Device APIs
W3C TPAC 2022
Vincent Scheib (Google)
goo.gle/tpac2022-device-apis
Goal:
People can accomplish their daily computing tasks with the benefits of the web.
Let's talk about APIs that allow communication with peripherals & other devices using low-level protocols.
Windows, Mac, etc apps
Chrome Apps
Electron Apps
Web Apps
“Lack of APIs” is #1 request from “Progressive Programmers” segment.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Rating</th>
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</thead>
<tbody>
<tr>
<td>Working with different tracking protection and data storage policies in browsers</td>
<td>3.95</td>
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<tr>
<td>Determining the root cause of a bug</td>
<td>3.55</td>
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<tr>
<td>Running end-to-end tests</td>
<td>3.35</td>
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<tr>
<td>Lack of APIs to take advantage of device capabilities (e.g., sensors, OS and hardware features, etc.)</td>
<td>3.38</td>
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<td>Integrating with third parties for authentication</td>
<td></td>
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<tr>
<td>Achieving visual precision on stylized elements (e.g., buttons)</td>
<td>2.90</td>
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<tr>
<td>Using web technologies in a native or hybrid context (e.g., using WebViews, Electron, CEF)</td>
<td>2.80</td>
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<tr>
<td>Lack of support for progressive web apps (PWAs)</td>
<td>2.05</td>
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<tr>
<td>Running front-end tests</td>
<td></td>
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</tbody>
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USB, Bluetooth, HID, Serial
28-day average over 5 years

↓2018

↓2022
Bluetooth, HID, Serial
28-day average over 5 years
Areas of Use
Education: NASA Tech Rise Telemetry Simulator
Education: Microsoft MakeCode
"Download your code onto physical hardware devices"
Education: Microsoft MakeCode
"Download your code onto physical hardware devices"

Who else is using the MakeCode Editor?

**Adafruit: Circuit Playground Express**
Learn to code electronics, with an all-in-one board that has sensors and LEDs built in.

**LEGO® MINDSTORMS® Education EV3**
Program robots to walk, talk and much more

**Chibi Chip**
Blend circuit building and programming with arts and crafts

**Cue**
Use MakeCode to instruct the Cue robot to complete creative problems solving tasks

Start coding ➜
Start coding ➜
Learn more ➜
LEGO Education
Bluetooth
Serial

Select your SPIKE™ solution

SPIKE Essential

SPIKE Prime
Education: VEX Robotics, The Pocket Lab, more…
Flash Tools: TI & NumWorks Graphing Calculators

Let’s Get Started

1. Connect your TI-Nspire™ CX II graphing calculator to your computer using the USB cable.
2. CONNECT TO CALCULATOR
Welcome to Android Flash Tool

You can use this tool to flash Android builds to your device as well as side load APKs, transfer files from your device and other Android device utilities.

This tool allows you to flash Android onto recent Pixel phones and Android development devices (view full list). This tool doesn’t support flashing Android onto Chrome OS devices.

To flash a device the tool requires 10GB of available storage on your computer.

Install an Android build in three easy steps

- Connect your device via USB cable
- Select the software you want to install
- Install the software on your device
Enterprise: Call Control

Settings

Audio

Microphone
Default - Poly Blackwire 8225 Series

Noise cancellation
Filters out sound from your mic that isn’t speech

Speakers
Default - Poly Blackwire 8225 Series

Call control
Control Meet using your USB device

CONNECTED DEVICES
Poly Blackwire 8225 Series
Connect device
Entertainment: Stem Player

Web App using WebUSB is the single application option.

Kanye West & Kano Computing

Exclusive distribution of Donda 2 album
Hobbyist: Microcontrollers
Esprino & ESP Web Tools

I've just released a video about the Esp web tools, which allow you to flash full projects to your Esp in about a minute without installing any software (not even the Arduino IDE) or downloading any code.

I think this an amazing way of sharing projects with people!

Javascript interpreter on microcontroller.
Web IDE
Select your Logi USB receiver to connect your device to it.

Insert your Logi USB receiver and select it by clicking the button below to connect your device to it.

SELECT RECEIVER
Personal Electronics: Wooting Keyboard Tooling

Set actuation point
Set the point to activate a keypress. This change will affect: all keys

Rapid Trigger
Rapid trigger dynamically actuates and resets your key based on your intention to press or release the key. Rapid trigger starts and ends after the actuation point.

Tachyon mode
Tachyon mode optimizes your keyboard for input speed. When enabled, every keypress responds as fast as possible. The RGB effects are disabled for an optimal result. Analog stability might be affected.

