# TringIt: Easy Triggering of Web Actions from a Phone

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**Abstract.** Much information that is of interest to mobile users is available on the Web, yet is difficult to access for most users. We introduce a novel method for users to interact with network-connected computers using their phones, and describe a system called TringIt that implements the method. TringIt enables users to trigger Web actions by simply dialing specific numbers – an action that we call a Phone Click. TringIt can be used out-of-the-box by any phone user. The Phone Click is most useful from mobile phones that can receive messages in response to the click. TringIt enables users to easily initiate interaction with businesses and content owners by simply dialing numbers discovered in offline media (e.g. print, TV, radio) as well as online media (e.g. Web, SMS, MMS.) It makes every mobile phone a more compelling information, interaction and participation device.

**Keywords:** Phone Click, Tring, Dial-to-Click, Call Triggered Messaging, User-to-Application Signaling, SMS/MMS Click-through, Dial-able hyperlinks.

## 1 Introduction

Dialing phone numbers is the easiest thing that users can do from a mobile phone. Users manually dial numbers, dial them out of address books, speed dial them, voice-dial them, and even "click" on phone numbers in messages and Web pages to dial them. Phone-car integration systems (including e.g. Microsoft Sync) allow users to place calls hands-free in their automobiles. So far, users have been able to do one of two things by dialing a number: set up a voice call (to interact via voice with another user or with an Interactive Voice Response system) or set up a dial-up connection (to interact with a remote system via data modulated over the voice channel).

In this paper, we describe a new way in which users can interact with network-connected computers using their phones. We introduce the notion of a "*Phone Click*" – the triggering of a Web action in response to the dialing of a number. We describe a system called *TringIt* that enables any mobile phone user to interact with Web applications in this easy-to-use yet powerful way, and discuss how it is used to easily request information.

The paper is organized as follows. In Section 2 we discuss several capabilities of mobile phones, some of which are leveraged by the new technique. In Section 3 we describe how phone signaling is used for user-to-application signaling, and describe some applications. Finally, we summarize our conclusions and discuss upcoming work.

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## 2 Background and Motivation

The mobile phone is the most widely used connected device. Over 3.9 billion (and growing) mobile phone users worldwide connect to the "network" - including the Public Switched Telephone Network (PSTN) and the Internet - via their mobile phones. Importantly, every mobile phone – even a relatively basic feature-phone – is a very sophisticated, network-connected computer. For most users, however, it is still difficult and/or expensive to request and receive information in their phone – the device is vastly under-utilized, compared to its potential!

Most users use their mobile phone just to make voice calls and to send and receive messages. While the number of mobile users who access the Internet from their mobile phones is steadily increasing, adoption is still low in most markets (other than Japan and South Korea, which have seen significant adoption.) In the US, about 16% of subscribers use applications that access the Internet from their mobile phones [9]. Adoption is even lower in other mature markets - e.g., 10% in France, 7% in Germany – and especially in emerging markets - e.g., 2% in India, 7% in China. Many emerging mobile Web/Internet based applications have been unable to reach critical mass because limited adoption of mobile Internet leaves little room for network effects to kick in.

Key barriers to adoption include:

- Cost - User-incurred cost of data service is a key issue.
- Usability - Mobile web browsing poses significant usability challenges. Mobile-optimized Web sites are still more the exception than the rule, and most mobile-optimized applications are not yet widely used.

It is reasonable to posit that information solutions that work for all users, are easy to use and also are sensitive to user-incurred cost have a higher likelihood of adoption than those that are not.

Mobile phone subscribers typically pay for calls that they place from their mobile phone, for messages that they send from their phone as well as for data connections initiated from their phone. In many parts of the world (e.g. Europe, Africa and Asia), incoming calls and incoming messages are free to the user, while in other parts of the world (e.g. USA) subscribers pay for incoming calls as well as incoming messages. Messaging uptake and usage has historically been high in markets where calls are/were significantly more expensive than messaging. This can be attributed to the subscriber's desire to minimize cost of communication, even at the cost of poor usability (e.g. triple-tapping to create messages.).

