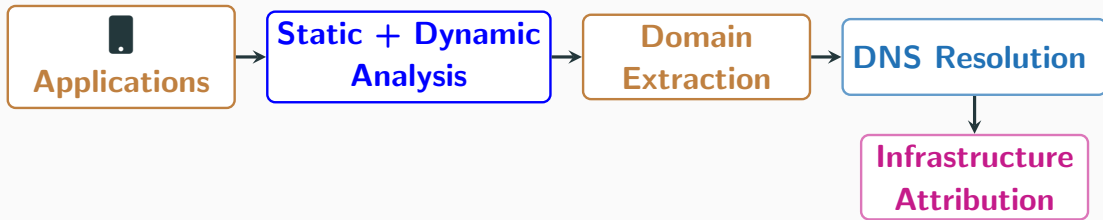
Methodology: Backend Infrastructure Discovery



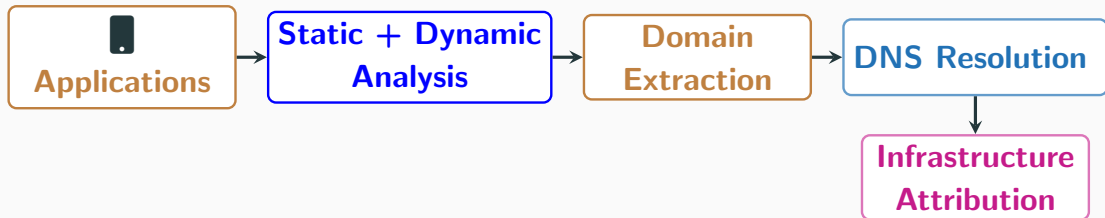
Methodology: Backend Infrastructure Discovery



Methodology: Backend Infrastructure Discovery



Methodology: Backend Infrastructure Discovery



Backend infrastructure discovered.

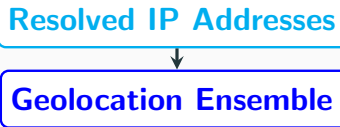
Next: Where is it hosted?

Methodology: Jurisdiction Inference

Resolved IP Addresses

Methodology: Jurisdiction Inference

Resolved IP Addresses

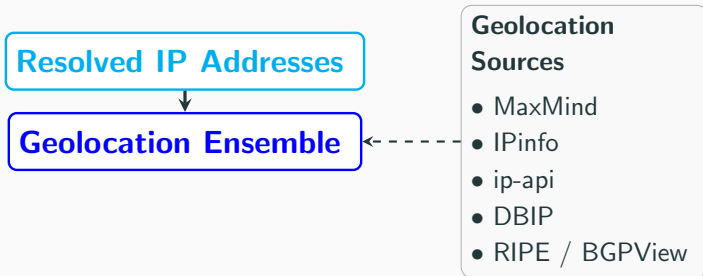


```
graph TD; A[Resolved IP Addresses] --> B[Geolocation Ensemble];
```

