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1. INTRODUCTION

Work package 2 of the HTML5Apps project aims at launching new standardization efforts to close gaps between native apps and HTML5 apps, by looking ahead to plan and execute further standardization activities required to make HTML5 apps competitive with native apps.

Whereas standardization work happens in W3C Working Groups, the work to prepare and accompany future standardization is often informed via public events known as W3C Workshops as well as in W3C Interest Groups and Community Groups:

- W3C Workshops are events organized by W3C that any interested party can participate in and bring input to; they often mark the first milestone of new work starting its way to W3C standardization.

- W3C Interest Groups are groups formally chartered by W3C to bring input (such as use cases and requirements) to existing groups and to identify the need and scope for potential new groups.

- Community Groups are groups that anyone can create, join and participate in; they allow the wider Web community to collaborate on experimental work, with a simplified path towards formal standardization in W3C should that experimental work prove successful.

The second year of the project in the "Future Standards" work package had two main goals:

- Bringing the opportunities identified in the first year of the project regarding standardization of payments operation in Web apps to standardization.

- Supporting and animating the W3C Web and Mobile Interest Group; this group has for mission to "accelerate the development of Web technology so that it becomes a compelling platform for mobile applications"[1], and thus is the natural home in W3C to gather and define the needs for new Web technologies relevant to mobile.

This report summarizes the work accomplished by the HTML5Apps project toward these goals from October 2014 to September 2015. It is structured as follows: In Section 2, we report on the progress made around standardizing payments on the Web, via our involvement in the Web Payments Interest Group; in Section 3, we look at the broader set of standardization needs identified and advocated by the project, especially in the space of new APIs that bring better integration with device capabilities. In Section 4, we

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[1] Web and Mobile Interest Group Charter: http://www.w3.org/2013/07/webmobile-ig-charter.html

summarize the overall impact of the project in terms of advancing standardization opportunities for HTML5 applications.

2. FUTURE STANDARDS ON WEB PAYMENTS

This Section describes the work done by the Web Payments Interest Group along with the contributions made by the HTML5Apps project.

2.1. Current Status

In the first year of the project, the HTML5Apps project organised a workshop to explore the potential for initiating standards work around improving Web payments, see the workshop report[1]. We followed up by creating a W3C Community Group to prepare a charter[2] for a W3C Interest Group for the W3C Advisory Committee. Following a successful review, the Web Payments Interest Group[3] was launched on 15th October 2014 accompanied by a Press Release[3] with testimonials from W3C Members Bloomberg, Gemalto, GRIN Technologies, Ingenico Group, NACS, Rabobank and Yandex.

The Web Payments Interest Group is chaired by Erik Anderson (Bloomberg[4]) and David Ezell (NACS[5]). The Interest Group focuses on building a shared vision for Web payments with work on use cases and requirements, consideration of existing payment schemes, payment flows and identification of areas where new standards are needed. The Group conducts its business using frequent phone calls, blog posts, wiki-pages, shared editing of documents on GitHub, and regular face to face meetings.

The Interest Group has proposed a charter[6] for a new W3C Working Group focusing on APIs for Web Payments, but excluding work on the broader opportunities around the economic transactions of which payments is just one part. The Working Group charter thus covers proof of payment, but not transaction receipts. The plan is for the Interest Group to continue to study opportunities for new standards relating to economic transactions, including support for loyalty schemes, vouchers, receipts and value added services, as well as offline payments, and harmonising the experience across Web-based payments, person to person payments and payments in a brick and mortar store.

The W3C Advisory Committee Review[7] of the proposed Working Group Charter was initiated on 5th August 2015. A couple of webinars to the attention of group members were organised on the 3rd and 9th September to facilitate discussion of the draft Working Group charter. It is now anticipated that the Working Group will be officially launched in November 2015 following strong support for the draft charter. A preliminary meeting of

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[2] http://www.w3.org/2014/04/payments/webpayments_charter.html

[3] http://www.w3.org/2014/10/payments.html.en

[4] Bloomberg is an international agency for business and market news and analysis.

[5] NACS is an association of North American convenience stores and gasoline stations.

[6] http://www.w3.org/2015/06/payments-wg-charter

[7] The W3C Process requires Advisory Committee Review of charters for Interest and Working Groups, see http://www.w3.org/2015/Process-20150901/#CharterReview

those who are interested in joining the Working Group will take place during W3C's all annual group meeting (TPAC) in late October in Sapporo, Japan.

2.2. The Web Payments Interest Group

The mission of the Web Payments Interest Group[8], part of the Web Payments Activity, is to provide a forum for Web Payments technical discussions to identify use cases and requirements for existing and/or new specifications to ease payments on the Web for users (payers) and merchants (payees), and to establish a common ground for payment service providers on the open Web Platform. The overall objective of this group is to identify and leverage the conditions for greater uptake and wider use of Web Payments through the identification of requirements for further standardisation to increase interoperability between the different stakeholders and the different payment methods. The objective of the group is also to enable more competition and innovation in the area of Web payments and to prevent possible payment vendor monopoly and vendor lock-in.

The Interest Group has set up seven task forces as a way to efficiently group work on different aspects:

- **Use cases** — This task force gathers use-cases that the IG is planning to address. A W3C Working Draft *Web Payments Use Cases 1.0*[9] was published on 30th July 2015. The Interest Group Wiki includes a page on draft requirements[10] derived from these use cases.

- **Payment Architecture** — This task force is defining an architecture that would address the prioritised use cases the group wishes to address. The draft Interest Group Note on *Web Payments: Capabilities 1.0*[11] is being actively worked on as an "editor's draft", and covers capabilities that if standardised would improve payments on the Web.

