Counter Intelligence & Kitchen Sync

White Paper

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Introduction

This paper presents a vision of a future. In the last t o decades a great deal of time and research has been spent on Living oom of the uture pro ects. These usually meant big screen televisions uadraphonic sound and strategically placed sofas. The problem ith the living room is that it s a passive environment the user sits and absorbs be it reading the ne spaper or atching television. Compare this to the fundamentally interactive itchen.

The itchen is an intrinsically dynamic environment. a materials enter are processed and leave. The user of the itchen invariably contributes to that processing hether it be putting a pre fro en lasagna in the micro ave or meticulously leafing through The Joy of Coo ing for a four course dinner. As the t o ay conversation of the Internet is to the one sided oratory of television Kitchen Sync is to the Living oom of the uture.

Kitchen Sync is a digitally connected self a are itchen hich has no ledge and memory of its activities. It is a multifaceted system consisting of both intelligent individual elements and fundamentally connectivity bet een those elements. In practice e are building individual components hile maintaining design philosophies that encourage inter unit communication. Within the Personal Information Architecture group e are also building an infrastructure specifically designed to enable communication bet een such elements.[1]

[1] More information available from the leader of the ive pro ect Matthe ray ***mkgray@mit.edu)***

We present here a basic overvie of the three stages of devices hich comprise Kitchen Sync. eferences to individual pro ects ill be made clear as e go into more depth on the theories behind their operation.

Primary Stage Devices: Self-Identity & No Communication

At the lo est level of intelligent elements are devices hich are only a are of themselves and do not communicate to the outside. One of the first reali ations in or ing ith Things That Thin is that this is simply not interesting. With intelligence comes the need to communicate to move data in and out.

Secondary Stage Devices: Self-Identity & Communication

The first element of Kitchen Sync as a micro ave provisionally named PC inners and later renamed MicroChef. It embodied some of the basic ideas around hich Kitchen Sync is based identification and association of information ith that identification. Later versions added more control over the actual use of the micro ave including ne functions correlating coo ing time to eight but the basic information identification structure has remained unchanged.

Mr. Java is e emplar of the second stage of Kitchen Sync. An intelligent coffee machine it identifies the user through their cup and feeds the user the coffee they ant and the information they ant. or e ample as an e patriate nglishman I have a double tall latte and listen to the latest ne s from London.

MicroChef as developed by Steve ray gray mit.edu

At the Media Lab e refer to this in terms of bits and atoms Mr. Java feeds the user the arrangement of bits and the arrangement of atoms they ant. Atoms are things you can pic up touch manipulate. its are information. A dog is an arrangement of atoms hereas the concept over is an arrangement of bits. In this case the arrangement of atoms is espresso or latte. Arrangements of bits can be the ne s from London or the local eather report or my personal stoc portfolio .

Third Stage Devices: Memory

The third stage of Kitchen Sync has components that are not only self a are but have some memory of their use. A Mr. Java coffee cup is tagged ith a simple I tag functioning similarly to a barcode. A given cup merely no s it is say ob ect 1 . A single step along is a coffee cup that no s hen it as last used and ill release this information hen as ed perhaps by a coffee machine or a des that ants to ma e sure your coffee doesn t get cold. Perhaps more useful is a fridge door that no s hen it as last opened and if it s been closed since that point. The simple addition of memory adds a ealth of possibilities for an item.

One can also thin of this third stage of having memory as being a are of temporal se uences. Mr. Java a second stage device functions in the instant hen a cup is presented he ma es coffee and plays the ne s. ach cup is treated as a separate isolated incident unrelated to the one before it. Counter Intelligence ho ever is a are of time and se uence it s important to add the flour before putting on the icing for e ample.

