

---

# Internet Privacy: Big Brother and Little Brother

Steven M. Bellovin

<http://www.cs.columbia.edu/~smb>

Columbia University

March 14, 2008

## Introduction

What is Privacy?

A Security  
Perspective

Big Brother is  
Watching You

Little Brother is  
Watching You

One Vision of the  
Internet

Another Vision of the  
Internet

A Third Vision of the  
Internet

Three Visions of the  
Internet

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

# Introduction

# What is Privacy?

Introduction

What is Privacy?

A Security

Perspective

Big Brother is

Watching You

Little Brother is

Watching You

One Vision of the

Internet

Another Vision of the

Internet

A Third Vision of the

Internet

Three Visions of the

Internet

Types of Privacy

Violation

The Privacy Threat

from Governments

The Privacy Threat

from Corporations

Defenses

Conclusions

- “The right of individuals to control or influence what information related to them may be collected and stored and by whom and to whom that information may be disclosed.” (OSI Reference Model)
- “Privacy is the interest that individuals have in sustaining a ‘personal space’, free from interference by other people and organisations.” (Clarke)
- “The right to be let alone.” (Future U.S. Supreme Court Justice Louis Brandeis, 1890)

# A Security Perspective

Introduction

---

What is Privacy?

A Security Perspective

Big Brother is Watching You

Little Brother is Watching You

One Vision of the Internet

Another Vision of the Internet

A Third Vision of the Internet

Three Visions of the Internet

Types of Privacy Violation

---

The Privacy Threat from Governments

---

The Privacy Threat from Corporations

---

Defenses

---

Conclusions

---

- What are you trying to protect?
- Who is the enemy?
- How much is your privacy worth? How much can your enemy spend?

# Big Brother is Watching You

Introduction

---

What is Privacy?

A Security

Perspective

Big Brother is  
Watching You

Little Brother is  
Watching You

One Vision of the  
Internet

Another Vision of the  
Internet

A Third Vision of the  
Internet

Three Visions of the  
Internet

Types of Privacy  
Violation

---

The Privacy Threat  
from Governments

---

The Privacy Threat  
from Corporations

---

Defenses

---

Conclusions

---

- From George Orwell's classic book *1984*
- Refers to the threat from dictators
- Is that a risk on the Internet?

# Little Brother is Watching You

Introduction

---

What is Privacy?

A Security

Perspective

Big Brother is

Watching You

Little Brother is  
Watching You

One Vision of the

Internet

Another Vision of the

Internet

A Third Vision of the

Internet

Three Visions of the

Internet

Types of Privacy

Violation

---

The Privacy Threat

from Governments

---

The Privacy Threat

from Corporations

---

Defenses

---

Conclusions

---

- Refers to corporations
- Often harder to stop
- But is it a threat?

Introduction

---

What is Privacy?

A Security  
Perspective

Big Brother is  
Watching You

Little Brother is  
Watching You

One Vision of the  
Internet

Another Vision of the  
Internet

A Third Vision of the  
Internet

Three Visions of the  
Internet

Types of Privacy  
Violation

---

The Privacy Threat  
from Governments

---

The Privacy Threat  
from Corporations

---

Defenses

---

Conclusions

---

*“On the  
Internet, no one  
knows you’re a  
dog.”*

Introduction

What is Privacy?

A Security  
Perspective

Big Brother is  
Watching You

Little Brother is  
Watching You

One Vision of the  
Internet

Another Vision of the  
Internet

A Third Vision of the  
Internet

Three Visions of the  
Internet

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

*It wags its tail,  
it barks, and it  
acts the same  
as last time.*



# A Third Vision of the Internet

*It snarls and  
bites; we have  
to deal with it.*

Introduction

What is Privacy?

A Security

Perspective

Big Brother is

Watching You

Little Brother is

Watching You

One Vision of the

Internet

Another Vision of the

Internet

**A Third Vision of the  
Internet**

Three Visions of the

Internet

Types of Privacy

Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

# Three Visions of the Internet

---

## Introduction

What is Privacy?