- **External Reviews** — This task force provides feedback on relevant external specifications as well as arranging for external review of the Interest Group's documents. The external groups include other standards organisations such as X9 ad ISO, the US Federal Reserve Bank (e.g. their task forces on security and faster payments), merchants and regulators. Some of the documents under review include:
    - ISO 12812, parts 1-5 (mobile payments)
    - X9.119 part 2 (tokenisation)
    - X9.69 (framework for key management extensions)
    - X9.73 (cryptographic message syntax)
    - ISO 2022 (business process framework and data dictionary)

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[8] http://www.w3.org/Payments/IG/

[9] http://www.w3.org/TR/web-payments-use-cases/

[10] https://www.w3.org/Payments/IG/wiki/Use_Cases_Task_Force/Requirements

[11] https://dvcs.w3.org/hg/webpayments/raw-file/default/latest/capabilities/index.html

- **Internet of Value** — Today's payment networks are disconnected like the documentation systems that the Web sought to connect. This task force explores how the Web can connect new and existing value networks and enable cross-network clearing and settlement that is secure, low-cost, and fast. The central question is how standardisation could make Web payment mechanisms more interoperable, accessible and competitive. Could the Web be used to enable cross-network payments such that users and merchants would never have to worry about whether they have the   same payment instruments in order to do business?

- **Security** — This task force is the liaison with W3C and relevant industry groups in the area of   security. The group will help determine what new work is required within the W3C, or will be better left to other organisations. Relevant groups within the W3C include Web Crypto Working Group[12], and the proposed new Working Groups on stronger authentication and secure hardware.

- **Glossary** — The terms used in the Use Cases and Payment Agent definitions are listed and referenced in a shared glossary.

- **Communications Strategy** — This task force will develop messaging and communications plans to share the group's work with a variety of stakeholders including the payments industry and W3C Working Groups. Some products of this task force include an FAQ for the Web Payments Working Group Charter[13], an analysis of industry segments and interests, and open meetings such as the Web Payments Round Table which was held in New York on 18th June 2015.

2.3. Web Payments Interest Group Meetings

We held a total of three group meetings during the past year:
- 27-28 October 2014 — first face to face meeting was hosted by the HTML5Apps project during the W3C all groups meeting (TPAC) in Santa Clara, California.
- 2-4 February 2015 — second face to face meeting was hosted by Rabobank in Utrecht, Holland.
- 16-18 June 2015 — third face to face hosted by Bloomberg at their offices in New York, USA.

And we are preparing an important face to face meeting at the end of October 2015:
- 26-27 October 2015 — upcoming face to face during TPAC2015 in Sapporo, Japan

The New York face to face ended with a round table event with a joint meeting between the Interest Group members and participants invited from a wide range of financial institutions, mostly from the New York area. The aim was to share W3C progress around

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[12] http://www.w3.org/2012/webcrypto/
[13] https://www.w3.org/Payments/IG/wiki/Web_Payments_WG_Charter_FAQ

Web payments, and to discuss priorities for standardisation. The event started with an overview on "Shaping the future of Web payments" from the W3C CEO Jeff Jaffe.

The following table lists the organisations that attended the meeting, with the IG (and W3C) member organisations shown in bold:

American Express	**Apple**	Barclays	**Bloomberg**	**Camara Interbancaria de Pagamentos**	**Canton Consulting**
CapitalOne	CitiGroup	City of NY (CTO)	Deutsche Bank	Deutsche Telekom	Digital Bazaar
Dwolla	Electronics Transactions Association	**Financial Services Roundtable**	French Treasury	Gates Foundation	**Gemalto**
Google	**GS1**	**GSMA**	HSBC	MasterCard	**Mozilla**
NACHA	**NACS**	**NIC.br**	**Oracle**	**PayGate**	R3CEV
Rabobank	**Ripple Labs**	Santander	SWIFT	Target	**US Federal Reserve**
Verizon	VISA	Wells Fargo	**Worldplay**		

The New York face to face and round table is described in more detail in a blog post[14].

2.4. Web Payments Working Group Charter

The aim of the proposed Working Group is to make payments easier and more secure on the Web, through incremental improvements to Web infrastructure that support and facilitate payments. The charter uses the term "digital wallet"[15] to mean an agent that supports the registration of payment instruments, user selection of payment instruments applicable to a given transaction, the passing of a payment request from the payee to the selected payment instrument, and finally, the means to pass a proof of payment to the payee. The expected benefits include:

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[14] http://www.w3.org/blog/wpig/2015/06/26/payments-charter-progress-and-roundtable-roundup/

[15] Note that some companies instead identify the term "digital wallet" with a particular payment instrument.

- Streamlined payment flow and reduced transaction abandonment
- Increased customer satisfaction through additional payment options and a harmonised experience across websites
- Improved transparency and confidence in digital payments
- Improved security and privacy by providing information only to those who require it to complete the transaction
- Easier integration of new payment schemes by payment service providers
- Easier deployment of digital wallets
- Lower costs for merchants due to easier adoption of new payment instruments
- Added value through machine readable payment requests and responses

The Working Group will standardise a set of messages and a message flow for the initiation, confirmation, and completion of a payment. The group will not define a new payment scheme, neither will the group develop standards for loyalty schemes and coupons, digital receipts, digital credentials, tickets, and location services. Future W3C activities may seek to increase interoperability of these or other additional digital wallet capabilities.

The charter's scope covers a payment initiated through a Web browser. Users will be provided with the means to register new conforming digital payment instruments with their digital wallet. Payees will be able to provide information that can be used by the wallet to determine which of the payer's registered payment instruments are applicable to a given payment request.

The user's choice of a payment instrument may have an impact on the amount to be paid, e.g. where an additional fee is incurred through the use of a credit rather than a debit card payment. The choice may further effect the terms and conditions, e.g. where payment is deferred until after delivery. The selected payment instrument interacts with the user and device to confirm the payment and to apply the appropriate level of assurance for that payment scheme for authenticating the user/device. A proof of payment is then passed to the payee.