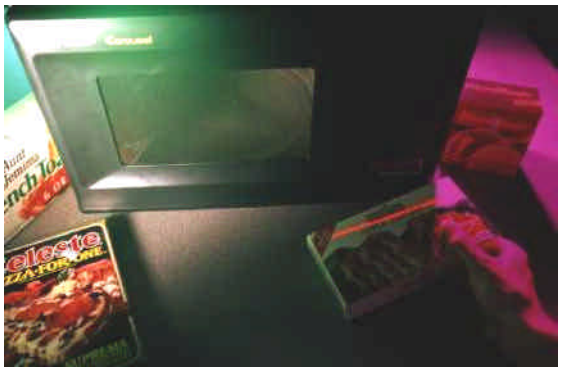
We can continue along this trail one pro ect for the future is to produce a fridge hich is a are of its contents and can ta e action based on that

a areness. We envisage a fridge that is not only a are ho much mil it contains but also orders more should that mil run out. Once a fridge or a cupboard a pantry a larder is completed Kitchen Sync ill have reached a stage here there is a serious possibility of using the intelligent Kitchen on a day to day basis.

ventually e hope to assemble an entire intelligent itchen environment and spend time or ing ithin the space and using the e uipment on a day to day basis. In the long term of course e hope to see Kitchen Sync pro ects being used in commercial and residential itchens.

Past Pro ects

PC Dinners / MicroChef



PC

PC inners as the first Kitchen Sync pro ect formed as a collaboration bet een myself and Steve ray prior to conceiving an intelligent itchen as a hole. In its simplest incarnation PC inners as a micro ave ith a barcode scanner controlled by a computer. It associated t o sets of information ith a barcode coo ing information and a sound file. oth ere tailored to the product so rench toast as ed you to Pli remove e toast from e pac et and put it in e micro ave si vous plait. ro en anishes had the anish Chef saying something along the same lines ith the addition of the occasional bor bor bor .

ray later added to the user interface providing the facility to change coo ing times and store ne recommended times and also added a simple eight scaling function. The pro ect as renamed MicroChef.

Mr. Java

Mr. Java is an intelligent coffee machine. It s based on an Acorto ***s*** automatic coffee machine hich in its unaltered state ma es a variety of hot coffee and mil based drin s at the touch of a button. y interfacing ith the diagnostic

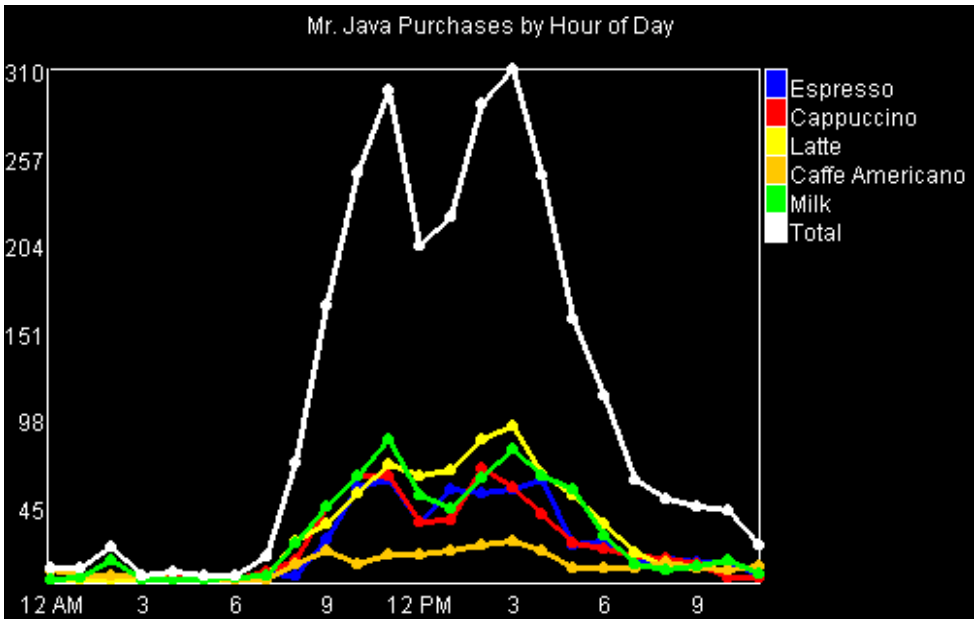
More information is available in ray s thesis

serial port e ere able to control Mr. Java by means of a tag reader placed under the spout.

Mr. Java

The user places their cup under the spout as usual. The reader located under the spout reads the tag on the bottom of the cup and transmits the result to a computer. The computer ould then issue commands to the Acorto to ma e the appropriate drin and play the associated ealAudio feed through the spea ers.

