Access Control and Privacy Policies (1)

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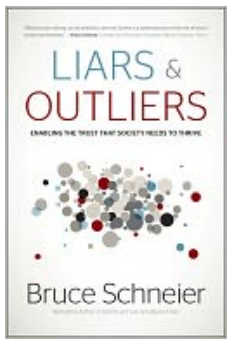
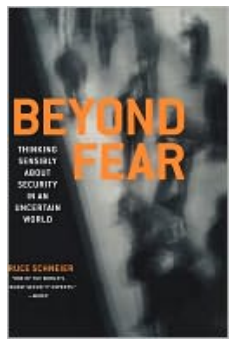
Security Engineers

According to Bruce Schneier, **security engineers** require a particular **mindset**:

"Security engineers — at least the good ones — see the world differently. They can't walk into a store without noticing how they might shoplift. They can't use a computer without wondering about the security vulnerabilities. They can't vote without trying to figure out how to vote twice. They just can't help it."





Chip-and-PIN

- Chip-and-PIN was introduced in the UK in 2004
- before that customers had to sign a receipt
- Is Chip-and-PIN a more secure system? What do you think?

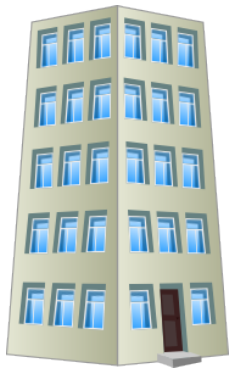
(Some other countries still use the old method.)

Yes...

"Chip-and-PIN is so effective in this country that fraudsters are starting to move their activities overseas," said Emile Abu-Shakra, spokesman for Lloyds TSB (in the Guardian, 2006).

- mag-stripe cards cannot be cloned anymore
- stolen or cloned cards need to be used abroad
- fraud on lost, stolen and counterfeit credit cards was down £60m (24%) on 2004's figure

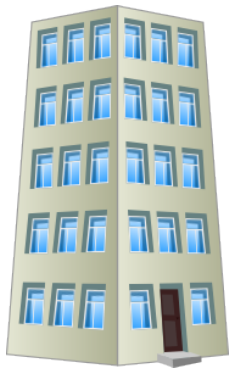
Let's see...



Bank

costumer / you

Let's see...



Bank

terminal producer

costumer / you

Chip-and-PIN

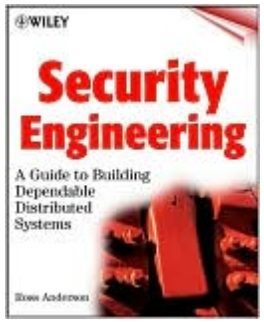
- A "tamperesitant" terminal playing Tetris on youtube.

  (http://www.youtube.com/watch?v=wWTzkD9M0sU)

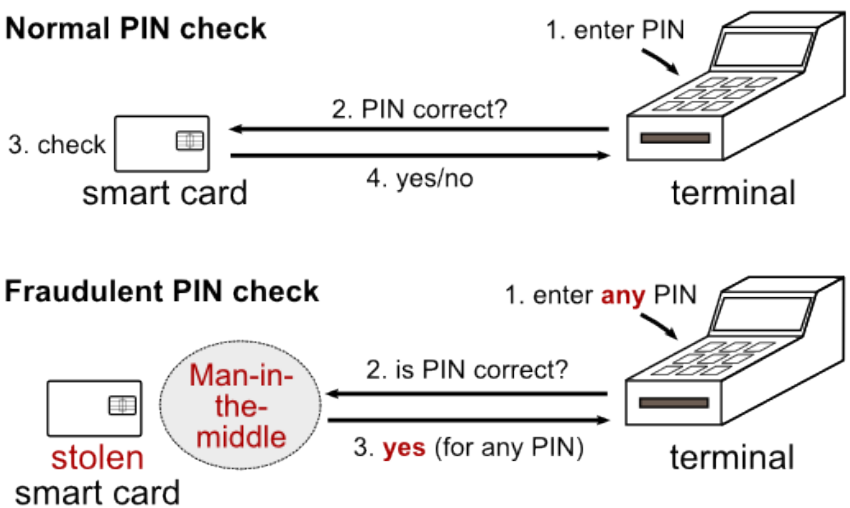
Chip-and-PIN

- in 2006, Shell petrol stations stopped accepting Chip-and-PIN after £1m had been stolen from customer accounts
- in 2008, hundreds of card readers for use in Britain, Ireland, the Netherlands, Denmark, and Belgium had been expertly tampered with shortly after manufacture so that details and PINs of credit cards were sent during the 9 months before over mobile phone networks to criminals in Lahore, Pakistan