Let us quickly look at the main communication channels available to users in their mobile phone in terms of their reach, their relative cost and their key deficiencies.

### 2.1 Phone Calls

Voice calls dominate user-generated traffic in mobile phone networks, and continue to be the mainstay of mobile network operator revenue worldwide. Users call to interact with other users and businesses. Phones are optimized for voice calls, and provide capabilities like address books, speed dialing, voice dialing etc. to streamline communication via voice calls.

Businesses widely use phone numbers (often toll free numbers, like 1-800 numbers in the US) that users can call to speak with representatives, customer service agents etc. to receive information and to trigger interactions. While most voice calls are person-to-person calls, use of Interactive Voice Response (IVR) [7] systems is the second largest use case. Sophisticated IVR applications are widely used worldwide – reducing the need for expensive human agents. Technologies like VoiceXML [12] allow users to interact with these systems using voice and/or touch-tone input. IVR systems interconnected to the Web provide a powerful channel for information retrieval by all phone users.

Universal reach (any phone user can make voice calls) is a key strength of the voice call. Additionally, phone numbers are familiar, and easily disseminated via both offline and online channels. However, there are some key deficiencies of voice as a channel for requesting and receiving information. Voice is the most expensive channel in most markets. Information received via voice does not persist in the phone for subsequent use (the user must either remember what he was told by the other party, or must transcribe it onto another medium - e.g., by writing something down on paper.) IVR systems are somewhat cumbersome to navigate. Finally, voice interfaces are not optimal for use in noisy environments – typical of mobile usage.

### 2.2 Messaging

Messaging is the second most frequently used communication channel from mobile phones. Users transmit and receive billions of messages every day. Messaging is analogous to email – messages created by a sending party are transmitted using a store-and-forward metaphor towards the target party.

SMS (Short Message Service) [1] is the most popular form of messaging. Since it is limited to a small payload of 160 7-bit characters, SMS is frequently used to send short messages and status updates. MMS (Multimedia Message Service) [10] is a high-capacity messaging channel that has support for larger messages possibly containing images and/or short video clips. While MMS message size limits are sometimes imposed by operators, typical limits are upwards of 100K bytes.

Messaging initially offered an economical communication channel alternative to the much more expensive voice call. The benefit of lower cost outweighed poor usability - the fairly cumbersome process of multi-tapping messages via a phone's numeric keypad. However, messaging has some key strengths. It works in every mobile phone. It is less intrusive than voice calls. It is very easy to receive messages in phones. And much application infrastructure now exists allowing messaging systems to be interfaced to Web systems for a variety of applications.

However, messaging has drawback: it is still somewhat cumbersome to create a message by multi-tapping. A typical call to action displayed in a magazine or TV ad, or transmitted via SMS/MMS is of the form "`TEXT PIZZA to short code 123456 to receive a coupon`." It takes about 18 button presses to react to that call to action on a typical phone. And the vocabulary for interacting with different application servers varies greatly, imposing a cognitive load. Collectively, these present a usability barrier for users who want to respond to the call to action.

### 2.3 USSD

Unstructured Supplementary Services Data [2] is a communication channel available in GSM networks. Users can manually (or via an in-phone client application) create and send USSD messages, and can receive/review USSD messages via a notifier application. Unlike SMS, which uses transaction-based store-and-forward communication, USSD uses session based point-to-point communication and is therefore much faster.

The key strengths of USSD are its wide deployment on GSM networks (every GSM phone is capable of sending and receiving USSD messages) and its low cost. The key drawbacks there are no standard vocabularies for interacting with application servers to request information, so messages are cumbersome to create. Additionally, USSD application server infrastructure is not as widely deployed as SMS application server infrastructure. And USSD does not work in CDMA networks.