Mr. Java does not gather information on individual users coffee use although it provided that facility by letting users set their o n L for their audio feed hich ould let users eep trac of their o n consumption. o ever e did eep trac of overall consumption including dividing the data by day and by hour over time. or e ample e sa a consistent daily pattern



Mr. Java – Purchase by hour of day

Morning coffees pea ed at 11am and e sa another mid afternoon pea at pm. arely visible at 9pm is our first espresso pea apparently if you re still drin ing coffee at 9pm then it better be espresso.

This ind of information as of great interest to many sponsors both Kraft oods o ner of Ma ell ouse and P& o ner of olgers spend a great deal of time and effort trac ing usage statistics such as these. Presently it s entirely done by hand someone sits ne t to the coffee machine ith a clipboard. Mr. Java s type of unobtrusive monitoring that can actually add value to the product being purchased has possibilities for a ide variety of applications.

Mr. Java has been a great success. S purchased an entire system for their allas Mar etSpace of the uture and are presently considering assembling another ten systems for various offices and sho rooms. Kyle Anderson C O of Acorto sees Mr. Java as the missing element bet een a regular Acorto automatic espresso machine and the barista it provides entertainment. A barista chats about the eather tells o es Mr. Java adds bac that functionality. There are currently plans to e hibit a Mr. Java in Acorto s main lobby.

Current Pro ects

Counter Intelligence

The itchen counter is one of the most used portions of the itchen or space is invariably prime real estate in food preparation. A ide variety of tools are used in con unction ith the counterspace in any food preparation eighing scales measuring cups bo ls spoons and importantly ingredients. Counter Intelligence tries to integrate itself into your

or habits by serving as an interface bet een you the recipe and the food being prepared.

o can a itchen help you ma e bro nies ou pull out the coo boo and start measuring ingredients into a bo l. Out of ba ing po der Well you remember you can use ba ing soda but do you double or half the uantity Oops. Just put the eggs in before the mil . ope it doesn t matter onder hy they re listed in that order in the recipe if it doesn t If you use semi s eet chips instead of dar chocolate ho do you ad ust the sugar Can t see ho much butter to add that dar chocolate from last time got on the page.

Counter Intelligence ta es a ay these problems. It s fully a are of a recipe the se uence the ingredients possible substitutions. We re in the process of building it as a fully e pandable system enabling us to modify the user interface as e learn more. The current e tremely prototype system uses a barcode scanner a scales and a eyboard for input and a standard screen for output . It no s a handful of recipes can suggest substitutions for one or t o products and has a te t based interface.

Since riting this Counter Intelligence has been changed to include a proprietary I tag sensing system in the place of barcodes and a touch screen for input and output. It is incorporated in a itchen counter. We e pect to add voice input and output in the near future.

We envisage a system almost entirely integrated into a standard or space area. A scale built into the counter along ith an I tag reader lets you identify and tare mi ing bo ls hereas other tag readers barcode readers or La y ish could identify ingredients. A La y ish ould let you select ingredients and finished products by tapping their picture on the surface ith the entire recipe becoming an interactive e perience. Perhaps instead of a line of te t saying Mi in t o cups of flour Counter Intelligence ill have a pair of elves pro ected on your counter apparently tugging at your real bag of flour.

The possibilities of Counter Intelligence are practically endless. We are consciously not predicting an e act path of evolution for this pro ect or e act technologies e ish to or ith. y letting it evolve ith the technology and change as possibilities arise e re free to create and invent entirely ne concepts of itchen interaction ithout being loc ed into an obsolete model.

uture Pro ects

CoolIO: The Fridge

The concept of an intelligent fridge Cool I O is one that seems fundamental to the intelligent itchen. We see a fridge as performing for e ample the follo ing functions

- Keeping trac of its contents
  - Location in fridge
  - ate entered fridge
  - piration dates

Magnetic field sensing devices.
http://www.media.mit.edu/physics/projects/fieldimaging/imaging.html

- Keeping trac of desired contents
  - Keeping at least one gallon of mil not more than t o days old on hand at all times
  - Automatic shopping list generation or online ordering to replace staple items

An intelligent free er ould perform many of the same functions but ould perhaps be easier to prototype as ob ects that go in or out of a free er are generally either in Tupper are type pac aging or in their original pac aging.

We see the development of CoolIO or a similar intelligent fridge as a fundamental part of the Kitchen Sync vision.