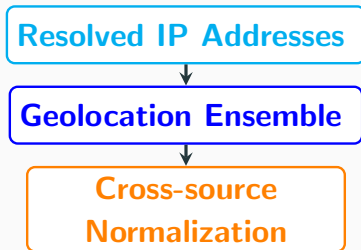


Geolocation Ensemble

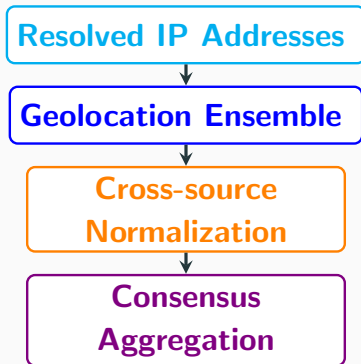
Methodology: Jurisdiction Inference



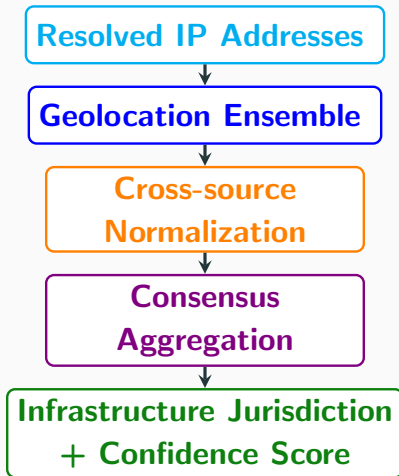
Methodology: Jurisdiction Inference



Methodology: Jurisdiction Inference



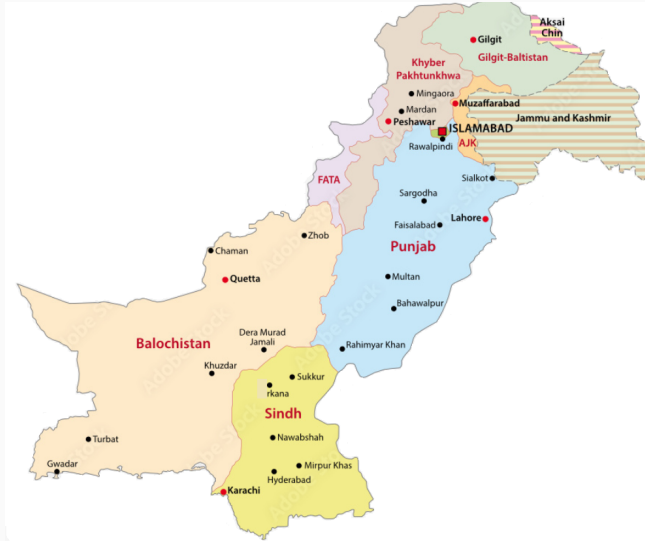
Methodology: Jurisdiction Inference



Interpreting Jurisdiction

**Location alone
does not determine
privacy risk.**

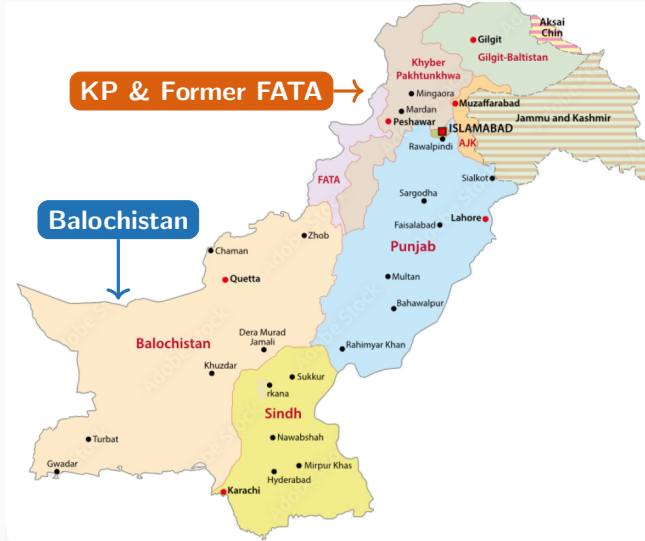