The charter allows for both push and pull payments. A push payment is where a payment is initiated by the payer and pushed to the payee's account. A pull payment (e.g. a typical credit card payment) is initiated by the payee, resulting in a request from the payer's account. Many such payment schemes are actually binding commitments to pay, as the actual transfer of value doesn't take place until a settlement process occurs, which could be seconds to days later.

The charter lists a deliverable specifying a suite of Web Payment APIs. This will address payment scheme descriptions, payment terms descriptions, proof of payments, registration of payment instruments, payment initiation and completion, Web application to user agent integration, user agent to server-side wallet communication, and optionally, inter-app messaging on mobile devices. The charter further describes optional work items on the integration of existing card payment schemes, and good practices for "discovery" of payment instruments, including recommended algorithms.

2.5. Overall Summary Payments WG/IG

In summary, the W3C Web Payments Working Group will have a narrow focus on moving quickly on minimal standards for Web payments. There are opportunities for work on a broader context for payments, e.g.

- Push payments, subscriptions, reversals
- Offline payments, person to person payments
- Brick & mortar stores and contactless payments
- Pre-authentication of payer on entry to store, etc.

In addition there are opportunities on related standards for the economic transaction, e.g. loyalty cards, prepaid vouchers, discount coupons, tickets, itemised receipts with terms and conditions. This provides an expanded role for the W3C Web Payments Interest Group and raises the question for which additional stakeholders need to be involved to realise the potential. This is likely to lead to new standardization opportunities in the future.

2.6. HTML5 Project contributions to work on Web Payments

2.6.1. General Overview

The HTML5Apps work on Web payments seeks to reduce the burden on merchants for integrating with payment solutions, to give users control over how they want to pay, along with support for prepaid vouchers, discount coupons and loyalty cards, to increase security and reduce online fraud, and to create a level playing field for a broad range of payment solutions and digital wallets. For Europe, the Interest Group is seeking to support SEPA based payments in which the parties are identified using their IBAN (International Bank Account Number) and BIC (Bank Identifier Code).

During this reporting period, the HTML5Apps project took care of finalising the review and approval of the Interest Group charter, launching the group and accompanying the selected co-chairs of the new group. The project also focused on recruiting participants for the group, both from existing W3C members and potential new members.

The HTML5Apps project has funded W3C Staff involvement for the group. This was Stéphane Boyera through January 2015, and Dave Raggett from February 2015 until the end of the reporting period. We are very grateful for Stéphane's work on launching the Interest Group and he has kindly agreed to continue to provide advice by becoming an Invited Expert. Dave resumed his work on Web payments, having driven preliminary studies in 2012-2013, including the initial preparations for the Paris workshop, before handing this over to Stéphane in late 2014. He participated in the Interest Group Task Forces on use cases and architecture, as well as the weekly management calls with the group's co-chairs.

During the reporting period, the HTML5Apps project has organised weekly teleconferences for the Interest Group, and three face-to-face meetings. The first took place on 27-28 October 2014 as part of the W3C Technical Plenary in Santa Clara,

California, and hosted by the HTML5Apps project. The second face to face took place on 2-4 February 2015 in Utrecht, NL hosted by Rabo Bank. The HTML5Apps project invited a number of organisations that were not yet W3C members to send representatives as observers, including:

- Patrik Smets (EMVCORepresentative)
- Floris Kleemans (UETP/Focafet Foundation)
- RichardMartin(VisaEurope)
- Vish Shastry (Visa Inc.)
- JohannCaubergh (QisQi)

In addition to maintaining the Interest Group Web site[16], and helping with recruiting new members, the HTML5Apps project has assisted the Interest Group Co-Chairs (David Ezell from NACS and Erik Anderson from Bloomberg) with the management of the group's activities, and contributed to the technical work, e.g. on use cases, architecture, and the security framework (more details below). The Interest Group is continuing to grow in size, and the HTML5Apps project ensured that it includes a broader range of stakeholders.

2.6.2. Helping with Outreach and Recruitment of New Members

The HTML5Apps project has contributed to Interest Group's communications plan[17] to help with recruiting and external messaging of the group's activities.

As a result of this work, as of late September 2015, the W3C Web Payments Interest Group has seven invited experts, and 104 official W3C Member representatives, from 44 W3C Member organisations, 11 (25%) of which are based in Europe (shown in bold below):

Alibaba, China	Google, USA	PayGate, Singapore
Apple, USA	GRIN Technologies, USA	**Rabobank**, The Netherlands
AT&T, USA	**Groupe BPCE**, France	Ripple Labs, USA
Bloomberg, USA	GS1, USA	SHIFTMobility, USA
Brazilian Network nformation Center, Brazil	Huawei, China	Shimply, India
C-DAC, India	IBM, USA	SK Telecom, Korea

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[16] http://www.w3.org/Payments/IG/

[17] https://www.w3.org/Payments/IG/wiki/Communications_Strategy_Task_Force

Camara Interbancaria de Pagamentos, Brazil	Intel, USA	Standard Treasury, USA
Canton Consulting, France	Knowbility, USA	Target, USA
De Nederlandsche Bank, Holland	Merchant Advisory Group, USA	Tencent, China
Deutsche Telekom, Germany	Mozilla Foundation, USA	Verisign, USA
Digital Bazaar, USA	National Association of Convenience Stores, USA	Viacom, Europe (Viacom is represented by their European wing)
ETRI, Korea	Nbreds, Korea	**Visa Europe**, Europe
Federal Reserve Bank of Minneapolis, USA	**Opera Software**, Norway	**Worldpay**, France
Financial Services Technology Consortium, USA	Oracle, USA	Yandex, Russia
Gemalto, France	**Orange**, France	

The HTML5Apps project has continued to help with recruiting new members to the W3C Web Payments activities. We are following up with a broader range of companies.