Everything Bit: The Kitchen Sink

In an interconnected itchen even disposal units are part of a communications net or that eeps trac of comings & goings. We see the sin in such a itchen at a minimum having a tag reader to read tags from reusable containers being ashed Tupper are and the li e.

nvision the follo ing scenario. ou ve had lasagna for dinner and there s some left over. ou put the leftovers in a Tupper are container and put it in the fridge. Is that lasagna as s the fridge it remembers you made that for dinner. ou confirm. Later on feeling pec ish you pull out the leftovers and ta e half for a snac putting the Tupper are bac in. CoolIO remembers hat as in that tagged container and so assumes it still contains lasagna. ungry again you pull out the remainder and eat it for lunch the ne t day.

ou put the dirty container into verything it and ash off the food. As you do that the I tag reader reads the tag and ashes off the data labeling it as empty. e t time you use that container the fridge ill as you hat s in the bo .

Other Pro ects

We see all itchen appliances as having the facility to be integrated into the Kitchen Sync environment. Cameras above stoves can ensure that a atched pot never boils over. Tagged Tupper are can or in con unction ith your sin so it no s hen it s dirty hen it s clean and hat it s got in it. ish ashers no hat they have inside and hen hat s inside needs to be clean. Trash cans sort recyclables and no hen they re full.

o ever much of this level of automation is only possible hen the entire itchen as a hole is a are. The above pro ects particularly Counter Intelligence and CoolIO present fundamental portions of the Kitchen Sync vision. Much of the brainstorming to create these ideas has been through the establishment of scenarios given a situation hat could Kitchen Sync do to help you We present an e ample and encourage readers of this paper to do so ithin their particular fields of interest.

Scenario *Chocolate Cake*

Kitchen you announce bringing Kitchen Sync out of its sleep. I d li e to ma e a chocolate ca e for desert tonight.

I m afraid e re out of butter the delivery as delayed. We can substitute olive oil though you li ed that last time.

ine.

The sounds of John Coltrane fill the air as you assemble the ingredients list pro ected on the all ith the Kitchen only occasionally advising you on here you last put the ba ing po der. ou put a mi ing bo l do n on the counter and loo at the all. The recipe is replaced ith a grinning foot high character in a tall coo s hat ho points at the flour. ou pic it up.

our cups of flour. ou start pouring.

One cup... t o... three... three and half... and stop.

ou put the flour bac on the counter.

ou can put that a ay no . ou on t be needing it. And it ll ma e the place tidy.

uess you accidentally engaged the Mother mode. Still you continue ith the rest of the recipe mi ing and stirring. The Kitchen reminds you of the substition and suggests you use lo fat chocolate a suggestion you cheerfully ignore despite a t inge of guilt as it updates the calorie count at the bottom of the page. It s only a matter of sliding the ca e into the pre heated oven and aiting until the Kitchen reminds you to ta e it out. And if you re in the sho er hen that happens o need to orry your Kitchen ill remember to turn the oven off even if you don t.

Theory and Concepts

Cloud Of Bits

We ve discovered a lot of ays to loo at human computer interaction and the very concept of data in the process of or ing ith Mr. Java and Kitchen Sync. The first is a common enough reali ation at the Media Lab that e e ist in a cloud of bits a set of information about your current condition. Today e mainly thin of bits as perhaps graphics ebpages uic Time movies. In Personal Information Architecture e go beyond this definition and see bits as a spectrum ranging from the fi ed and uantifiable to the fu y and intangible.

or e ample I am si foot t o inches tall. That s a constant and relatively unchanging bit. Continuing along our spectrum of bits I have a body temperature pulse and blood pressure that are measurable and recordable using a variety of sensors. earer the other end of the spectrum I may be hungry or ant a particular ind of coffee today. These are far less fi ed and easy to measure hunger is a function of blood sugar but goes unnoticed ith sufficient levels of adrenaline in the bloodstream.

Context

In our initial design for Mr. Java e had thought about a number of ays to recognise users of the machine. One possibility for e ample as I transmitting badges previously used on the Penguin emo to great success. Stuffed penguins ore nametags that emitted a constant infra red signature saying in effect I m Irv. I m Irv . When Mort the other

Mort & Irv

penguin received this Mort and Irv ould have a conversation as they ne they ere facing each other.

