IBM Research, Watson Research Laboratory

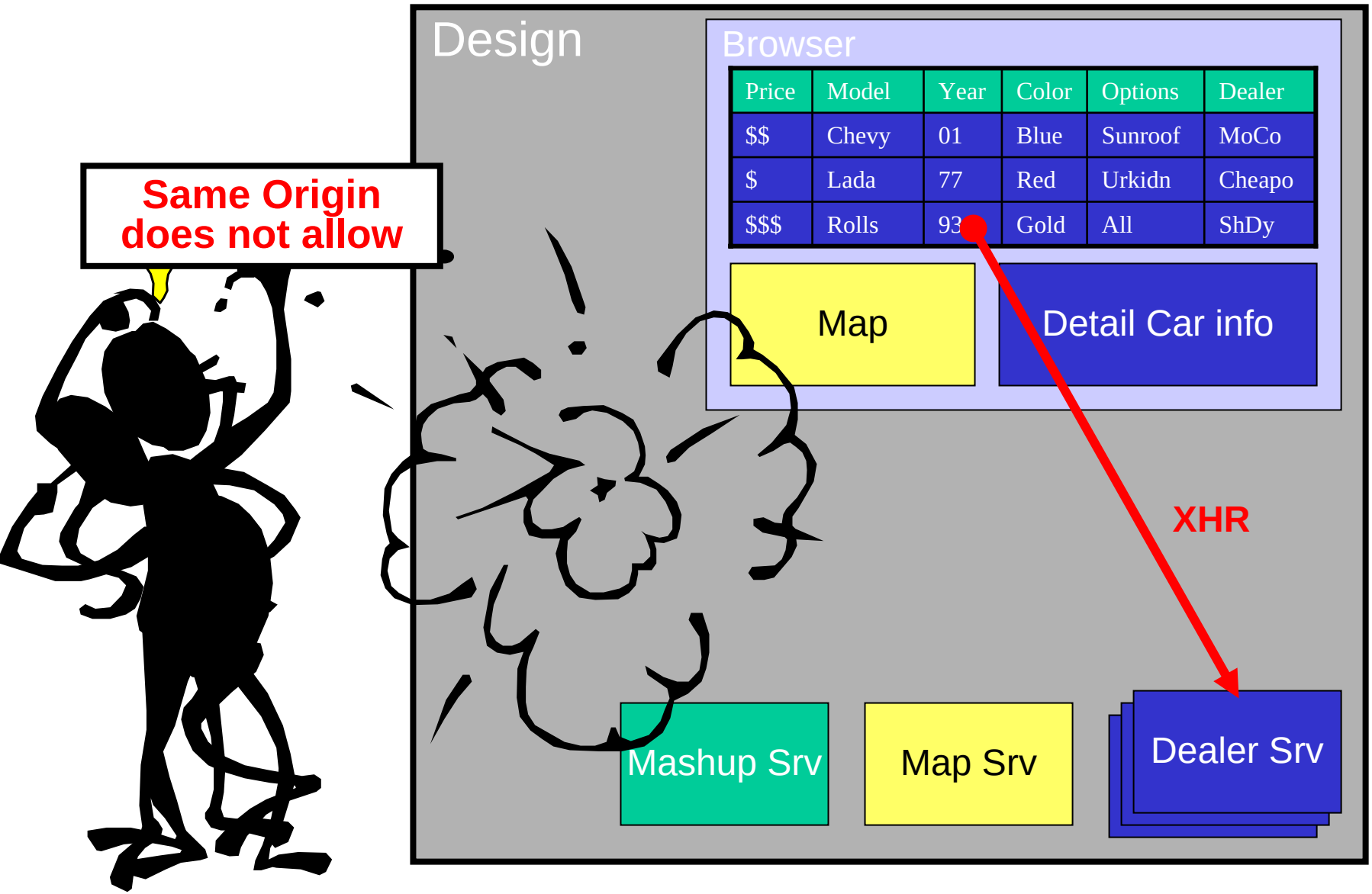
Security for Web2.0 application scenarios: Exposures, Issues and Challenges