2.6.3. Technical Contributions

The HTML5Apps project has contributed to
- the use cases study, by providing a set of use case narratives from the end user perspective[18].
- work on architecture, identifying the interfaces that will be needed to realise the use cases.

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[18] See https://lists.w3.org/Archives/Public/public-webpayments-ig/2015Mar/0018.html and https://lists.w3.org/Archives/Public/public-webpayments-ig/2015Mar/0025.html

- security requirements for strong authentication, and potential W3C standards using public key pairs together with second factors as a replacement for today's user id and password. We anticipate work starting based upon ideas developed in the FIDO Alliance. This enables a relying party to verify that this is the same person and device that was previously used to set up an account. This is supported by techniques involving secure hardware, biometrics and other second factors.

The Interest Group has also discussed opportunities for W3C to start standards track work on credentials. The HTML5Apps project have provided input on this relating to use cases such as "know your customer" where banks are required to verify personal information when setting up accounts, but it is also applicable to merchants, e.g. in respect to age limits for certain product categories, and potentially in respect to taxation. The HTML5Apps project have argued in favour of minimising the use of credentials tied to long lived identifiers as a means to protect the user's privacy.

Short lived credentials can be tied to a session identifier, which itself can be tied to a given user/account (see above for connection to the work by the FIDO Alliance). Secure hardware can be used to locally generate credentials to avoid the privacy leakage involved in going back each time to the credential issuer's website. Related techniques involve credential tokens and zero knowledge proofs, which the HTML5Apps staff have experimented with during an previous EU project (Primelife[19]), e.g. building a browser demo *Anonymous credentials in the browser*[20] involving a zero knowledge proof that a student is a member of a student union, where the student's identity remains hidden.

2.6.4. Contributions to Implementation Considerations and Future Plans

The HTML5Apps **project was asked to provide a presentation[21] for the Interest Group's New York face to face that would analyse the technical considerations and opportunities** for the proposed Working Group and for further work by the Interest Group. The slides propose that W3C should move quickly to develop standards for Web payments that minimally constrain implementations.

This includes the concept of a selection agent that presents users (payers) with a choice of which payment instrument to use for a given transaction. Payers may want to set preferences to pay with a given instrument/payment scheme in particular circumstances, e.g. the merchant, amount, currency, time of day and location, etc. Payers will prefer a seamless experience regardless of which device or Web browser they are using. We need a standard for the payment request interface to the selection agent that encourages such innovation and which is neutral in respect to how the agent is implemented, e.g. as a hosted Web app, locally installed web, native app, browser extension or integrated as part of the Web browser.

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[19] http://primelife.ercim.eu

[20] http://people.w3.org/~dsr/blog/?p=95

[21] https://www.w3.org/Payments/IG/wiki/images/e/ea/Implementation-considerations.pdf

Similar considerations apply to the payment instruments. The HTML5Apps project considers defines these instruments as software and hardware used as a client for a payment scheme. The browser can play a valuable role when it comes to invoking payment instruments given the desired to enable a range of implementation techniques as per selection agents. The browser can also assist when it comes to authentication where the level of assurance required will depend on the payment instrument and the value of the transaction. For a low value, it may be sufficient to authenticate the device, for intermediate value this could be supplemented with a biometric, PIN, or secret gesture. For high value, there will be a need for additional factors including specific requirements on secure hardware. This provides use cases and requirements for the proposed W3C hardware based Web security Working Group.

The discussions in the Interest Group confirmed the need to differentiate between payments and economic transactions. There was strong agreement on the need for the initial standard to focus purely on the payment, and to defer standards on the surrounding economic transaction to later. This provides a continuing role for the Interest Group to study the opportunities and build a rough consensus around what new standards are needed to realise the opportunities for supporting economic transactions. The aim is to address pain points and enable value added services. Some examples include:

- Making it easier for business travellers to submit expense claims
- Making it easier for people to manage their monthly expenditure
- Making it easier to support tax audits
- Avoiding the need for paper when returning faulty goods
- Avoiding the need to fill out forms on small screens, e.g. shipping and billing address, and other personal information

A key part of this is the need for digital receipts as opposed to the proof of payment associated with the payment transaction. In today's transactions, you get one paper slip for the use of your credit card slip and another for the receipt which typically includes details of the merchant, and a list of the items purchased as well as the terms and conditions associated with the purchase.

Users want to keep track of their payments regardless of which device they paid with, and without the complications of having to separately go through each of the accounts for all of their payment instruments. Customers need proper receipts e.g. in case of disputes, for tax purposes, for corporate expense claims, for value added services and so forth. Credit card statements are inadequate for these purposes, and the current practice of emailing customer receipts is a really bad solution.

You need information relevant to disputes, e.g. return of faulty goods. This may need to be signed by both the merchant and customer. It needs to be machine interpretable as well as having the flexibility involved in a nice presentation, e.g. on devices with different screen sizes. You need receipts for payments, declined payment and so forth.

An open question is whether the agent that holds receipts is the same as the selection agent. This would make sense to end users, as most people would think of the combined

agent as their wallet. This would further permit the installation of valued added service that you grant access to your receipts.

There are many opportunities for economic transactions focusing on the transfer of value, e.g. purchasing digital tickets for a concert, paying for a taxi ride and receiving a receipt that can be presented to your employer, purchasing a gift card as a birthday present, perhaps involving a paper or digital card you can send to your daughter. A related use case is to send a friend flowers. When making a purchase you may want to reduce the price by redeeming points on your loyalty card, e.g. the UK's Nectar card that is supported by a group of participating businesses.

When travelling on business and having dinner in a group, it would be desirable to have convenient painless way to just what you ordered and to get the corresponding digital receipt. A further use case is where a merchant needs to refund a customer for one part of a previous purchase based upon presentation of the original receipt.