A Security

Perspective

Big Brother is

Watching You

Little Brother is

Watching You

One Vision of the

Internet

Another Vision of the

Internet

A Third Vision of the

Internet

Three Visions of the  
Internet

Types of Privacy

Violation

---

The Privacy Threat  
from Governments

---

The Privacy Threat  
from Corporations

---

Defenses

---

Conclusions

*“On the Internet, no one knows you’re a dog.”*

*It wags its tail, it barks, and it acts the same as last time.*

*It snarls and bites; we have to deal with it.*

All three perspectives are valid; all three co-exist on the Internet.

Introduction

**Types of Privacy  
Violation**

Types of Privacy  
Violation

Reading Full Content

Behavior Tracking

Example

Web Cookies

Cookie Linkages

Traffic Analysis

Database Linking

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

# Types of Privacy Violation

# Types of Privacy Violation

Introduction

Types of Privacy Violation

Types of Privacy Violation

Reading Full Content

Behavior Tracking

Example

Web Cookies

Cookie Linkages

Traffic Analysis

Database Linking

The Privacy Threat from Governments

The Privacy Threat from Corporations

Defenses

Conclusions

- Full content monitoring
- Behavior tracking
- Traffic analysis
- Linking multiple sources

Introduction

Types of Privacy  
Violation

Types of Privacy  
Violation

**Reading Full Content**

Behavior Tracking

Example

Web Cookies

Cookie Linkages

Traffic Analysis

Database Linking

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

- Typically done via a wiretap
- In theory, easily prevented by encryption
- But — encryption is hard to use; very few people actually use it
- It's even harder to use *correctly*
- It can also be inefficient
- Result: rarely used except to protect passwords and credit card numbers

# Behavior Tracking

Introduction

Types of Privacy Violation

Types of Privacy Violation

Reading Full Content

**Behavior Tracking**

Example

Web Cookies

Cookie Linkages

Traffic Analysis

Database Linking

The Privacy Threat from Governments

The Privacy Threat from Corporations

Defenses

Conclusions

- Monitor what sorts of sites users visit
- Can be done by login or “cookies”
- Often hard to block
- Very common on sites that require subscriptions

[Introduction](#)

[Types of Privacy Violation](#)

[Types of Privacy Violation](#)

[Reading Full Content Behavior Tracking](#)

[Example](#)

[Web Cookies](#)

[Cookie Linkages](#)

[Traffic Analysis](#)

[Database Linking](#)

[The Privacy Threat from Governments](#)

[The Privacy Threat from Corporations](#)

[Defenses](#)

[Conclusions](#)

- The New York Times and Wall Street Journal track what articles you read, and select appropriate ads
- Amazon.com tracks your purchases and recommends related items
- Google looks at queries and mail keywords; then serves up appropriate ads

[Introduction](#)

[Types of Privacy Violation](#)

[Types of Privacy Violation](#)

[Reading Full Content](#)

[Behavior Tracking](#)

[Example](#)

[Web Cookies](#)

[Cookie Linkages](#)

[Traffic Analysis](#)

[Database Linking](#)

[The Privacy Threat from Governments](#)

[The Privacy Threat from Corporations](#)

[Defenses](#)

[Conclusions](#)

- Technically: cookies are small text files sent by a site to your web browser
- Intended uses: login name; shopping cart
- Actually: used to track you from session to session
- Third party cookies: a lot of Internet advertising is done by sites like Doubleclick.com, which set their own cookies
- Result: Doubleclick sees your behavior on *many* sites