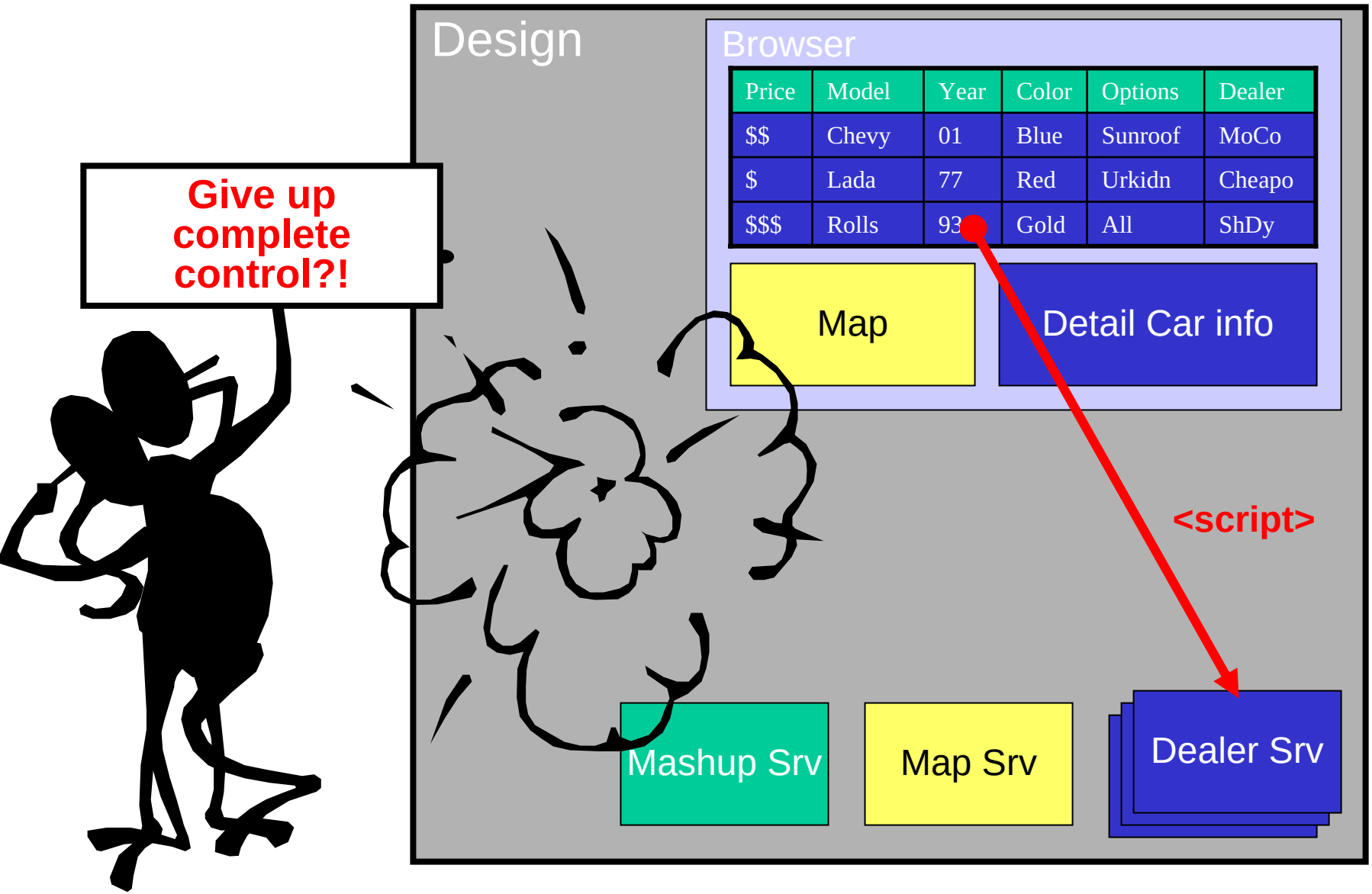
Sumeer Bhola, Suresh Chari, Michael Steiner