Chip-and-PIN is Broken

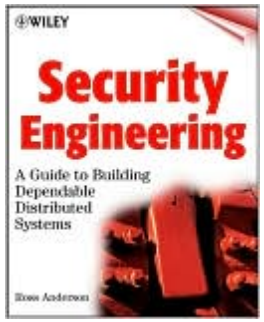


- man-in-the-middle attacks by the group around Ross Anderson



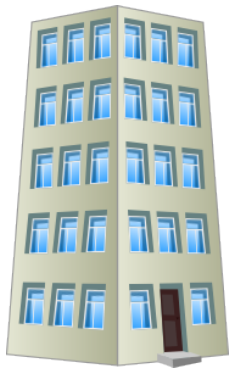
on BBC Newsnight in 2010 or youtube

Chip-and-PIN is Really Broken



- same group successfully attacked this year card readers and ATM machines
- the problem: several types of ATMs generate poor random numbers, which are used as nonces

The Problem. . .



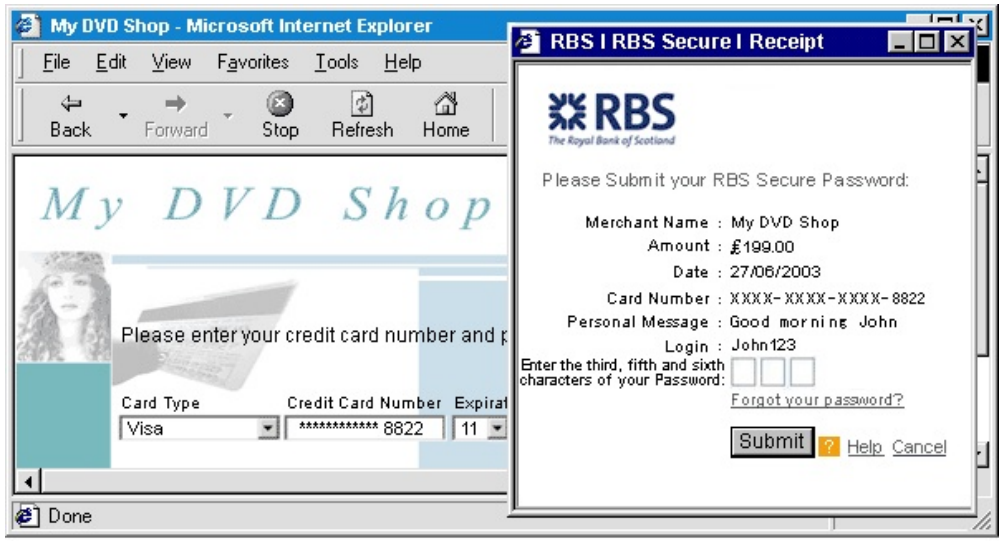
Bank

terminal producer

costumer / you

- the burden of proof for fraud and financial liability was shifted to the costumer

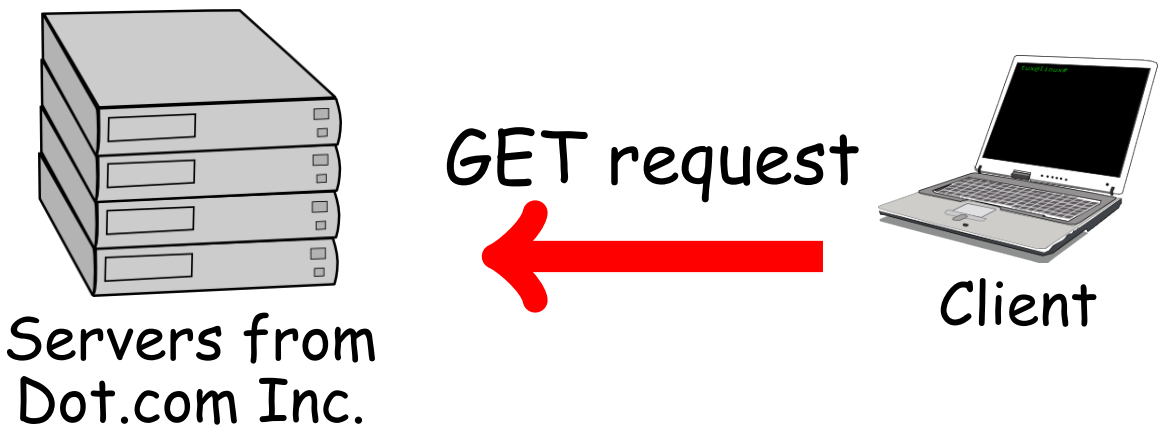
Screwed Again



- **Responsibility**
  "You understand that you are financially responsible for all uses of RBS Secure."