# Cookie Linkages

Introduction

Types of Privacy  
Violation

Types of Privacy  
Violation

Reading Full Content  
Behavior Tracking

Example

Web Cookies

**Cookie Linkages**

Traffic Analysis

Database Linking

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

- If the web site ever learns who you are, they can associate that with your cookie
- Web bugs from third parties: one-pixel “clear GIFs”
- Going to just [www.nytimes.com](http://www.nytimes.com) resulted in cookies from [.atdmt.com](http://.atdmt.com), [.bluestreak.com](http://.bluestreak.com), [.doubleclick.net](http://.doubleclick.net), [.mediaplex.com](http://.mediaplex.com), [.nytdigital.com](http://.nytdigital.com), [.nytimes.com](http://.nytimes.com), and [.questionmarket.com](http://.questionmarket.com).
- If you visit another Doubleclick-using site, Doubleclick will know you’ve been to the N.Y. Times, and even something about what pages you viewed.

Introduction

Types of Privacy Violation

Types of Privacy Violation

Reading Full Content

Behavior Tracking

Example

Web Cookies

Cookie Linkages

**Traffic Analysis**

Database Linking

The Privacy Threat from Governments

The Privacy Threat from Corporations

Defenses

Conclusions

- Use wiretaps to see what site a user visits
- Track email the same way
- *Very* hard to block with encryption
- Frequently used by law enforcement or intelligence agencies

Introduction

Types of Privacy Violation

Types of Privacy Violation

Reading Full Content

Behavior Tracking

Example

Web Cookies

Cookie Linkages

Traffic Analysis

**Database Linking**

The Privacy Threat from Governments

The Privacy Threat from Corporations

Defenses

Conclusions

- Combine multiple sources of information
- Example: link address from online purchase to cookies
- Privacy principle: the secondary uses of the data are much more troublesome

Introduction

Types of Privacy  
Violation

**The Privacy Threat  
from Governments**

Goals

Government Purposes

Considerations

Threat Level

The Privacy Threat  
from Corporations

Defenses

Conclusions

# The Privacy Threat from Governments

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

**Goals**

Government Purposes

Considerations

Threat Level

The Privacy Threat  
from Corporations

Defenses

Conclusions

- Many governments spy on some Internet traffic
- Some, of course, do it more than others
- Generally aimed at government purposes

Introduction

Types of Privacy Violation

The Privacy Threat from Governments

Goals

**Government Purposes**

Considerations

Threat Level

The Privacy Threat from Corporations

Defenses

Conclusions

- Foreign intelligence
- Law enforcement
- Tracking domestic dissidents
- These categories can overlap
- Scope depends on type of government

# Considerations

Introduction

Types of Privacy Violation

The Privacy Threat from Governments

Goals

Government Purposes

**Considerations**

Threat Level

The Privacy Threat from Corporations

Defenses

Conclusions

- Generally must be completely invisible to person being monitored
- Result: done by wiretaps and by obtaining ISP and web site logs
- (Cookies aren't used)

# Threat Level

Introduction

---

Types of Privacy Violation

---

The Privacy Threat from Governments

---

Goals

Government Purposes Considerations

Threat Level

The Privacy Threat from Corporations

---

Defenses

---

Conclusions

---

- Not a major threat in most democracies
- Some democratic governments abuse their authority, but this can be dealt with politically
- Volume of traffic limits the amount of monitoring possible
- Even democracies monitor foreign traffic
- Dictatorships monitor much more internal traffic



Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

**The Privacy Threat  
from Corporations**

Corporate Goals

Attitudes

Techniques

Wiretapping?

Selling Data

Defenses

Conclusions

# The Privacy Threat from Corporations

# Corporate Goals

Introduction

Types of Privacy Violation

The Privacy Threat from Governments

The Privacy Threat from Corporations

**Corporate Goals**

Attitudes

Techniques

Wiretapping?

Selling Data

Defenses

Conclusions

- Primary goal: making money
- Privacy issue: can corporations make money by tracking users?
- Many of them think so!

---

Introduction

---

Types of Privacy Violation

---

The Privacy Threat from Governments

---

The Privacy Threat from Corporations

---

Corporate Goals

---

**Attitudes**

Techniques

Wiretapping?