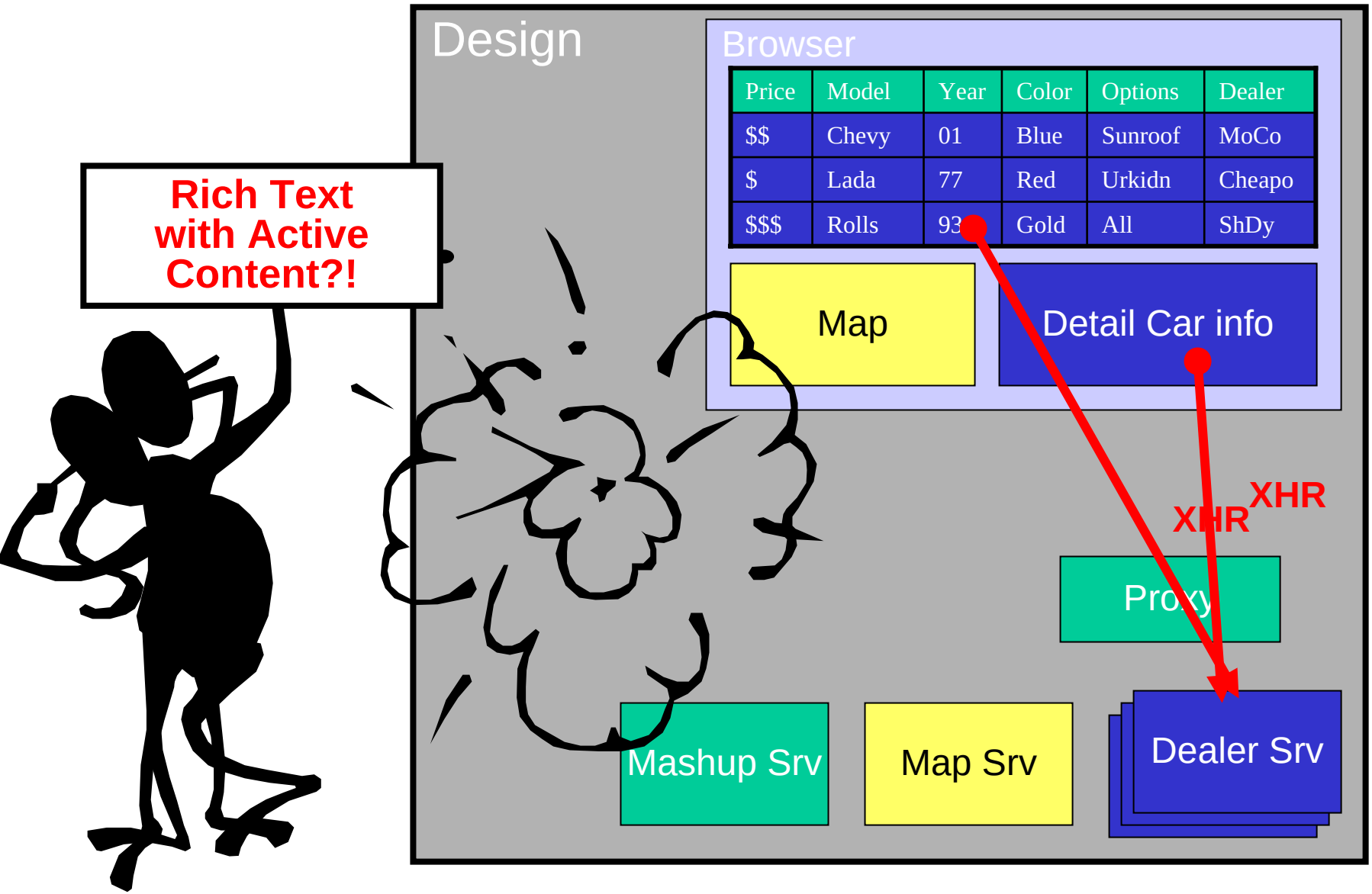
Storyboard for motivation slides

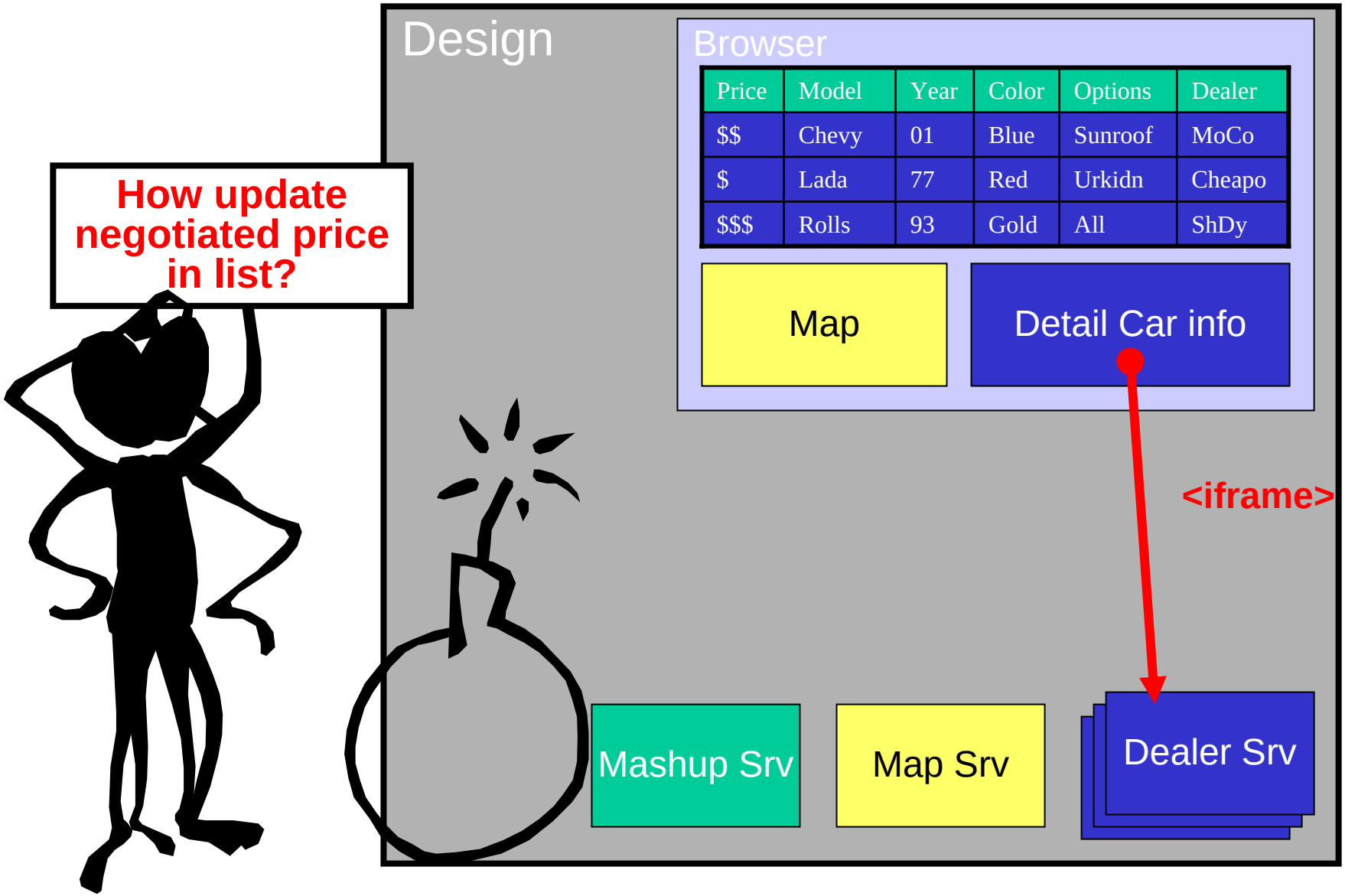
- *Setup:*
  - *Security-consicous developer on drawing board for used-car mashup*
    - *Services offered:*
      - *goohooque (map)*
      - *Dealers (generally: address, inventory via REST/JSON, dealer-specific details for example as active (link to KBB) HTML)*
- *Sequence:*
  - *Goes through various cycles & rejects each for functional or security problems, finally gives up ...*
    1. *Get info for list via **Direct XHF** -> non-functional: same origin*
    2. *Try with **ScriptSrc** -> no security: complete access to DOM & user credentials*
    3. *Try with **Proxy** -> controlled (data) service access ...*
       *... but what about rich-text dealer info? -> ahh, **ACF?!** ...*
       ... yet dealer wants to mash up with to KBB & allow price negotiation -> aargh, no security on active component
    4. *Ok, get via **Iframe** -> secure but now no way to synchronize update table for negotiated price?!*
    5. *Give up frustrated ...*
- *Observations:*
  - *Very hard to find security solutions; very context/deployment specific!!*
  - *Most developers would not even have realized problems; insofar, above idealistic scenario!!*
- *Message:*
  - *We need to give developer a ``tool'' which is*
    - *fail-safe (secure-by-default),*
    - *easy-to-use (otherwise not used) &*
    - *deployment setup-independent (important for mashup component providers)*

Once upon a time there was a mashup developer ...









... and he lived for a long
time afterwards, unhappy and problem
unsolved.

A Fairy Tale?

Yes ...

... but not because problem not hard --- we have not even talked about authentication & credentials --- and very deployment-sensitive ..