Why Jurisdiction Matters



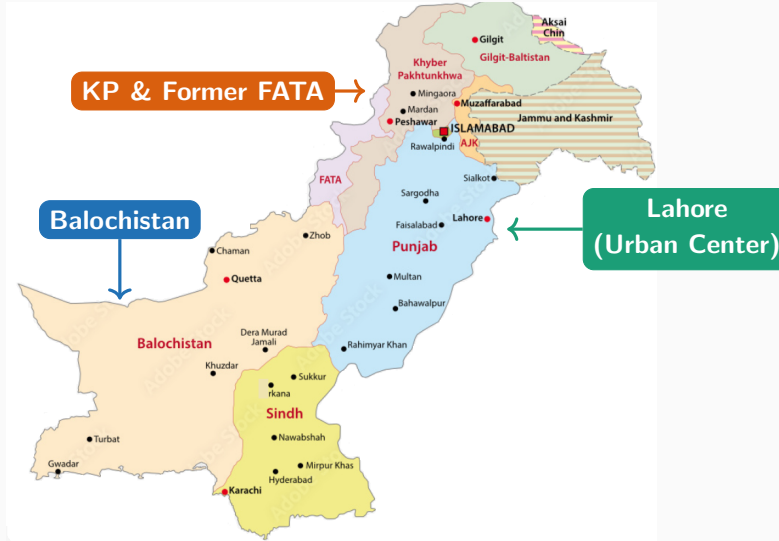
Why Jurisdiction Matters



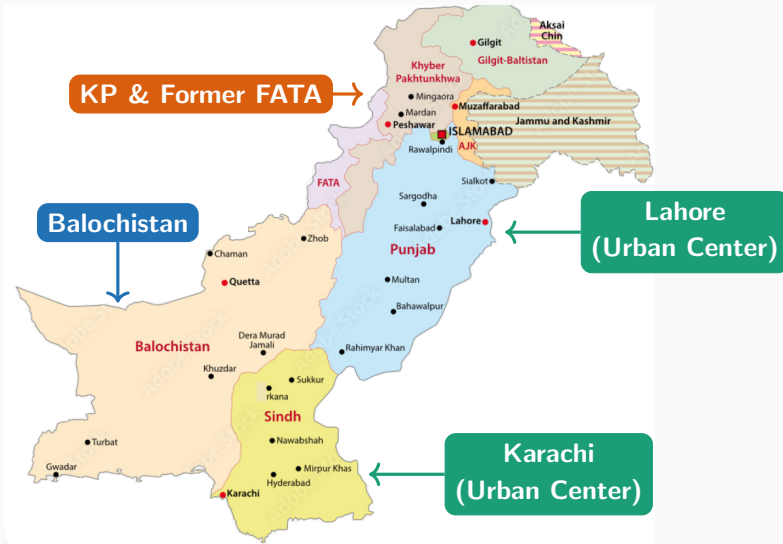
Why Jurisdiction Matters



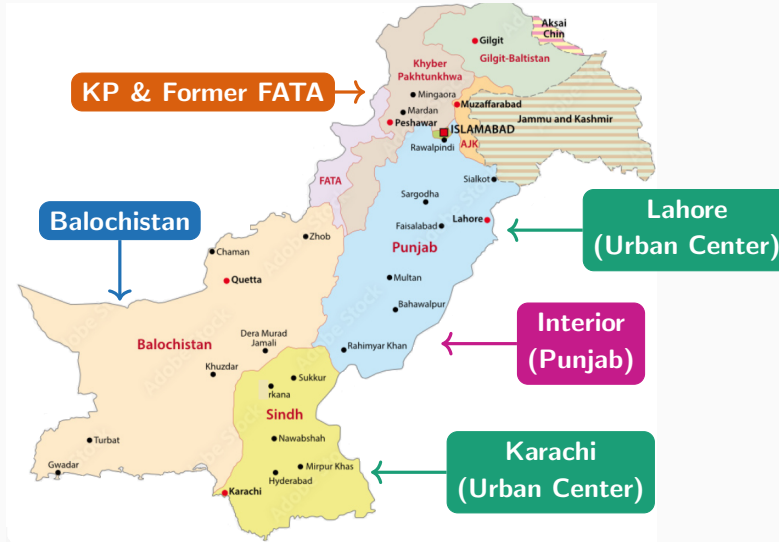
Why Jurisdiction Matters



Why Jurisdiction Matters



Why Jurisdiction Matters

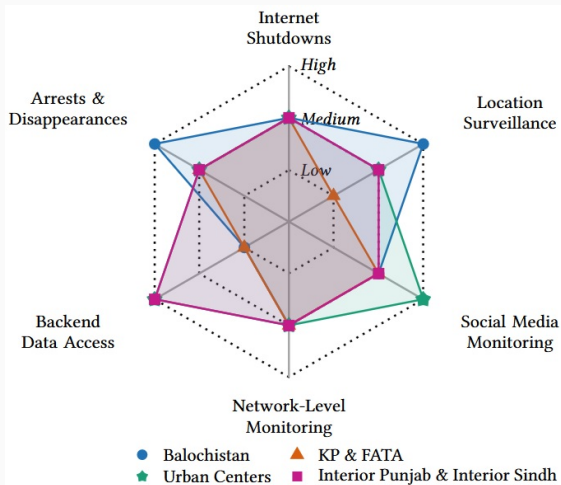


Dimensions of Digital Control

We evaluate jurisdiction across six dimensions of digital control.