Selling Data

---

Defenses

---

Conclusions

From a Wall Street Journal article on how Nielsen will use set-top boxes to monitor viewership:

Supporters of set-top-box data say it is more useful to marketers and less burdensome to participants than traditional Nielsen ratings. The set-top boxes cover many more households, and, unlike the panels, researchers don't have to secure agreement from those households to participate.

Introduction

Types of Privacy Violation

The Privacy Threat from Governments

The Privacy Threat from Corporations

Corporate Goals  
Attitudes

**Techniques**

Wiretapping?

Selling Data

Defenses

Conclusions

- Cookies
- Third-party cookies
- Cooperation with third-party advertising sites:  
pass information both ways
- Web site registration

# Wiretapping?

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Corporate Goals

Attitudes

Techniques

Wiretapping?

Selling Data

Defenses

Conclusions

- Some ISPs monitor user traffic
- Often for traffic engineering
- Example: Comcast (a US ISP) interfering with BitTorrent
- Some ISPs (i.e., Rogers in Canada) insert ads in some traffic
- Some British ISPs, including BT, are watching users' web traffic for sale to advertisers
- In some countries, monitoring is done to deal with copyrighted material

Introduction

---

Types of Privacy  
Violation

---

The Privacy Threat  
from Governments

---

The Privacy Threat  
from Corporations

---

Corporate Goals

Attitudes

Techniques

Wiretapping?

Selling Data

Defenses

---

Conclusions

---

- Corporations can sell data about users
- Often, they won't do that — but they'll sell aggregate data
- User behavior data used for targeted ads, online and offline
- Sometimes, they sell data to the government that the government can't collect by itself

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

**Defenses**

Defenses

Encryption

Onion Routing

Onion Routing

Example

Discarding Cookies

Lying

Laws

Conclusions

# Defenses

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

**Defenses**

Encryption

Onion Routing

Onion Routing  
Example

Discarding Cookies

Lying

Laws

Conclusions

- Encryption
- Onion routing
- Discarding cookies
- Lying
- Laws



Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Defenses

**Encryption**

Onion Routing

Onion Routing

Example

Discarding Cookies

Lying

Laws

Conclusions

- As noted, hard for most users
- Only protects against wiretappers
- Does not protect against attacks from end-site, such as cookies or third-party cookies