The problem ith this is that there s no implicit conte t. We anted to avoid the problem of a coffee machine that spe ed out espresso henever you al ed through the rd floor itchen. In the plans for Kitchen Sync there are many tag readers and ays to identify ob ects it s important to no the conte t in hich this is happening.

Another ay to thin about the importance of conte t is in thin ing about sharing bits. nless you no hat you re loo ing for it s hard to figure out hether the stream of information you re loo ing at is biometric data from a human being on a bicycle eather data from a probe at ase Camp on verest or an ***I Love Lucy*** rerun. its be bits. Once bits leave their creating environment it s important to ensure that they re implicitly and unambiguously labeled.

Recognise

umans recognise ob ects through their senses vision touch smell and so on. ather than have computers try to use the same senses to identify ob ects an area in hich there is already e tensive research e elected to use senses developed specifically for computers. There are a number of systems in current use designed so computers can identify ob ects.

- arcodes

  arcode technology has a number of advantages it s cheap and it s idely available. Commercial products fre uently come ith barcodes

enabling easy recognition.

o ever there are problems ith current barcodes as implemented in the PC standard that is to say the labels on nearly every product you buy at the grocery store. They don t distinguish bet een different iterations of the same product one can of tomatoes loo s li e another can of tomatoes. That s fine at the chec out but difficult if you re trying to tell ho many cans you have in your larder. If e re trying to eep trac of ho old mil is for e ample it s important to be able to distinguish bet een t o cartons of mil that have the same barcode but ere purchased a ee apart.

One possibility ould be for every PC code to have t o separate parts an identification portion and a serial number portion. or e ample a particular

bottle of apple uice currently has the barcode 8 1 1 . 8 refers to the company ho ma e the product as assigned by the PC council. 1 1 is the company s code for 8 fl. o . bottle Pressed Apple Juice. panding this to include a serial number thus say 8 1 1 . 1 ould enable trac ing of that particular bottle s history including storage sale and environmental conditions during shipping.

The most important change in barcodes ill come hen barcodes are no longer seen as identifying ob ects in themselves but as lin s to information. There is a practical limit on the uantity of information that can reliably be stored in a physical label space there is no limit to the amount of information that can be lin ed to that label.

There s also a t elth number in small print that s the chec sum for the reader to ma e sure it read correctly.

The ne t step ill come hen you purchase a product hich has its o n individual ebpage. A can of beans ill come ith its o n individual ebpage detailing such information as production date transport history and time spent on the shelf all entered automatically as it moves along the retail chain. T o apparently identical pac ets of rice you purchased on t o trips to the supermar et can have entirely different histories of transport storage and origin. This incredible uantity of information ill begin to appear for high end items a eb accessible history of your car say but as time goes on ill continue do n the value chain.

- I

adio re uency Identification has the potential to be one of the most idely used and po erful identifying technologies e have. Tags can be battery po ered or unpo ered and can be purchased in a variety of si es and configurations to allo for a ide range of uses. In particular they or through plastic ood and other materials and can be set up to or in harsh environmental conditions here barcodes or less robust e uipment ould be unable to function. Our classic e ample of this is under the spout of Mr. Java here a polyurethane encased reader is regularly sub ected to ° espresso. The itchen is no place for fragile technology.

There are a ide variety of I tags. The simplest or in much the same ay a barcode does giving out a single pre programmed number hen placed in the vicinity of a reader. It s also possible to store a limited amount of information on the tags themselves.

The main argument against tags right no is that of cost. Compared to a printed barcode the cost is presently prohibitive e cept in harsher environments unsuited to barcodes. o ever researchers at the Media Lab including ich letcher and the recently formed Penny Tags special interest group are ma ing great head ay in this problem . Currently a simple tag has a lo er price limit of appro imately ten cents too much to put on a pac et of cornfla es but an entirely reasonable ay to trac the history of a ac et. A tagged orld ill arrive one bit at a time.

- iometrics

iometrics is the term used for identification of people by their physical attributes such as finger print recognition face recognition and the li e. Much research is being done on their possibilities for security identification and the li e. o ever many people feel very uncomfortable about being identified in this ay. We have made a conscious decision to avoid or ing ith biometrics in Kitchen Sync as much as possible. othing says ig rother uite li e the phrase fingerprint identification e cept perhaps retinal scan.