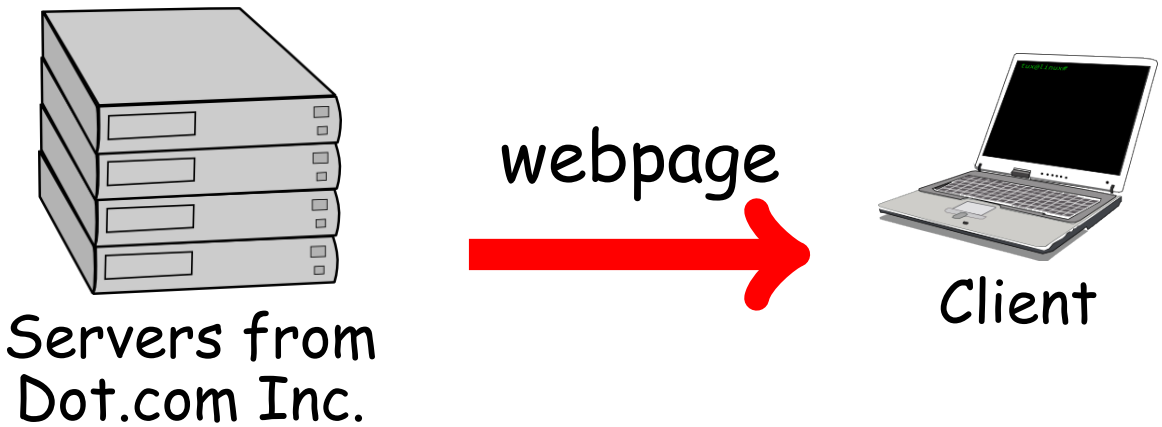
  https://www.rbssecure.co.uk/rbs/tdsecure/terms_of_use.jsp

Web Applications



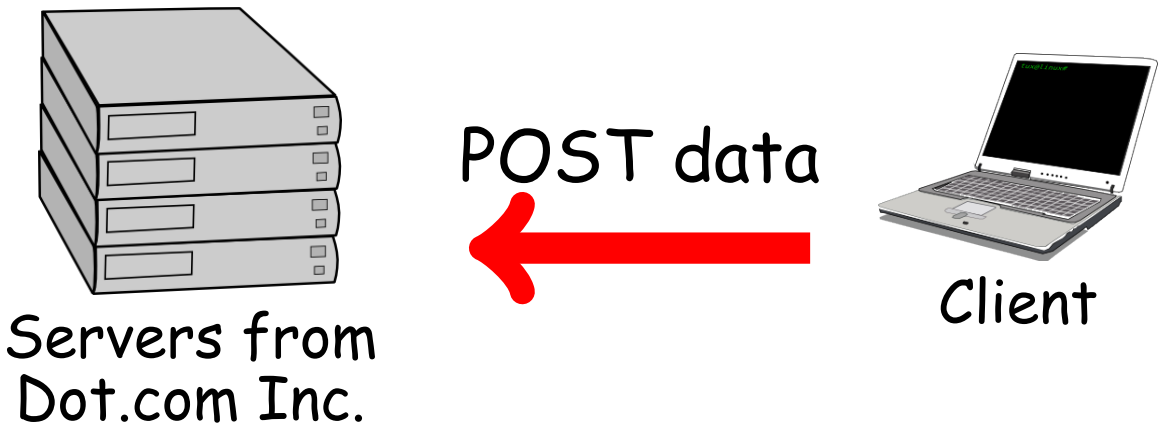
- What are pitfalls and best practices?

Web Applications



- What are pitfalls and best practices?

Web Applications



- What are pitfalls and best practices?

