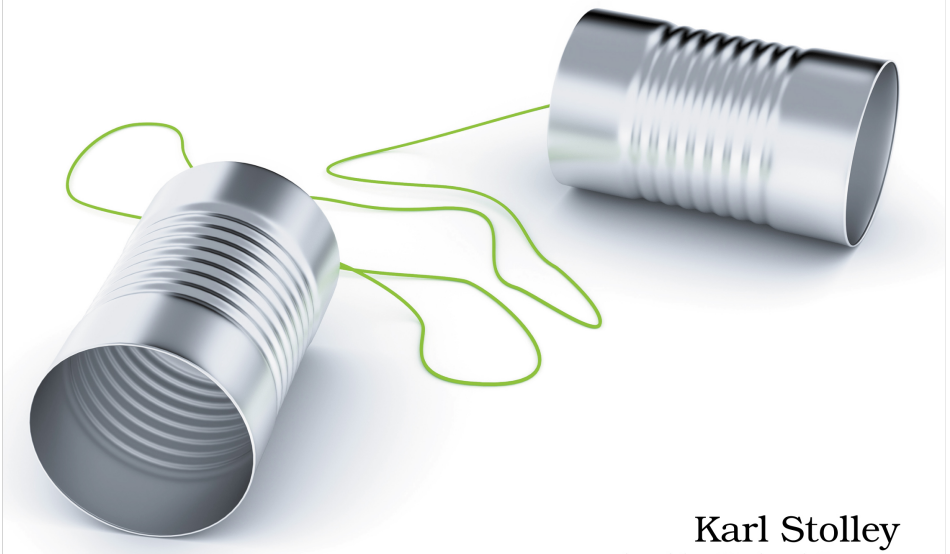
The Pragmatic Programmers

Programming WebRTC

Build Real-Time Streaming Applications for the Web



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Structuring Chat Messages in JSON

Instead of sending messages as unadorned strings, as we did in the last chapter, let's use JSON to structure some metadata with each message sent over the chat. To start with, the remote peer will use the metadata's content to acknowledge each message received. We can even add a little CSS so that, on the sender's side, there is a visual difference between messages that have been received by the remote peer and those that have not.

Preparing and Sending JSON

Sending JSON isn't much different from sending strings: JSON, or JavaScript Object Notation, is a fancy kind of string. Let's rework handleMessageForm() so that it builds a small object literal on message in place of the message strings we relied on in the previous chapter. We'll set up two properties on the message object: the text of the message, and a timestamp, which uses the Date.now() class method to generate a Unix timestamp in milliseconds.[1] The timestamp will uniquely identify each sent message:

demos/dc-chat-json/js/main.js

```
function handleMessageForm(event) {
  event.preventDefault();
  const input = document.querySelector('#chat-msg');
➤ const message = {};
➤ message.text = input.value;
➤ message.timestamp = Date.now();
➤ if (message.text === '') return;

  appendMessage('self', '#chat-log', message);

  sendOrQueueMessage($peer, message);

  input.value = '';
}
```

If you're like me, you much prefer working with JavaScript objects directly. Let's set up the sendOrQueueMessage() function to make a JSON string out of the message object at the last possible moment. We'll do that by calling JSON.stringify() inside the call to the data channel's send() method:

demos/dc-chat-json/js/main.js

```
function sendOrQueueMessage(peer, message, push = true) {
  const chat_channel = peer.chatChannel;
  if (!chat_channel || chat_channel.readyState !== 'open') {
    queueMessage(message, push);
    return;
```

1. https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Date/now

```
  }
  try {
➤   chat_channel.send(JSON.stringify(message));
  } catch(e) {
    console.error('Error sending message:', e);
    queueMessage(message, push);
  }
}
```

Messages that wind up in the queue will remain as JavaScript objects. That's the benefit of stringifying objects within the send() method, even if it makes the method call look a bit crowded: an object is only JSON when it's sent. At the same time, you can glance at a call like chat_channel.send(JSON.stringify(message)) and know that there's JSON involved. Best of all, JSON.stringify() relieves you of the error-prone business of constructing a JSON string yourself by hand.

With handleMessageForm() now handling messages and objects, and sendOrQueueMessage() properly sending messages as JSON, we need to update how messages are appended to the chat log. Two changes are all we need: referencing message.text from the new message object that we're passing in and preserving a reference to the Unix timestamp in a data-timestamp attribute.

demos/dc-chat-json/js/main.js

```
function appendMessage(sender, log_element, message) {
  const log = document.querySelector(log_element);
  const li = document.createElement('li');
  li.className = sender;
➤ li.innerText = message.text;
➤ li.dataset.timestamp = message.timestamp;
  log.appendChild(li);
  if (log.scrollTo) {
    log.scrollTo({
      top: log.scrollHeight,
      behavior: 'smooth',
    });
  } else {
    log.scrollTop = log.scrollHeight;
  }
}
```

If you've not used data- attributes before,[2] they are a super useful feature for storing out-of-band data in HTML. The HTMLElement.dataset property that you referenced as li.dataset.timestamp makes it pretty straightforward to read and write data- attributes using JavaScript too.[3]

2. https://developer.mozilla.org/en-US/docs/Web/HTML/Global_attributes/data-*
3. https://developer.mozilla.org/en-US/docs/Web/API/HTMLElement/dataset