### 2.4 Mobile Internet/Web

Internet access from mobile phones is a powerful communication channel. Modern mobile networks provide high bandwidth and low latency Internet access. Most modern mobile phones have a mobile Web browser built in, and mobile-ready Web sites can provide a compelling interactive user experience.

However, the mobile phone is a very constrained device, with a small screen and limited input capabilities. The browser in a typical mobile phone is significantly less sophisticated than a PC browser (but this is changing with high end phones like the Apple iPhone). Most Web sites are not mobile ready, leading to a very poor user experience when accessed from a mobile phone. These factors collectively make it a low-reach information channel - most mobile phone users do not use the mobile Web.

To address usability concerns in mobile phones, a variety of in-phone client applications are being built and deployed. Clients that let users interact with email as well as instant messaging (IM) systems are available in many phones, and have seen some uptake. However, application infrastructure that enables interfacing these channels with Web servers is limited. Emerging mobile widget solutions (like Yahoo Go! [13]) provide the user a mobile-optimized information browsing experience, but have seen limited uptake. Such solutions, however, do provide infrastructure for interfacing with Web applications.

## 3 TringIt: Dial to Click

Dialing a number is the easiest thing that a user can do from a mobile phone. And every mobile phone can receive messages. We exploit these attributes to create a solution that is both easy to use and usable by the entire mobile phone user population. The key idea is to use telephone signaling for application signaling, and to use messaging for information delivery.

The PSTN (Public Switched Telephone Network) is the interconnection of POTS (Plain Old Telephony System) networks and PLMN (Public Land Mobile Network) networks operated by multiple network operators. To support VoIP (Voice Over IP), the PSTN interconnects to the Internet.

Modern phone networks use separate signaling and "data" channels and can be thought of as two parallel networks - the Common Channel Signaling network that uses protocols like SS7 (Signaling System 7) [6] to set up and tear down calls, and the "media" network that carries audio "data." Many networks now have all-IP cores. From the user perspective, however, the details are irrelevant. Users simply care about the fact that the call gets set up to the appropriate party when they place a call.

A call in a telephone network proceeds in two stages:

- A "signaling" stage in which the phone network locates and rings the called phone and provides feedback to the calling phone.
- A "communication" stage involving voice transport between the calling party and the called party, possibly with data modulated over the voice channel.

Importantly, the telephone network transmits two key pieces of information in the signaling stage of a call - the calling number and the called number. Dialed Number Identification Service (DNIS) [11] is a telephone network service that lets a subscriber of the service determine which telephone number was actually dialed by a caller. Automatic Number Identification (ANI) [4] is a telephone network service that permits subscribers of the service to capture the telephone number of a calling party. Via such services, call signaling automatically transmits a small amount of information from the calling party's network to the called party's network.

### 3.1 Similarity between Phone Signaling and Web Requests

Interestingly, a user's interaction to place a call via the telephone network can be likened to Web request. We can think of a phone number as a URL, the phone as a browser, and the PSTN as an amalgamation of Internet infrastructure (name servers, routers etc.) and Web servers. A user uses his phone (the browser) to manually enter a number (a URL) or to speed-dial a number (a "browser bookmark"). The phone (the browser) transmits a request into the phone network. The request includes information about the called party (the URL) and the calling party (a Header in the request). The phone network attempts to route the call to the appropriate party (like the browser uses DNS to identify the IP address of the target server) and delivers signaling information to the called party (like a Web request being delivered to the server). If there is an error during this process (e.g., invalid number) appropriate feedback is provided to the calling party (like a "404 Not Found" error in HTTP). Otherwise, the phone starts the "voice client" that allows the user to listen to ringing tones. If the call is answered by the called party, all subsequent interaction happens via bi-directional streaming over a voice channel that is set up as a side effect of successful signaling. (This is equivalent to the browser launching a helper application that supports bi-directional voice.)