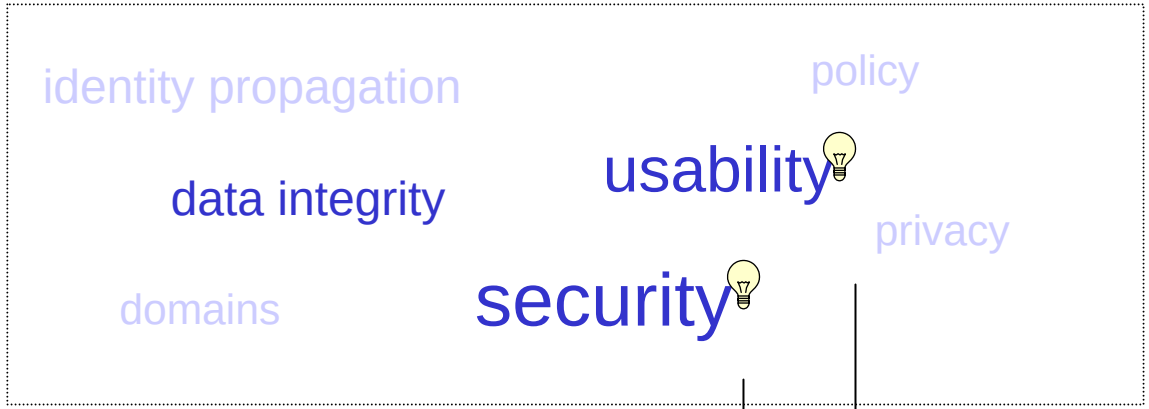
... but because most developers would not even have realized all problems!

Therefore ..

... we need to give developer a “tool” which is

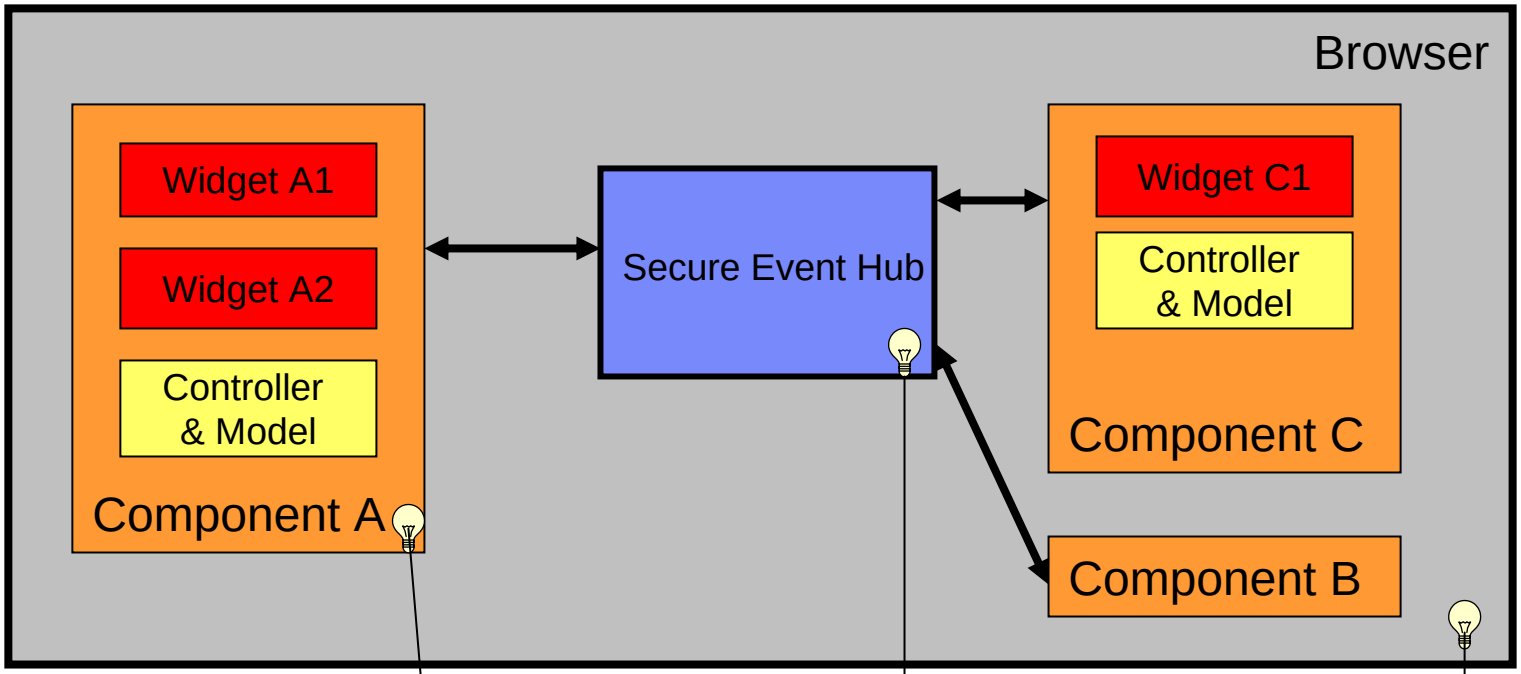
- fail-safe (secure-by-default),
- easy-to-use (otherwise not used) &
- deployment setup-independent (important for mashup component providers)