The **HTML5Apps project has further contributed to architectural discussions** on harmonising the user experience across Web payments to websites and at brick and mortar stores, restaurants, taxis and so forth. For example, if you use a contact-less payment card, can you get a digital receipt in your cloud based wallet, in the same way as if you had paid from the web browser on a desktop computer or from your mobile phone? The architectural discussions related to the respective roles of the device and the point of sales terminal, as well as to the communications medium, e.g. Bluetooth or NFC. Further discussion considered the role of beacons as part of the user experience, including pre-authentication of payers on entry to a store.

3. PAVING THE WAY TOWARDS NEW STANDARDS

3.1. W3C Web and Mobile Interest Group

The HTML5Apps project is staffing the W3C Web and Mobile Interest Group. As defined in its charter, this group's mission is "to accelerate the development of Web technology so that it becomes a compelling platform for mobile applications."

This mission has been aligned with the goals of the HTML5Apps project in general, and of the "Future Standards" work package specifically: one of the primary role of this group is to evaluate and refine the need for new standards to make Web technologies competitive with native developments, and increase their interoperability.

By investing resources in this Interest Group, the HTML5Apps project leveraged W3C's process and membership to increase the impact of its work in the identification and definition of the future standards needed to make HTML5 apps competitive with native apps.

Co-chaired by a representative of GSMA (the mobile operators association) and a representative of Mozilla (maker of the Firefox browser) the Web and Mobile Interest Group started the gist of its work at the same time as the HTML5Apps project itself started. The project funded the effort of a W3C team contact in this group, Dominique Hazäel-Massieux, also WP2 leader.

During the first year of the project, the HTML5Apps staff had conducted work under four broad categories:

- Getting the group starting and running,
- Laying the ground framework for identifying and defining new standard opportunities,
- Driving and contributing to the identification and definition of new standard opportunities,
- Identifying and documenting barriers to the adoption or the definition of new standards for HMTL5 applications.

During the second year of the project, the HTML5Apps staff focused its efforts on:

- Bringing some of the standard opportunities identified during the first year to standardization,
- Exploring new areas of standardization opportunities and setting up more tools for these opportunities to emerge.

These efforts (described below) were facilitated by the organization of 6 Interest Group teleconferences[22] during the second year of the project, as well as weekly coordination calls with the Web and Mobile Interest Group chairs, completed with occasional task force specific teleconferences.

As recommended by the European Commission, the collaboration with Cordova, the popular hybrid applications framework, that the project had started during the first year, was reinforced and acted upon as described in deliverable D1.2 of the project.

3.2. Bringing identified opportunities to standardization

During the first year of the project, the HTML5Apps staff took part to the discussions in the Web and Mobile Interest Group on the interest expressed by developers on APIs in the following spaces (as reported in deliverable 2.2[23]):

- a networking API that would enable developers to adapt their mobile content to the network context in which their app operates,
- a screen-lock API to let an app disable the automatic screen lock that mobile devices use to save on battery usage,
- a way to better integrate identity management and authentication in Web applications,
- an API to manage which audio output device to use to play a given audio stream,
- an API to interact with Bluetooth Low Energy devices (such as the large emerging fields of wearable devices).

In the second year of the project, we worked toward bringing these ideas to pre-standardization and standardization.

3.2.1. Networking API

In 2014, the HTML5Apps project contributed to the development of use cases in the Web and Mobile Interest Group for an API that gives information about the network in which a given Web application operates.

Since then, browser vendors have continued experimenting with such an API in their mobile products; the HTML5Apps project thus looked whether there was now a clearer path to standardizing such a work item. As of September 2015, while there is still clear interest in enabling applications that adapt to the network conditions[24], it remains unclear whether the proposed network API is the right way to approach this.

That persistent lack of clarity on this topic was one of the motivators for the project to proactively start a broader reflection on how Web applications should interact with the network on which they are distributed, as described in more details below in the Networking Task Force section.

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[22] https://www.w3.org/wiki/Mobile/Meetings

[23] https://html5appsproject.files.wordpress.com/2015/02/d2-2-html5apps-futurestandardsreport.pdf

[24] See e.g. "Adapting without assumptions" http://blog.yoav.ws/adapting_without_assumptions/, a blog post by one of the originators of the Responsive Image work

3.2.2. Screen-Lock API

During the first year of the project, as part of the Web and Mobile Interest Group, the HTML5Apps project contributed to the development of use cases and requirements for an API to control the automatic lock of screen on mobile devices[25]. Based on that work, and given the confirmed interest from developers on getting access to that feature, as part of HTML5Apps WP1, the HTML5Apps project brought the proposal for standardization in the W3C Device APIs Working Group, ensuring that it be accepted under the existing charter of that group to enable quick progress.

As a result, a first public working draft of the Wake Lock API was published by the Device APIs Working Group in February 2015[26]. This marks the first step of that specification on the W3C standardization process, and the September 2015 publication of an updated working draft[27] confirms the interest and progress toward a full W3C standard for that feature. Further information on the content and status of this standard is available in D1.2.

3.2.3. Identity management and authentication

The HTML5Apps project brought the topic of authentication and identity management to the Web and Mobile Interest Group early in the project life, based on the gap analysis the project had conducted.

During this second year of the project, the HTML5Apps staff worked with interested parties to define the proper outline of the work needed in this space. In particular, we worked with a number of European organizations that highlighted the need for European citizens to interact with their governmental e-services without relying on third-party identity mechanisms (often managed by non-European companies); since a number of European governments have already started deploying hardware-based authentication mechanisms (e.g. via RFID chips in passports, or Estonia electronic ID card).The project accompanied some of these interested parties in the definition of the scope of a potential new Working Group in this space.[28]

As of September 2015, this draft charter is planned to be presented for review by the W3C Advisory Committee, the first required step for starting standardization work not yet in scope of any existing groups.