Acknowledging Received Messages

Let's set up the logic to send a response that acknowledges each message a peer receives. This will take two steps: first, the receiving peer must parse the JSON message and check the resulting object for an id attribute. Only responses will have id attributes—messages have only text and timestamp attributes. When a message comes in, we create a response object whose id will take the timestamp value of the incoming message. The response object will also include its own timestamp, which captures the moment the message was received. Let's also reference a handleResponse() function that we'll build next for—you guessed it!—handling incoming responses:

demos/dc-chat-json/js/main.js

```
function addChatChannel(peer) {
  peer.chatChannel =
    peer.connection.createDataChannel('text chat',
      { negotiated: true, id: 100 });

  peer.chatChannel.onmessage = function(event) {
    const message = JSON.parse(event.data);
    if (!message.id) {
      // Prepare a response and append an incoming message
      const response = {
        id: message.timestamp,
        timestamp: Date.now(),
      };
      sendOrQueueMessage(peer, response);
      appendMessage('peer', '#chat-log', message);
    } else {
      // Handle an incoming response
      handleResponse(message);
    }
  };

  peer.chatChannel.onclose = function() {
    console.log('Chat channel closed.');
  };

  peer.chatChannel.onopen = function() {
    console.log('Chat channel opened.');
    while ($self.messageQueue.length > 0 &&
        peer.chatChannel.readyState === 'open') {
      console.log('Attempting to send a message from the queue...');
      // get the message at the front of the queue:
      let message = $self.messageQueue.shift();
      sendOrQueueMessage(peer, message, false);
    }
  };
}
```

Should the call or data channel fail in the time it takes to respond, the sendOrQueueMessage() function steps in and queues the response. Responses will of course be sent from the queue like any other message, as soon as the data channel opens again. Pretty snazzy, right?

Now you can turn your attention to building out the handleResponse() function. What it will do is use document.querySelector(), backed by CSS attribute selectors,[4] to hunt down in the DOM the exact list item for the appended message that the remote peer is acknowledging. That message will take a received class. If more than a second elapses between the message being composed and the acknowledgment, the list item also takes a delayed class:

demos/dc-chat-json/js/main.js

```
function handleResponse(response) {
  const sent_item = document
    .querySelector(`#chat-log *[data-timestamp="${response.id}"]`);
  const classes = ['received'];
  if (response.timestamp - response.id > 1000) {
    classes.push('delayed');
  }
  sent_item.classList.add(...classes);
}
```

If you've been quietly irritated by my use of the old-school className property across all the earlier code, I hope you can now breathe easier with the call to the modern classList API.[5] Note also the use of the fancy spread syntax,[6] ...classes, to ease passing in the array's values as a series of comma-separated arguments like .add() expects. The delayed class is only pushed onto the classes array if there is more than 1000 milliseconds difference between the timestamps for when a message was composed and when it was acknowledged.

Let's reference and style both the received and delayed classes in CSS:

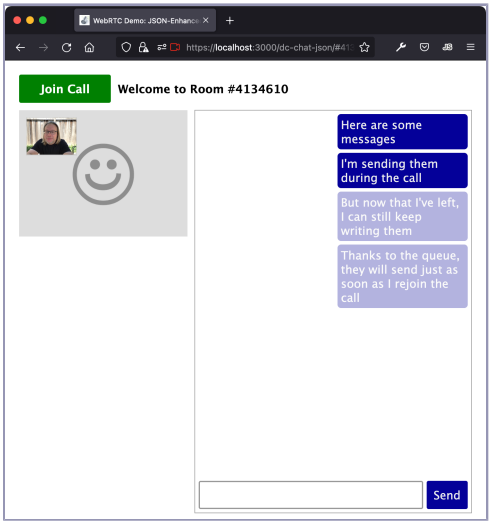
demos/dc-chat-json/css/screen.css

```
#chat-log .self {
  background: #009;
  color: #EEE;
  opacity: 0.3;
  float: right;
}
#chat-log .self.received {
  opacity: 1;
}
#chat-log .self.received.delayed {
```

4. https://developer.mozilla.org/en-US/docs/Web/CSS/Attribute_selectors
5. https://developer.mozilla.org/en-US/docs/Web/API/Element/classList
6. https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Operators/Spread_syntax

```
  transition: opacity 0.4s;
}
```

A user's sent messages might now appear faded out when appended to the chat log, thanks to a semi-transparent opacity value. The received class restores full opacity (opacity: 1.0). For the delayed class, however, let's add a nice little touch to the interface: delayed messages will appear to fade up from semi-transparency to full opacity over a little less than half a second, thanks to the CSS transition property.[7] Messages with less than a one-second delay will appear appended at full opacity. That prevents users from being annoyed by messages always fading up during a low-latency call—which would make the message interface feel like molasses. Here you can see acknowledged and queued messages sent after leaving the call:



Excellent. You're now sending and receiving JSON over data channels. You've also implemented a simple method for acknowledging messages as a peer receives them. And thanks to some carefully crafted DOM attributes and CSS, you've seen once more how tight the connection is between WebRTC and interface design.

Let's apply that same tightly connected approach to a fundamental feature of WebRTC applications: giving users the ability to toggle their cameras and microphones on and off.

7. https://developer.mozilla.org/en-US/docs/Web/CSS/transition