Placing a phone call, therefore, can thus be thought of as a special kind of Web "click" from a phone. So far, this click has had very limited range of behavior - the click either results in the voice call being established or failing. (Setting up of a dial-up connection is a special case, where a voice channel is first established, and the established channel is used to modulate/demodulate data over a carrier signal.).

*TringIt generalizes the use of telecom signaling*, enabling it to drive any Internet-connected application. In particular, it enables rich phone + Internet converged applications [8] that work with any phone.

TringIt enables mobile phone users to interact with Web applications in a powerful yet easy-to-use way by enabling Web actions to be triggered by simply dialing numbers - "Dial to Click!" TringIt is most useful for users who do not yet use the mobile Internet - it uses SMS/MMS to deliver information to users in response to the received phone call. However, TringIt is also useful for mobile phone users who currently use the mobile Internet. Numbers can be discovered via any media - online, TV, print etc. In a few button presses from an idle screen - the phone number + SEND, the user can "connect" with the real world entity associated with that number. A mobile phone with Internet access can be driven to the appropriate Web site.

### 3.2 Signaling Numbers: Phone Numbers as URLs

As described in the preceding section, dialing a number to place a phone call can be likened to making an HTTP request. *A phone number can therefore be thought of as a URL!* So far, these URLs have simply been used to trigger the setting up of a voice call. We know that any action on the Web can be represented as a URL [5] - data needed for that action can either be encoded into the URL used for an HTTP GET request, or can be stored in a descriptor that is used to generate an HTTP POST request to the appropriate server. A phone number can be associated with such a URL by simply maintaining a lookup table mapping the phone number to the URL. If the system can detect when the phone number is called, it can use the lookup table to retrieve the associated URL and can trigger the appropriate Web action. *This fundamentally changes what users can do by calling a number!*

The behavior of such a phone number is different from a regular phone number that is used to set up a voice call. We refer to this kind of number as a "Phone Signaling Number" (more concisely, "Signaling Number." Any Web action can be associated with a Signaling Number, and thus be triggered by a simple phone call from any phone - wired or mobile. Importantly, this requires no new software in the phone, and thus works out-of-the-box with every phone in use on every network. If the associated Web action causes the generation and transmission of e.g. an SMS/MMS message to the phone, the calling user can dynamically receive "feedback" for the call – possibly containing requested information!

The numeric form of this new kind of URL is ideal for easy input on the phone. Its compact and familiar form makes it easy to display and disseminate via any medium - books, magazines, newspapers, flyers, packaging, receipts, TV, radio, video and audio content, Web sites, email, SMS/MMS messages etc. And conventional letters-to-number mnemonics (1-777-4PIZZA to represent 1-777-474992) can make some subset of the numbers self-describing. These numeric URLs – "dial-able hyperlinks" – can easily be direct dialed from an idle phone screen. They can be stored in phone address books and can be speed-dialed and voice-dialed. They can be communicated from user to user. They can be embedded in SMS/MMS/email messages or in Web content and can be easily clicked by the receiving user.

### 3.3 Tring: A Phone Click

As described earlier, when a call is being set up in the phone network, the calling party's network transmits a small amount of information to the called party. This information can be used to create tremendous value.

If the called party is associated with multiple phone numbers, the calling party can signal different things to the called party, based on the number it calls. If the calling party and called party can maintain state - i.e. remember information about previous transmissions, the interaction gets richer. E.g. if the calling party calls different numbers in some sequence it can convey additional information to the called party. Additionally, if the calling party and called party have shared context - i.e. some persistent (non-transient) data that both parties share (that is possibly transmitted and shared between the calling party and the called party using some separate offline mechanism) - the interaction gets even richer. The shared context allows specific meaning to be attributed to calls to and from different numbers, and the calling and called parties can be aware of that meaning. The ability to exchange user-to-application signals in the presence of state as well as shared context enables very compelling applications.