3.2.4. Audio-output device API

During the first year of the project, the HTML5Apps staff helped identify and describe a set of features needed to improve the way developers can determine on which audio output device a given sound would play, allowing for instance to use a different speaker for a song than the one used for a notification.

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[25] http://www.w3.org/TR/wake-lock-use-cases/

[26] http://www.w3.org/TR/2015/WD-wake-lock-20150212/

[27] http://www.w3.org/TR/2015/WD-wake-lock-20150904/

[28] http://www.w3.org/2015/hasec/2015-hasec-charter.html

Based on that identified need, as part of HTML5Apps WP1, the HTML5Apps project then worked with other interested parties to bring this proposed work item for standardization in the Web Real-Time Communications and Device APIs Working Groups, where it fitted well with the overall mission of their joint Media Capture Task Force.

This resulted in the first steps toward standardization of such an API, with the publication as first public working draft in February 2015 of the Audio Output Devices API[29]. Further information on the content and status of this standard is available in D1.2

3.2.5. Bluetooth Low Energy API

In 2014, the HTML5Apps project identified the need to interact with Bluetooth Low Energy devices (such as wearables) as an important factor to the wide applicability of Web technologies to the development of mobile applications. Early research in this topic showed a shared interest in this topic with other contributors to the W3C, which led to the creation of a Bluetooth Community Group (i.e. pre-standardization group) in July 2014 which the project supported.

During the second year of the project, a lot of progress was made in the Bluetooth Community Group on a proposed API. As part of HTML5Apps WP1, the HTML5Apps staff thus offered to work with the most active participants of that group on plans to bring it to formal standardization status. Although these discussions have not yet allowed to fully determine the exact standardization plan for that work, the HTML5Apps project ensured the group would get a dedicated meeting room[30] at the upcoming W3C plenary meeting (scheduled in October 2015) where the group will be in a good position to discuss with existing active Working Groups which would be best fitted to start proper standardization. Further information on the content and status of this standard is available in D1.2

3.3. Identifying new areas of standardization

3.3.1. Deep Linking

During the 2014 fall, several press articles and announcements were made around the notion of so-called "deep links", i.e. the ability to link to specific views inside a native app, the same way one can link to a specific page in a Web application.

Based on that expression of interest, the HTML5Apps project researched the existing solutions in this space and brought the result of that research to the Web and Mobile Interest Group in January 2015[31], showing at least four competing (if somewhat complementary) technical approaches. That combination of convergence on a problem

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[29] http://www.w3.org/TR/2015/WD-audio-output-20150210/

[30] https://www.w3.org/wiki/TPAC/2015/ad-hoc-meetings#Web_Bluetooth_and_Web_NFC

[31] https://lists.w3.org/Archives/Public/public-web-mobile/2015Jan/0000.html

space and divergence in the available spaces identifies this space as a likely standardization opportunity.

Under the impulsion of the project, the discussions led to an update to an existing W3C specification, "Manifest for a Web application" that enables installed Web apps to play a role in this deep-linking space by claiming a specific URL space that they can provide content for, via the `scopeURL` property of their manifests.

While this update clarifies one of the aspects of the deep linking problem space, more work remains to be done; in particular, as noted by the HTML5Apps project[32], the release in September 2015 of Apple iOS9 and its Universal Links, demonstrates continued technical innovation and fragmentation in the field.

3.3.2. Cards for user interfaces

Similarly, several press articles during the Fall 2014 highlighted the emergence and wide adoption of a new user interface metaphor: presenting content as a set of "cards". An article in the popular tech on-line news site Techcrunch even specifically called out for W3C to start standardization work[33].

These cards can be found in most popular social services such as Facebook, Twitter, Instagram, etc. and are used as the unit of content that can be easily layout both on wide and small screens.

Due to this popularity, the HTML5Apps project started a discussion[34] in the Web and Mobile Interest Group to determine if any aspect of the card user interface needed attention from a technical and standardization perspective.

The analysis of the group showed that a combination of the following existing and in-progress standards would already address the needs for standards in this space:
- HTML5's sandboxed iframes,
- Web components,
- Scoped style sheets,
- CSS scroll snap points.

The conclusion from this analysis is thus that there is no specific standardization need on this aspect at the moment.

3.3.3. Networking Task Force

As illustrated in the analysis made around the Network Information API, discussed above as an opportunity for developers to determine the network environment (e.g. WIFI or 3G) in which their application operates, the networking layer matters more and more to the applications which run on top of it.

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[32] https://lists.w3.org/Archives/Public/public-web-mobile/2015Sep/0009.html

[33] http://techcrunch.com/2014/11/08/its-time-for-an-open-standard-for-cards/

[34] https://lists.w3.org/Archives/Public/public-web-mobile/2014Nov/0017.html

Beyond the type of the network, a number of information has been sought by developers in the past few years:

- actual bandwidth and latency of the network link,
- information on the type of data plan the user is on (to determine is network usage is expensive or not),
- whether it is better to do many grouped requests or spread them out over time on the particular network (e.g. due to congestion).

In addition, the usage of the networking layer from Web applications has grown more and more complex. Whereas the Web was born on the simplest form of networking, with HTTP providing uni-directional client-server interactions, the past few years have been the emergence of much more complex interactions:

- AJAX and XMLHttpRequest have seen Web pages initiating HTTP requests well-beyond the loading of the page, and possibly establishing long-lived requests,
- WebSockets have brought full bi-directional communication between clients and servers,
- WebRTC is bringing peer-to-peer exchanges where the distinction between clients and servers fades away,
- ServiceWorkers brings full control to the developers on how they want to handle network interactions, bringing in particular a solid framework for offline operations,
- HTTP2 and the Push API are enabling servers to begin an interaction, instead of having always the client be the one beginning a session.