Current speed: 3.4 ms
Personal Electronics:
remap-keys.app
Health: Tidepool

Electron app to upload diabetes data from devices.
Record any needed entry from multiple devices in real-time.
People are getting tasks done.
Developer Experimentation opportunity and potential
Developer Experimentation

@Vincent_Scheib
Twitter collection

micro:bit Tools - Fab Connect
Online tool & dashboard to bridge multiple #microbits together via the internet using a WebUSB connection to the browser.
Developer Experimentation

@Vincent_Scheib
Twitter collection

Made a Web Bluetooth REPL that works with @micropython and @CircuitPython 🐍 Supports Ctrl keys, history, indents, and tab completion 😊

MicroPython Web REPL

```
>>> for i in range(5):
...   print("Hello world!" + str(i))
...
Hello world!0
Hello world!1
Hello world!2
Hello world!3
Hello world!4
```
Thats so cool! I created a webapp, that accepts an image, downsamples and crops it down to 16*16px, gets the RGB values from each px and sends it via #WebUSB to the #Pico, which passes it to the RGB #pixelMatrix.
小さいスタックチェンたちをJINS MEMEで一斉に動かしてみるテスト。JINS MEME → ブラウザのWeb Bluetooth API → MQTT over Web Socket → MQTTブローカー → 小さいスタックチェンという経路。
（個体間の動きの同期は取ってない。横回転は顔の傾きで代用。）

Translate Tweet
We have resumed development of #flipperzero WebUSB application. Now it can update firmware directly from browser using the new updating protocol. Highly experimental demo: my.flipp.dev

Please check it out if you are brave enough.
As @joebarnard said in an interview: "Share your work with the world" 🌍

Inspired by your telemetry view for your rockets I coded a telemetry view for my upcoming drone.
The view is running in the browser and connects via WebUSB to my telemetry receiver.
#RP2040 #raspberrypi #FPV
Developer Experimentation

We handle device configuration, data uploads & firmware updates this way.

Still amazed how smooth #WebUSB works. I think it could solve the compatibility issues of many USB devices out there. Also feels safer than downloading drivers from grey corners of the internet. (7/12)
Today I learned about ZPL. A simple plain-text commands for Zebra label printers.

No drivers required. OS independant. All you need is WebUSB and some simple JS.

I made a quick demo app to send ZPL to my USB ZD421 and it works extremely well!
Comparing heart rate monitors from the two Finnish vendors using my #Webbluetooth example. R-R data is surprisingly identical, but Polar H10 probably calculates HR using more R-R intervals as the curve is slightly smoother. Source code: github.com/mstahv/hr-moni... java vaadin
How cool is this? #webbluetooth within a @googlechrome #pwa controls a stepper motor via #esp32 SOC for a #vinylrecords cutting lathe. I experienced the very beginning of the #web - but stuff like this I never even dreamed of.
Just published part 2 of the "Porting USB applications to the web". [web.dev/porting-gphoto...](web.dev/porting-gphoto...)

In this part I'm describing how I ported libgphoto2 to WebAssembly to control cameras from a web app, and showing how it was wrapped into a web UI with [@preactjs](https://github.com/preactjs/preact).

[Twitter collection](https://twitter.com/RRaverser/tweet/[Tweet-ID])
Many possibilities.

Efficient cross platform development, easy to use APIs, and distribution are key motivators.
Discussion
Security
Without Web APIs

- People will still use their devices. But how?
- People will install native apps.
- Pros: install friction reduces how often this is done (though security research shows it is not a barrier given incentives)
- Cons: Exposes people to security and privacy issues across many APIs, access to all devices
Security Model

- Balancing risk trade offs between
  - Installing Windows/Mac/etc apps with multi-device, multi-api access
  - Web Browser restricted access:
    - Requires secure context.
    - Permission granted one device to one site. **Least privilege** principle.
    - Blocklist device or attributes.
    - Users informed when the device is accessed.
WebUSB notification

WebLight detected
Go to sowbug.github.io/weblight to connect.
Chrome’s Chooser Dialog
Risk: Exposing information about user's devices

Sites can not access list of user’s devices

Access to a device only after a person selects one via a chooser.
Risk: Device can be compromised, e.g. firmware update

Users must select and grant access to a device

Sites do not know ahead of time whether a vulnerable device is available. Attempting to connect to many devices is very noticeable.

Devices under active attack can be added to a blocklist
Risk: Cross origin data sharing

Users must grant access to device multiple times, for each origin.

Comparable to saving and opening a file between sites.
Risk: Devices not designed to be accessed by any website

'Not designed' or 'fundamentally unsafe to be accessed by browser'? Native applications also provide any software to access any device Devices that are fundamentally unsafe can be added to the blocklist
Risk: Users don't understand the permission

Chooser designed to be hard to "just click yes". Must select a device first. Then connect.

User agents can provide in context help

User agents may add more information to the permission dialog