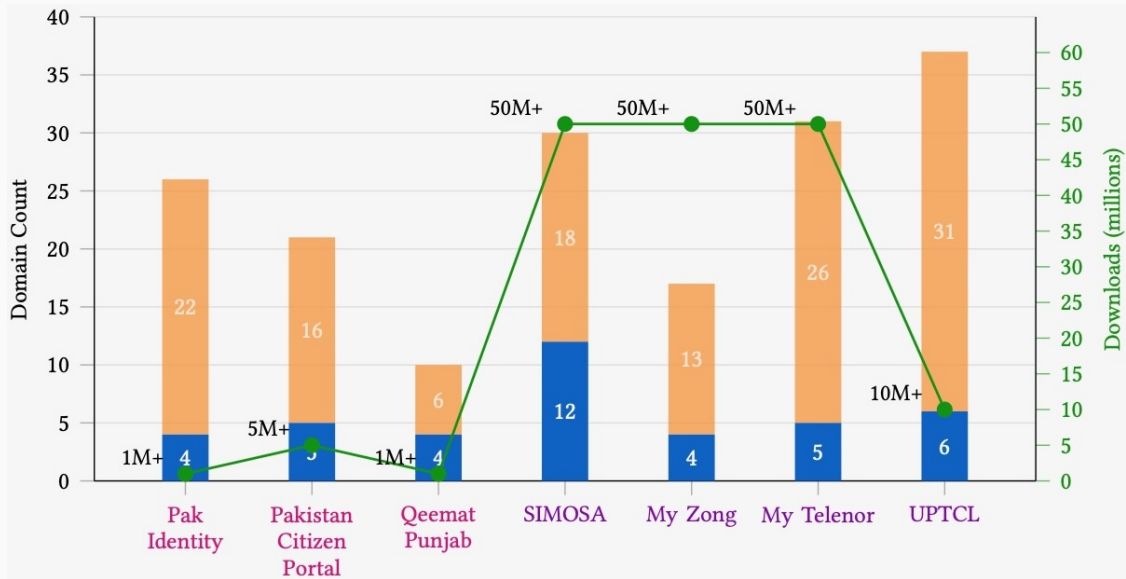
Dimension	Balochistan	KP/FATA	Urban Centers	Interior Punjab/Sindh
Internet Shutdowns	Medium	Medium	Medium	Medium
Location Surveillance	High	Low	Medium	Medium
Social Media Monitoring	Medium	Medium	High	Medium
Network Monitoring	Medium	Medium	Medium	Medium
Backend Data Access	Low	Low	High	High
Arrests / Disappearances	High	Medium	Medium	Medium

Digital Control Framework



This framework guides our interpretation of backend jurisdictions.

Findings



Pakistan Citizen Portal (api.pmdu.gov.pk)



Pakistan Citizen
Portal



api.pmdu.gov.pk

- Functionally Expected Data
- Non-essential (non-sensitive) Data
- ★ Non-essential Sensitive Data
- ⋯ Inferred Data

Privacy policy permits data sharing with authorities; users may request data deletion, but no data retention period is specified.

Attribution: api.pmd.gov.pk



Domain: api.pmd.gov.pk



IP Address: 203.101.184.112



CDN: No



Owner: CyberNet/National Telecommunication Company (NTC)



Observed Location: Islamabad, Pakistan



**Pakistan Citizen
Portal**

Implications for Users and Researchers



Users

Installing an app **is also**
trusting its **backend**
infrastructure.



Researchers

Backend infrastructure
shapes privacy risk.



Users

Installing an app **is also**
trusting its **backend**
infrastructure.



Researchers

Backend infrastructure
shapes privacy risk.

Privacy depends on the **infrastructure behind**
the interface.

Coordinated Disclosure

#	App Title	Email / Complaint Date
1.	Pak Identity [28]	Apr 07, 2025
2.	Pakistan Citizen Portal [29]	Apr 07, 2025
3.	Qeemat Punjab [30]	Apr 08, 2025
4.	SIMOSA [32]	Apr 13, 2025
5.	My Zong [27]	Apr 13, 2025
6.	My Telenor [26]	Apr 13, 2025
7.	UPTCL [33]	Apr 13, 2025

Key Takeaways

- Sensitive user data is concentrated in a small number of first-party backend domains.
- Apps provide little transparency regarding backend data retention and deletion.
- Backend transparency and data minimization remain critical for protecting user privacy.

Thank you!

Thank You!

Questions?



shabib3@asu.edu

Supported by the Open Technology Fund Information Controls Fellowship Program, the HIVE Fellowship with Center for Digital Resilience, and NSF Grant CNS-2452885.