Scala + Play

simple response from the server:

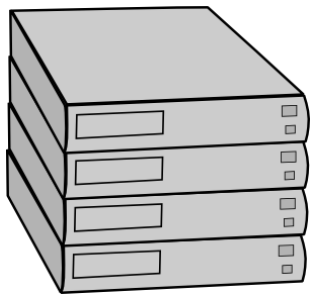
```
1  package controllers
2  import play.api.mvc._
3
4  object Application extends Controller {
5
6    // answering a GET request
7    val index = Action { request =>
8      Ok("Hello world!")
9    }
10 }
```

alternative response:

```
Ok("<H1>Hello world!</H1>").as(HTML)
```

```
1  object Application extends Controller {
2
3    // GET request -> present login form
4    val index = Action { request =>
5
6      val form =
7         """<form method="post">
8            Login: <input type="text" name="login"><br>
9            Password: <input type="password" name="password"><br>
10           <input type="submit"></form>"""
11
12     Ok(form).as(HTML)
13   }
14
15   // POST data: processing the login data
16   val receive = Action { request =>
17
18     val form_data = Form (tuple ("login" -> text, "password" -> text))
19
20     val (login, password) = form_data.bindFromRequest()(request).get
21
22     Ok("Received login: " + login + " and password: " + password)
23   }
24 }
```

Cookies

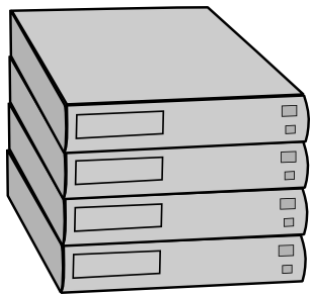


Servers from
Dot.com Inc.

GET request

Client

Cookies



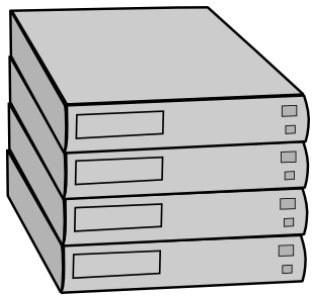
Servers from
Dot.com Inc.

GET request

read a cookie

Client

Cookies



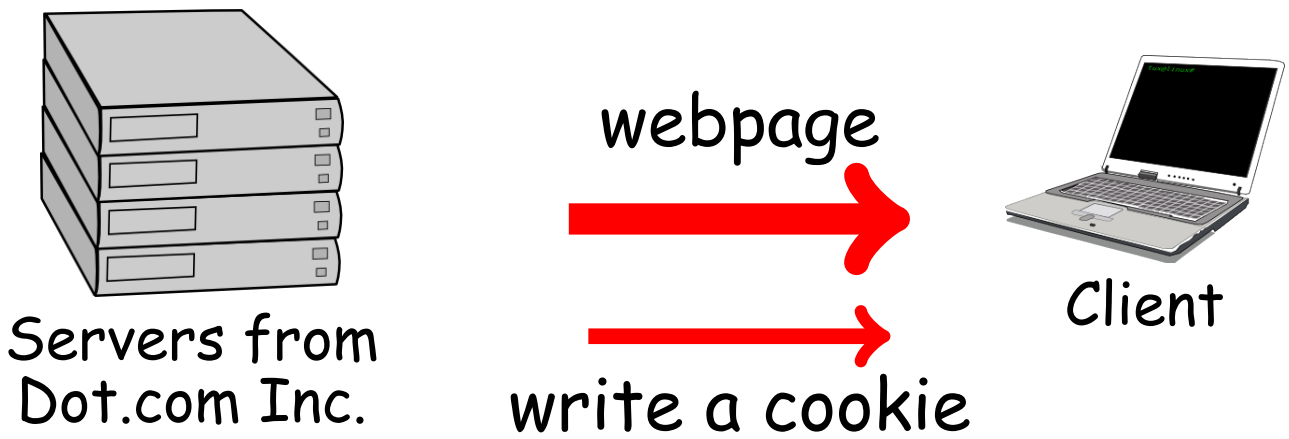
Servers from
Dot.com Inc.

webpage

write a cookie

Client

Cookies



- cookies: max 4KB data
- cookie theft, cross-site scripting attacks
- session cookies, persistent cookies, HttpOnly cookies, third-party cookies, zombie cookies

Cookies

EU Privacy Directive about Cookies:

"In May 2011, a European Union law was passed stating that websites that leave non-essential cookies on visitors' devices have to alert the visitor and get acceptance from them. This law applies to both individuals and businesses based in the EU regardless of the nationality of their website's visitors or the location of their web host. It is not enough to simply update a website's terms and conditions or privacy policy. The deadline to comply with the new EU cookie law was 26th May 2012 and failure to do so could mean a fine of up to £500,000."