TringIt enables the act of placing a call to a Signaling Number to be interpreted as the intent of the calling party to trigger the associated action registered by the called party. The associated Web action can equivalently be triggered by the called party or by any entity along the signaling path between the calling party and the called party. This makes the humble phone call much more versatile. A simple call can be used to trigger any Web action that has been associated with the number – a "Phone Click."

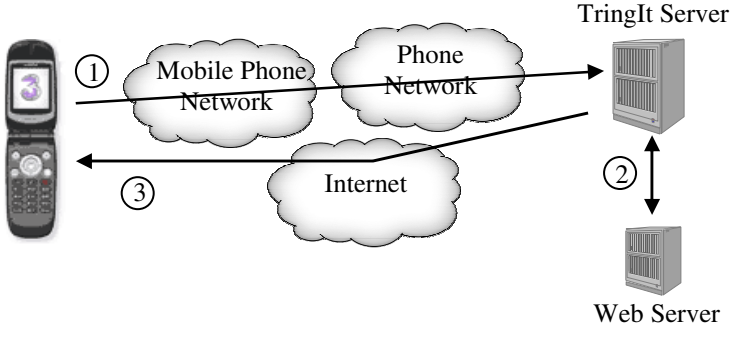


**Fig. 1.** The Versatile "Phone Click"

Figure 1 depicts the flow of a typical Phone Click. In Step 1, signaling information travels over the mobile phone network and the PSTN to a TringIt Server when a call is placed to a Signaling Number. The TringIt Server looks up and triggers the corresponding Web action in Step 2, over the Internet. In Step 3, the TringIt Server transmits a message to the calling phone via the Internet and mobile phone network.

The TringIt Server is a network-based server that interfaces to the phone network to receive Phone Clicks - calls that are used to trigger Web actions. Details of the TringIt Server are outside the scope of this paper, and are being published separately

[3]. At a high level, the TringIt Server interconnects to the PSTN via physical and logical connections. It receives and terminates phone calls aimed at Signaling Numbers and triggers appropriate Web actions in response.

Any phone number can potentially be used as a Signaling Number – the TringIt server just needs to be able to receive the call. Calls can be directed at the TringIt Server by routing or forwarding. For best usability, however, Signaling Numbers should come from a separate part of the phone number-space so that they are visually identifiable as numbers that trigger Web actions (as opposed to those that set up calls.) This can be achieved, e.g., by using numbers from a separate unused area code or country code, to create a concept like 1-800 numbers – users "know" that calls to 1-800 numbers are toll free. An appropriate prefix can be allocated and assigned by the appropriate phone number administration authority that controls and manages the phone numbering space.

### 3.4 Network-Based Context and Personalization

One of the key challenges for non-voice use of mobile phones is usability. Portability and power constraints impose the requirement that the screen be small. A majority of phones only have a small set of buttons (typically 15-20), most representing digits for dialing numbers (and via techniques that use multiple taps per key, allow users to input alphabets and symbols as well). While mobile phones have been optimized for numeric and voice input, non-voice and non-numeric input is still cumbersome.

Usability of interaction from such constrained devices can be greatly improved by maintaining as much information as possible in the network and allowing users and application servers to use that information easily as needed. We refer to this user-relevant information in the network as "Network Context" or simply context. TringIt stores commonly used user profile information like email addresses, postal addresses, preferences etc. in the network. The user maintains information in the context through a rich, non-phone mechanism – a Web portal accessed via an Internet-connected PC. The user can also maintain context information directly from the mobile phone - via a voice portal, SMS portal, phone client etc. if desired.

The mobile phone differs from a Web browser in a PC in a very important way. It is the only device that most users carry with them almost all the time yet rarely share with other users - making it an ideal device to deliver a personalized interactive experience. As described earlier, signaling information that is transmitted across the phone network to set up a phone call typically includes the calling party number and the called party number. TringIt uses information derived from the calling party number as part of the data used to trigger the Web action. Awareness of the calling party's "identity" is used to provide personalized services triggered by the Phone Click – TringIt uses ANI information as a key to look up profile data in the context database. Importantly, ANI information is transmitted by default - and requires no manual intervention on the part of the calling user. The calling user not only indicates to TringIt what action he wants to trigger (based on the called number) but also simultaneously, and with no extra effort, provides information that can be used to personalize his request. This greatly improves usability for the calling user. TringIt uses well-known and understood techniques and best practices for maintaining context

information in the cloud, and to deal with issues of scalability, reliability, security, access control etc.