We thank Pakistan's Digital Rights Foundation, anonymous contributors, and the FOCI'26 reviewers.

Backup Slides



Qeemat Punjab



qpapi.punjab.gov.pk

- Functionally Expected Data
- Non-essential (non-sensitive) Data
- ★ Non-essential Sensitive Data
- ⋯ Inferred Data

Privacy policy permits data sharing with authorities; users may request data deletion, but no data retention period is specified.

Attribution: qpapi.punjab.gov.pk



Domain: qpapi.punjab.gov.pk



IP Address: 103.226.217.186



CDN: No



Owner: Punjab IT Board (Provincial Gov.)



Observed Location: Lahore, Pakistan

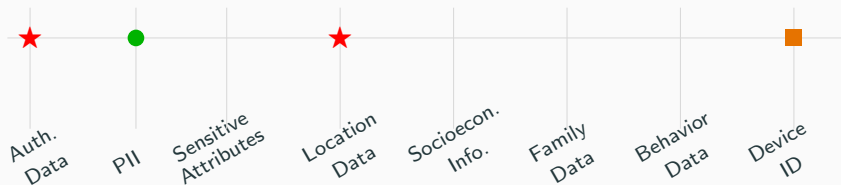


Qeemat Punjab

Pak Identity (shanakht.nadra.gov.pk)



Pak Identity



shanakht.nadra.gov.pk

- Functionally Expected Data
- Non-essential (non-sensitive) Data
- ★ Non-essential Sensitive Data
- ⋯ Inferred Data

Privacy policy permits data sharing with authorities; users may request data deletion, but no data retention period is specified.

Attribution: shanakht.nadra.gov.pk



Domain: shanakht.nadra.gov.pk



IP Address: 199.46.39.31



CDN: Akamai Prolexic



Owner: NADRA (State Agency)



Observed Location: Cambridge, United States

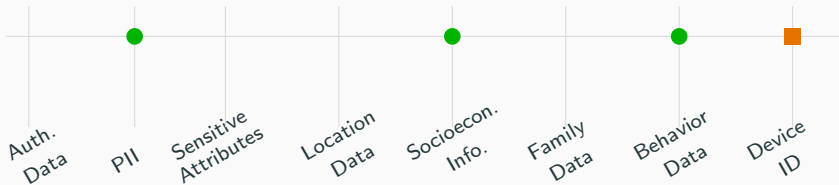


Pak Identity

My Zong (myzongapp-nlbt.zong.com.pk)



My Zong



myzongapp-nlbt.zong.com.pk

- Functionally Expected Data
- Non-essential (non-sensitive) Data
- ★ Non-essential Sensitive Data
- ⋯ Inferred Data

Privacy policy permits data sharing with authorities; users may request data deletion, but no data retention period is specified.

-  **Domain:** myzongapp-nlbt.zong.com.pk
-  **IP Address:** 209.150.154.153–156
-  **CDN:** No
-  **Owner:** China Mobile Pakistan (CMPak)
-  **Observed Location:** Rawalpindi/Islamabad, Pakistan

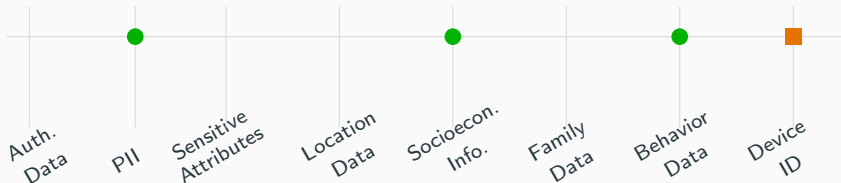


My Zong

My Telenor (theomancy.app.telenor.com.pk)



My Telenor



theomancy.app.telenor.com.pk

- Functionally Expected Data
- Non-essential (non-sensitive) Data
- ★ Non-essential Sensitive Data
- ⋯ Inferred Data

Privacy policy permits data sharing with authorities; users may request data deletion, but no data retention period is specified.



Domain: theomancy.app.telenor.com.pk



IP Address: Inactive/Deprecated



CDN: Not Observable



Owner: Telenor Pakistan



Observed Location: Not Observable



My Telenor

The End

Thank You