These increased interactions between networking and applications have in turn made surface the need to have more control and visibility on the networking layer: in particular, the requirements on the networking layer vary a lot between real-time communications, on-demand video streaming, sharing photos on a social network or writing an essay in an on-line editor.

The confluence of these trends have led the HTML5Apps project to try and push for a more formalized approach in how the Web (especially on mobile devices) should evolve in its interactions with the networking layer.

The project started by organizing a meeting of interested parties during the annual plenary meeting (TPAC) in October 2014 with a combination of mobile network operators, equipment providers, browser vendors and application developers. The discussion in that meeting led to the creation of a Networking Task Force in the Web and Mobile Interest Group, for which the HTML5Apps staff edited a charter[35], with the following deliverables:

- use cases and requirements for a data plan API to get information about the cost of network usage for the end-user,

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[35] https://github.com/w3c-webmob/networking-tf-charter/blob/master/charter.md

- use cases and requirements for a network optimization API that let Web apps adapt to the detailed network environment (e.g. how to group network requests based on the requirements on the radio used by the network),
- a review of the various approaches to bundling network requests,
- a review of how current and upcoming Web technologies impact the network,
- a roadmap of the evolutions in networking technologies (5G, NFV, etc) that may have an impact on future Web technologies.

This charter was adopted by the Web and Mobile Interest Group in January 2015, and the HTML5Apps project worked to garner interest from relevant players in the industry, especially mobile operators and networking equipment providers.

As of September 2015, this task force has made significant progress on the network roadmap deliverable[36]; this roadmap highlights important evolutions that delineates a number of standardization opportunities in this space:

- The development of so-called "mobile edge computing", i.e. the ability to deploy cache and distributed services as close to the end-user as possible, points toward the need of more decentralized services on the Web.
- Network Function Virtualization (NFV) opens the way for more scalable network tuning, enable for instance a Web Real-Time communications call center to be scaled up upon an expected peak of usage.
- The deployment of the next generation of network brings faster upload capabilities to end-user, which helps bringing more power for self-hosted and distributed services, away from the hyper-centralized services that the current network topology favors.

The task force has also explored in depth the feasibility of a data plan API which would enable developers to determine how much data usage their end-users can afford. While the prospects of starting standardization in this space are still some way off, that exploration highlighted several important issues that any effort of increased interactions between application and networking are likely to encounter:

- the infrastructure used by most mobile operators today is unlikely to be easily adopted to opening up that kind of data to a wide set of developers,
- there are legal, privacy and business considerations that would make many operators reluctant or unable to share that kind of data about their users,
- it is unclear whether such an information needs to be mediated by the browser or obtained directly by the developer from the network provider; in the latter case, the question arises of how that information can be obtained without requiring pre-existing relationships between developers and operators which would be incompatible with the neutrality of the networking layer.

These lessons and the overall description of the landscape in this space are expected to serve as a starting point for further standardization work that W3C will explore, in

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[36] https://github.com/w3c-webmob/network-evolution-roadmap/blob/master/roadmap.md

particular with an additional meeting being organized at the upcoming W3C plenary conference end of October 2015.

3.3.4. API Gap document

During the first year of the project, the HTML5Apps staff built a repository of data[37] to enable comparison of features available to mobile platforms, both native- and Web-based, as reported in deliverable 2.2.

The project continued to maintain and update that data, and worked with others in the Web and Mobile Interest Group to make the data easier to maintain and manipulate.

To that end, the project proposed an updated architecture for storing and displaying the collected data: instead of easy-to-display but hard-to-parse data maintained in the "MarkDown" format, the project suggested that the data be migrated to a set of simple JSON-files, which would then be collated into a human-readable HTML document via a JavaScript program, in a similar approach to the one the project used in the Standardization Roadmap it maintains (see deliverable 3.3[38] and 3.4[39]).

That approach was validated by the interested contributors to the project, and the work of converting and updating the data was then crowd-sourced among them.

With that updated data, the HTML5Apps staff then built an updated and more comprehensive view of the gaps between Web-based platforms and native platforms[40], as illustrated below with a screenshot of the table comparing hardware APIs across platforms:

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[37] https://github.com/w3c-webmob/web-api-gap
[38] https://html5appsproject.files.wordpress.com/2015/02/d3-3-html5apps-standardization-roadmap1.pdf
[39] http://www.w3.org/2015/08/mobile-web-app-state/
[40] http://w3c-webmob.github.io/web-api-gap/document/

Feature	HTML5	Apple	Android	Windows	BlackBerry	Tizen	Firefox OS	Chrome	Pinwheel
Bluetooth	✖	↗	↗	↗	↗	✖	↗	↗	↗
Bluetooth Low Energy	↗	↗	↗	↗	↗	✖	✖	↗	✖
NFC	↗	✖	↗	↗	↗	✖	↗	↗	✖
Magnetometer	✖	↗	↗	✖	↗	✖	✖	✖	✖
Wifi wake	✖	✖	↗	✖	✖	✖	↗	↗	✖
USB	✖	✖	↗	✖	↗	✖	↗	↗	✖

Key:

Mature Browser API	In Progress Browser API	Early work on a Browser API	Work on Browser API failed
No API for that feature	**Native platform API**	**Missing Information**	
Uses browser API	Proprietary JavaScript API	JavaScript API	

These tables provide a long-term tool for developers, browser vendors and standard makers to evaluate which technologies are wide-spread in native platforms, which are already deployed in HTML5-based platforms, and thus determine where the next valuable standardization opportunities may lie.

3.3.5. Input from European SMEs and developers

Part of the objectives of the HTML5Apps project is to ensure that European small and medium enterprises and their developers are in a better position to understand and influence the future of the Web platform on which they rely to develop innovative services.