# Onion Routing

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Defenses

Encryption

Onion Routing

Onion Routing

Example

Discarding Cookies

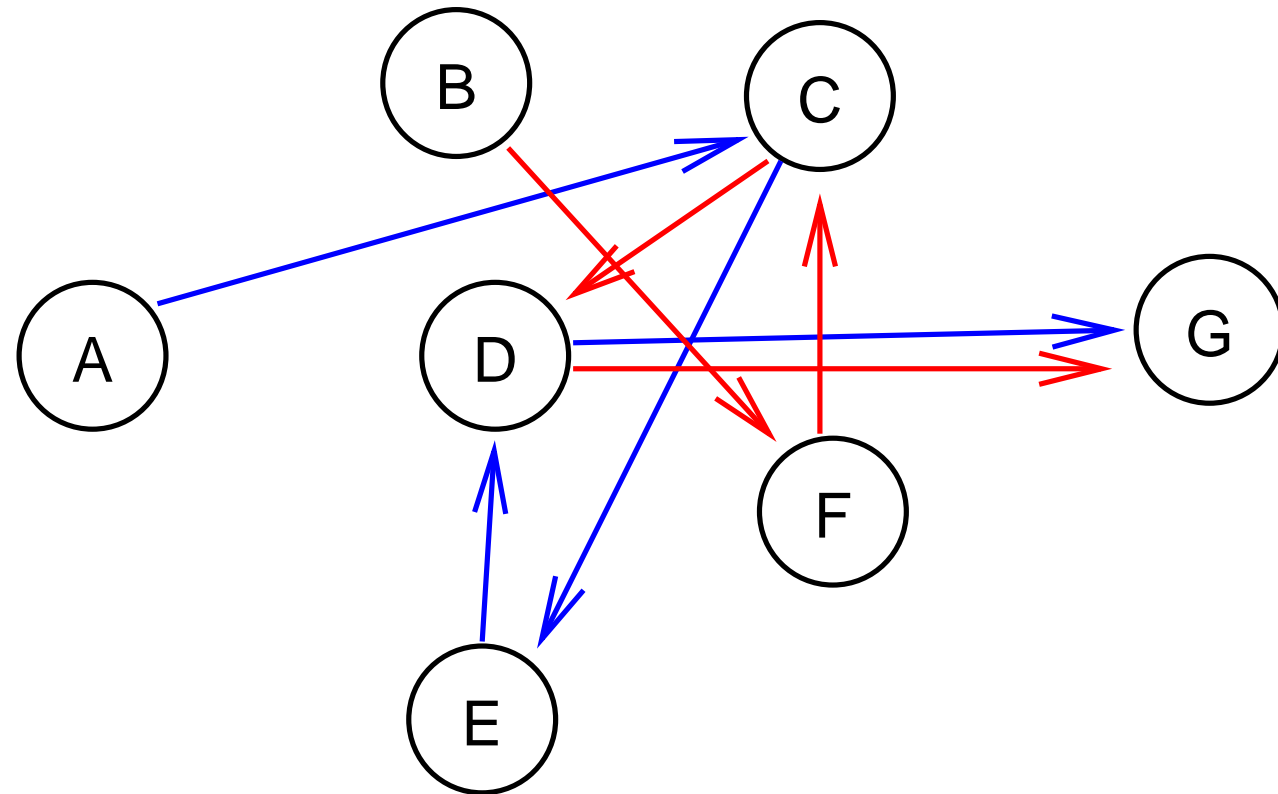
Lying

Laws

Conclusions

- Forward through random path
- Defeat wiretappers and traffic analysts
- But — slow
- Doesn't protect against attacks from end-site

# Onion Routing Example



To G, both traffic streams are coming from D. However, the two streams would have different cookies.

---

Introduction

---

Types of Privacy Violation

---

The Privacy Threat from Governments

---

The Privacy Threat from Corporations

---

Defenses

Defenses

Encryption

Onion Routing

Onion Routing Example

Discarding Cookies

Lying

Laws

---

Conclusions

# Discarding Cookies

Introduction

---

Types of Privacy  
Violation

---

The Privacy Threat  
from Governments

---

The Privacy Threat  
from Corporations

---

Defenses

---

Defenses

Encryption

Onion Routing

Onion Routing

Example

**Discarding Cookies**

Lying

Laws

Conclusions

---

- Some people delete all of their cookies periodically
- Most people don't
- Other tracking technologies exist, i.e., Macromedia Flash cookies

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Defenses

Encryption

Onion Routing

Onion Routing

Example

Discarding Cookies

Lying

Laws

Conclusions

- Some people lie when registering for web sites
- Give fake ages, location, gender
- Some sites notice, some don't; most don't care

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Defenses

Encryption

Onion Routing

Onion Routing

Example

Discarding Cookies

Lying

Laws

Conclusions

- Some countries have strong privacy laws
- But — the net is international
- Does EU privacy law apply to American companies?
- Laws won't stop foreign intelligence

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

**Conclusions**

The Three Visions

The Balance

# Conclusions

# The Three Visions

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

The Three Visions

The Balance

- Without outside information, there is some privacy against ordinary attackers — they don't know if you're a dog
- Corporations mostly care about behavior, and track that
- Governments have to deal with criminals



# The Balance

Introduction

Types of Privacy  
Violation

The Privacy Threat  
from Governments

The Privacy Threat  
from Corporations

Defenses

Conclusions

The Three Visions

The Balance

- What is the balance?
- How can governments track real criminals without invading the rights of others?
- Advertising pays for the net; it's more effective with tracking
- What is the right answer?