- session cookies, persistent cookies, HttpOnly cookies, third-party cookies, zombie cookies

My First Webapp

GET request:

1. read cookie from client
2. if none is present, set `visits` to 0
3. if cookie is present, extract `visits`
4. if `visits` is greater or equal 10,
   print valued customer message
   otherwise just normal message
5. increase `visits` by 1 and store new cookie with client

```
1  object Application extends Controller {
2
3    def gt_cookie(c: Option[Cookie]) : Int = c.map(_.value) match {
4      case Some(s) if (s.forall(_.isDigit)) => s.toInt
5      case _ => 0
6    }
7
8    def mk_cookie(i: Int) : Cookie = {
9      Cookie("visits", i.toString)
10   }
11
12   // GET request: read cookie data first
13   def index = Action { request =>
14
15     val visits_cookie = request.cookies.get("visits")
16     val visits = gt_cookie(visits_cookie)
17
18     val msg1 = "You are a valued customer who has visited this site %d
19     val msg2 = "You have visited this site %d times."
20     val msg =
21       if (visits >= 10) msg1.format(visits) else msg2.format(visits)
22
23     //send with new cookie
24     Ok(msg).as(HTML).withCookies(mk_cookie(visits + 1))
25   }
26 }
```

```
1  object Application extends Controller {
2
3    //SHA-1, SHA-256
4    def mk_hash(s: String) : String = {
5      val hash_fun = MessageDigest.getInstance("SHA-1")
6      hash_fun.digest(s.getBytes).map{ "%02x".format(_) }.mkString
7    }
8
9    def gt_cookie(c: Option[Cookie]) : Int =
10     c.map(_.value.split("/")) match {
11       case Some(Array(s, h))
12         if (s.forall(_.isDigit) && mk_hash(s) == h) => s.toInt
13       case _ => 0
14     }
15
16   def mk_cookie(i: Int) : Cookie = {
17     val s = i.toString
18     Cookie("visits", s + "/" + mk_hash(s))
19   }
20
21   def index = Action { request => ... }
22 }
```

SHA-1

- SHA-1 is a cryptographic hash function
- no known attack exists, except brute force

SHA-1

- SHA-1 is a cryptographic hash function
- no known attack exists, except brute force

- but dictionary attacks can be very effective for extracting passwords

```
1  object Application extends Controller {
2
3    val salt = "my secret key"
4
5    //SHA-1, SHA-256 + salt
6    def mk_hash(s: String) : String = {
7      val hash_fun = MessageDigest.getInstance("SHA-1")
8      hash_fun.digest((s + salt).getBytes).map{ "%02x".format(_) }.mkStr
9    }
10
11   def gt_cookie(c: Option[Cookie]) : Int =
12     c.map(_.value.split("/")) match {
13       case Some(Array(s, h))
14         if (s.forall(_.isDigit) && mk_hash(s) == h) => s.toInt
15       case _ => 0
16     }
17
18   def mk_cookie(i: Int) : Cookie = {
19     val s = i.toString
20     Cookie("visits", s + "/" + mk_hash(s))
21   }
22
23   def index = Action { request => ... }
24 }
```

Unix Passwords

Password Blunders

Brute Forcing Passwords

- How fast can hackers crack SHA-1 passwords?

Brute Forcing Passwords

- How fast can hackers crack SHA-1 passwords?
- The answer is 2 billion attempts per second using a Radeon HD 7970

password length	time
5 letters	5 secs
6 letters	500 secs
7 letters	13 hours
8 letters	57 days
9 letters	15 years

graphics card
ca. £300

5 letters $\approx 100^5 = 10$ billion combinations
(1 letter - upper case, lower case, digits, symbols ≈ 100)

Passwords

- How do recover from a breakin?

This Course

- breakins (buffer overflows)
- access control (role based, data security / data integrity)
- protocols
- access control logic
- privacy

  Scott McNealy:
  "You have zero privacy anyway. Get over it."

Thinking as a Defender

- What are we trying to protect?
- What properties are we trying to enforce?
- Who are the attackers? Capabilities? Motivations?
- What kind of attack are we trying to protect?
- Who can fix any vulnerabilities?
- What are the weaknesses of the system?
- What will successful attacks cost us?
- How likely are the attacks?
- Security almost always is **not** free!

The Security Mindset

- How things can go wrong.
- Think outside the box.

The difference between a criminal is to only think about how things can go wrong.