As reported in deliverable 4.4, the HTML5Apps staff made use of various dissemination opportunities to reach out to that audience.

These opportunities were both an occasion to advertize the existing standards under development in W3C, especially thanks the roadmap for Web applications standards it maintained over the duration of the project (see deliverable 3.4), but also a way to gather direct input from SMEs and developers in Europe.

The HTML5Apps project also took a more direct approach to sample more details input from SMEs by conducting interviews with 3 European SMES on their usage of Web technologies and the need of new standards that they have encountered in their practice.

These 3 interviews, published on the project Web site[41], highlighted the following needs from Web developers in their markets:

- the ability to use Push notifications in their apps was a common theme to the three SMEs, which were tracking the progress of the ongoing standardization and deployment of the W3C Push API with great interest;
- the ability to reliably operate operations offline was another major theme of interest, and there again, the ongoing work on standardizing ServiceWorkers in W3C was met with great expectations;
- interacting with the surrounding physical environment via Bluetooth Low Energy was a critical component of one of the interviewed company (Beepers), to enable features specific to a given locality (e.g. inside a concert room);
- the desire to integrate smoothly with existing identity providers (such as Facebook or Twitter) matched some of the ongoing discussions within the W3C Social Web Interest Group as well as proposed new work to facilitate authentication proposed by the FIDO alliance.

Based on this input, the HTML5Apps project researched which W3C standards are or will be applicable to these requirements, discussed them with the interviewees and encouraged them to send feedback to the relevant groups.

In addition, since a common theme of the interviews was the interest of these SMEs in using hybrid applications, especially with the Cordova project, the HTML5Apps project invested in ensuring greater continuity between hybrid and browser applications, as described in deliverable 1.2.

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[41] http://html5apps-project.eu/tag/sme-interview/

4. SUMMARY

During its second year, the HTML5App project brought to fruition much of the work that it had put in motion during the first year, making the value proposition of HTML5 application development ever more appealing.

The table below summarizes the twelve standardization opportunities were identified by the project during its lifetime, their current status as the project ends and the expected group that will follow up on these opportunities after the project.

Standardization opportunity	Current Status	Expected follow-ups
Integrated payments in Web applications and role of digital wallets for streamlining checkout and easing integration of new payment schemes	Active Web Payments Interest Group to map out standardization needs. Proposed Web Payments Working Group for starting standardization work.	Payments Working Group standardizes APIs for integrated payments. Payments Interest Group develops a roadmap for further standardization in this space (mobile payments in brick & mortar stores, offline payments, P2P payments, etc)
Digital receipts	In discussion in the Web Payments Interest Group	Payments Interest Group responsible for assessing need and maturity of standard around this.
Support for loyalty schemes, coupons and vouchers	In discussion in the Web Payments Interest Group	Payments Interest Group responsible for assessing need and maturity of standard around this.
Support for third party value added services for digital wallets	In discussion in the Web Payments Interest Group	Payments Interest Group responsible for assessing need and maturity of standard around this.

Credentials, Authentication and Identity management	Proposed charter for a Hardware Security Working Group under development. Ongoing discussions to bring simplified two-factor authentication based on the FIDO alliance work to the Web platform. Web Payments Interest Group is developing use cases for better credentials management on the Web.	If approved, the Hardware Security Working Group would standardize APIs that enable access to hardware-based security tokens. Web Payments Interest Group determines if additional work on credentials management justifies creating a new Working Group or adding that work item to an existing group.
Information on network connectivity	Use cases and Requirements published by Web and Mobile Interest Group. Working Draft of a Network Information API exists in Device API Working Group with experimental implementations in Firefox and Chrome, but uncertainty about broad applicability of the API.	The Device APIs Working Group will determine whether that API has enough momentum to complete its standardization process.
Screen lock management	Use cases and Requirements published by Web and Mobile Interest Group. First Public Working Draft of the Wake Lock API published by the Device APIs Working Group in Feb 2015, updated in Sep 2015.	The Device APIs Working Group expects to continue to progress this specification towards full standard status.

Audio output control	Requirements gathered in the Web and Mobile Interest Group. First Public Working Draft of the Audio Output Devices API published by the Device APIs and WebRTC Working Group in February 2015.	The Device APIs and WebRTC Working Groups expect to continue to progress this specification towards full standard status.
Interaction with Bluetooth Low Energy devices	Requirements gathered in the Web and Mobile Interest Group. Web Bluetooth Community Group pushing pre-standardization work in this area, with intent to bring this to standardization in the upcoming months.	The Web Applications Working Group (or its successor) will likely host the standardization work for a Web Bluetooth API.
Deep Linking	State of the art discussed in the Web and Mobile Interest Group. The Web Applications Working Group adapted its Manifest for Web Applications specification to handle some of the requirements of deep-links.	The Web Applications Working Group (or its successor) will track development in this space as part of its work on the Manifest specification.
Cards for user interfaces	State of the art discussed in the Web and Mobile Interest Group. No further standardization work identified at this point.	
Deeper integration with the networking layer	A roadmap of upcoming network technologies evolution was developed in the Web and Mobile Interest Group.	A meeting is organized at the upcoming W3C plenary conference to establish what work and in which group should follow-ups on

	Use cases and requirements for a data plan API discussed.	this topic be explored.

Thanks to the industry collaboration enabled by the W3C Process, the combined work of the Web Payments Interest Group, the Web and Mobile Interest Group and the input gathered by the HTML5Apps staff in European events it organized or participated to and its interviews of European SMEs, the HTML5Apps project has managed to identify and bring to standardization a significant set of features.

These new features have already started to and will further change what developers can build on the Web, the most widely deployed and most open platform, creating a whole new range of opportunities for innovative European companies to deploy services without the constraints that native platforms impose on them.