``Tool'' requirements



- Foundation: Isolation/separation & mediation
- Make it easy to write secure component interactions
  - Secure by default
- Authorization Policies must be consumable
  - Base on simple abstractions: service interface as opposed to DOM level
  - Declarative to allow for separation of concerns
  - Closer in spirit to J2EE than to J2SE ...
- Minimize assumption on end-user

Secure Component* Model: Approach



Related concep

- •OpenAJAX Hub
- •Module Tag prop
- •Dojo publish/sub
- •UI
- •Int
- •Tru

- •Message passing abstraction
  - •High-level abstraction that can be implemented using multiple low-level mechanisms
  - •Publish/subcribe channels: topics for channel naming and support for many-to-many channels
- •Enforces security policy on all inter-component interaction
- •Security Policy expressed per message channel (send/receive access on that channel)

* Pick your favorite alternative name: Gadget, Widget, ..

Secure Component Model: Prototype

- Enforcement of component boundaries: Using <iframe> isolation and fragment ids for parent-child frame communication
  - Event Hub implemented by main application frame
    - provided by mashup maker
  - Mashup maker is trusted to define inter-component communication
- Channel Policy
  - Mashup maker defines static inter-component message channels when loading components
  - Dynamic channels only permitted between components with compatible labels
- End-to-end security
  - Component credential in addition to user credential
  - Unified and CSRF-resistant request authentication

End-user Experience of Security

Content from multiple domains on a page increases existing problems

- Theft or Misuse of user credentials (Phishing++, CSRF++)
  - Theft: Browser URL address bar is useless for mashups
    - Does not communicate context of authentication challenge to user – which credential should be given?
    - Need integrity of context and fail-safe protocols
      - e.g. Identity Selector for Windows CardSpace or Higgins Trust Framework, pwd-based key-exchange protocols
- Confidentiality of input and integrity of display
  - Need to securely delineate different trust domains or components in the user interface
  - How does the user know where its input is going
  - Where parts of the display are originating?
- Who are the stakeholders in defining security policy?
  - Mashup maker (a.k.a. man-in-the-middle) not necessarily trusted with user credentials
    - With browser support, need not trust mashup maker with confidentiality of input and integrity of display
  - Mashup maker deciding inter-component wiring policy
    - With browser support, can the user / component providers get more control of this policy?
      - How are these policies defined? Enforced?

Summary

- Current security models are inadequate for Web 2.0
  - Browser models are either too restrictive or permissive
  - Built on brittle ground (DNS, cookies, ..)
  - Workarounds lead to unsafe practices
- Need new security models to address the new application paradigms
  - End-to-end isolated components
  - Explicit and mediated component interaction
  - End-user experience and credentials
- Migration path
  - Need secure (but enforcement-independent) programming model **now**!!

Building Blocks for Enforcement

- Browser extensions
  - <module> tag proposal [Crockford]
    - Components talk ONLY through a send/receive interface
    - Could consider extending with each module exporting a list of allowed functions
  - DOM access control
    - Each component comes with a dom level access control policy
  - FRIV element proposal (MashupOS) (Microsoft Research)
- Server-side code instrumentation
  - Static analysis & code rewriting
    - BrowserShield [Microsoft Research]
    - Vikram and Steiner [IBM Watson]
    - Secure DOM Javascript Library [IBM Tokyo Research]
  - Safe language with code translation
    - e.g., GWT with security guarantees,
- Iframe isolation: server-managed DNS sub-domains (virtual server) per colocated components
  - inter-iframe communication using e.g. fragment ids (dojo), document.domain (crockfort, Subspace), applet

Actual technique (or combination thereof) allows for trade-offs and deployment time adaptation

- *Chosen (declaratively) according to setup & trade-off between security & performance*