Maintaining personalizable network context has a significant additional benefit – it enables multi-modal interaction. TringIt allows the user to dynamically intermix interaction via multiple input channels - e.g. via voice, by sending an SMS/MMS message, by clicking a link on a Web page or by using an application, and via Phone Clicks - the user can choose the channel that works best based on dynamic usability and price considerations.

### 3.5 Internet Access Not Required

The mobile phone differs from a Web browser in a PC in some other key ways. By virtue of built-in technologies (e.g. a messaging client, address book), a mobile phone provides "data persistence" and is also "spontaneously reachable" from the network – making it an ideal portable receiver of information delivered by Web applications.

TringIt leverages these features to make the mobile phone much more useful, even without Internet access. TringIt enables any mobile phone user to easily use the phone as an input device to trigger Web applications – like a programmable universal remote control – that then deliver information via messaging. The Phone Click is also useful for users with mobile Internet access. The incoming message can be a rich email message containing hyperlinks to Web sites, or a WAP Push that drives an in-phone Web browser to a particular mobile Web site to start a browsing session, or can wake up an in-phone application, triggering it to perform some action.

A key contribution is the elimination of the need for end-to-end HTTP from the phone. Users can request information via a Phone Click. Application servers can retrieve Web documents on behalf of the user, transform the results appropriately to fit into an SMS or MMS message, and transmit the message to the user. Users can allow received information to persist in the mobile phone for as long as required, possibly eliminating subsequent need to re-fetch that information.

TringIt makes it possible for a user to request news, weather and traffic updates, stock quotes etc. by simply dialing the corresponding number. The information request is personalized using profile data stored in the network. By simply adding numbers and content providers, TringIt makes it possible for users to easily request directions to a hotel, information about a product, daily specials at a restaurant, check order status etc. Like a Web click, the possibilities are limitless.

## 4 Conclusion

The Phone Click uniquely enables a class of applications that work by simply calling numbers – without requiring any additional input over the telephony media channel. These applications automatically trigger Web actions and possibly send information to users in response to a call. By using information that is delivered over the signaling channel as well as any context information available in the network (relevant to the calling number, the called number and the application server) very compelling applications can be created - the caller simply needs to be aware of the action that will be triggered by the application server when he calls that number. The Phone Click can

be employed to enable useful services for all phone users, not just users with mobile Internet access. Importantly, the Phone Click complements all existing channels for communication from a mobile phone - voice, messaging, USSD and mobile Web, making them all more powerful.

This user-to-application signaling capability is a broadly useful enabler. It enables all mobile phone users to economically and easily initiate contact and interact with businesses, brands and information providers via their mobile phone. Users simply need to know the number to dial, and numbers can easily be discovered via traditional offline and online channels. TringIt eliminates key usability and cost "friction," enabling mobile phone users to economically and easily initiate contact and interact with information providers via their mobile phone. It makes the mobile phone a more powerful tool and unlocks its potential as the ultimate information, interaction and participation device.

**Future Work.** While the act of dialing numbers to initiate a voice call is very familiar to users, the notion of triggering Web actions by doing so is not. The authors plan to study the usability barriers associated with the Phone Click via experiments and focus groups. The authors are working on simplifying discovery of Signaling Numbers and on simplifying browsing/review of information delivered by applications – existing software in mobile phones offers significant scope for improvement – and are designing an in-phone client application that will further simplify the user experience. The authors are also developing cloud-based infrastructure that will enable businesses, brands and content providers to easily integrate the Phone Click into their applications.

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