There is a regretful tradition among scientists of ignoring such sociological issues ith regards to ne technology. We feel it is better to loo for alternative forms of recognition technology rather than ignore this discomfort and the very serious issues behind it. or e ample Mr. Java

http .media.mit.edu physics tags tags.html

functions in a security and privacy conscious manner. o individual usage data is ept hile providing the possibility for users to eep trac of their o n coffee consumption.

- I tags

Infrared technology or s in an intuitive ay. If the transmitter say your remote control can t see the eye of the receiver say your T it on t or . We call this line of sight. It has dra bac s constant broadcasting is e pensive in terms of po er. o ever remote control type intermittent transmit devices are cheap and po erful. Only or ing line of sight can be frustrating as anyone ho s tried to change channels from off to one side of the television no s. This can be a feature a computer that doesn t see an ob ect until you hold it up front of it ma es sense to the user and is a simple ay to do nload data.

The point of all of these different methods of identification is that there are a plethora of technologies ith a variety of attributes that can be adapted to nigh on any use. ncoding of information is not a single choice arena and includes ones that I didn t mention from magnetic strips on cards to touch recognition technologies. In considering any technology design it is important to ta e into account the ide variety of methods in hich relevant data can be encoded.

Associate

The ne t step after identification is associating preferences ith the ob ect identified be it person cup clothing or penguin. These preferences fall into t o categories bits and atoms. This is an important distinction in defining hat

e re loo ing to do in Kitchen Sync. Loo ing bac at hat as seen as a itchen of the future in the si ties through the eyes of the Jetsons e see a itchen concerned ith manipulating atoms mechanical hands come out holding frying pans into hich other mechanical hands crac eggs. We re not trying to deal ith manipulating atoms e re interested in bits.

Mr. Java for e ample associates t o sets of information ith each tag ith each individual s cup. One set is ho they li e their bits arranged and the other set is ho they li e their atoms arranged. Arrangements of bits refers to for e ample the latest ne s from P or the current eather report or the sports scores. Mr. Java goes out across the eb and pic s up the ealAudio feed of your choice and plays it hile your coffee is being made. Importantly e ve provided the facility for users to create their o n ealAudio or .au files by lin ing to a L hich could contain their o n personali ed stoc portfolio or their messages. This also provides them ith the means to trac their personal coffee consumption ithout Mr. Java storing such personal individual data.

This concept of preferences for bits and atoms is a po erful concept that can be e tended far outside the realm of the itchen. A car could recognise you through your ey or ey fob and ad ust the seats and mirrors atoms and the radio bits to your preferences. A ashing machine could recognise clothing going in through fle ible I tags and no you might not li e your red T shirt in ith your other ise hite ash. All of these are e amples of simple but po erful operating concept

Within a conte t recognise and associate preferences.

Conclusions

The field of domestic media is one that ill truly come to fruition in the ne t decade. We currently have use of barcode and I technology almost entirely in industrial and commercial settings. As ith the computer the pager and the micro ave e can e pect this technology to start to be integrated in to home life.

We re fre uently as ed ho long it ill be until e see Kitchen Sync technology entering the mar etplace. ifferent pieces of technology ill no doubt ta e different periods of time to really become useful. Mr. Java is currently starting to move into the mar etplace ith the help of generous support and interest from S and Acorto. MicroChef PC inners technology is already arriving in the home in a variety of forms notably in the Japanese mar et. Longer term pro ects include Counter Intelligence and CoolIO hich currently appear to be in the ten year range as they re uire greater investment in an infrastructure and information base. oth ill be effected by the degree of gro th of shop from home services such as Peapod.

We are currently at the Model T stage of computers. The Model T is still no n seventy years later for being available in any colour you anted so long as it as blac . Computers are currently available in any si e you ant so long as they re a bo . ou can buy bo es that sit under your table on your table in your bag or in your poc et but they re all bo es.

Kitchen Sync is one e ample of technology designed to not be a bo but instead be a coffee cup a counter a toy. A vast uantity of research at the Media Lab is engaged in ma ing non bo computers. Kitchen Sync and the Counter Intelligence SI sho an e tremely e citing and viable area of research in this

arena ith a great number of both commercial and research possibilities.

Credits & Ac no ledgements

Photos

PC Dinners, pg. Webb Chappell

Mr. Java, pg. 8 Webb Chappell

Mr. Java by Hour pg. 8 http mr ava.media.mit.edu byday.gif

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