

The future of radio: combining music streaming with traditional terrestrial radio services

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Month 2020

Acknowledgments

When I have to write this part I'll definitely cry.

Abstract

Audio streaming services are used daily by millions worldwide, enabling on-demand listening and the discovery of songs, artists and podcasts that closely align with the listener's preferences. Meanwhile, traditional terrestrial radio persists as another ubiquitous and still viable mode of accessing more pre-programmed music and news content, including traffic reports and weather information. While both media services offer listeners a distinct set of value propositions, efforts to combine the 'best of both worlds' have been few and far between. Towards this objective, we describe our preliminary efforts to understand audio media consumers' music streaming and traditional radio listening habits and preferences as part of a project aimed at creating an integrated experience for individual listeners and their close networks of family and friends. Through rapid prototyping, and the speed dating method, we explore the design implications for creating and validating radio-like experiences that are at once personal, customizable and shareable.

Keywords

Music; Music streaming services; Music technology; Terrestrial radio; Interactive radio; User-centered design; Human-computer interaction

Resumo

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Palavras Chave

Colaborativo; Codificação; Conteúdo Multimídia; Comunicação;

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Acronyms

AVC	Advanced Video Coding
CC	Cloud Computing
CDN	Content Distribution Network
CPU	Central Processing Unit
DASH	Dynamic Adaptive Streaming over HTTP
GPRS	General Packet Radio Service
HD	High Definition
HTTP	Hypertext Transfer Protocol
LAN	Local Area Network
LTE	Long Term Evolution
OS	Operating System
SD	Standard Definition
SVC	Scalable Video Coding
UI	User Interface
UMTS	Universal Mobile Telecommunication System
WLAN	Wireless Local Area Network
WWAN	Wireless Wide Area Network

1

Introduction

Contents

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Rui Cruz: The examples of techniques, tools, and packages along the document are for you to get familiarized with them. It is advisable to preserve those examples of usage, for reference, by moving the respective blocks of text to the last Chapter of this template (or to a Chapter file that you know you will not use), until you finish your document.

Example of using package `todo` for notes of authors. In this case the author Johnny is calling the attention for something at the specific place in the text.

Johnny
pointing out
to the place

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Rui Cruz
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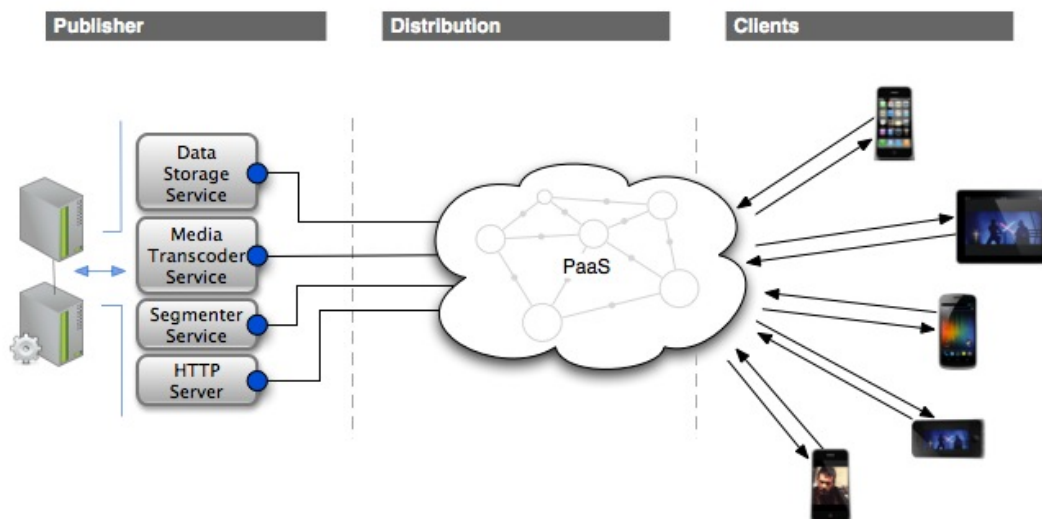


Figure 1.1: Ecosystem

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1.2 Organization of the Document

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Related Work

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2.1 Traditional Streaming Technologies

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Sed pulvinar, “felis id consectetur” malesuada, enim nisl mattis elit, a facilisis tortor nibh quis leo Table 2.1.

Table 2.1: Streaming Technologies Comparison

	Dynamic Streaming	Smooth Streaming	HLS
Streaming Protocol	RTMP	HTTP	HTTP
Video Codec	H.264, VP6	H.264	H.264
Audio Codec	AAC, MP3	WMA, AAC	AAC, MP3
Container Format	MP4, FLV,	MP4	MPEG2-TS
iOS	NO	YES	YES
Android	NO	YES	YES

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Table 2.2: A nice Spreadsheet using package “spreadtab”. Notice the calculations.

22	54	76
43	65	108
49	37	86
114	156	270

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Table 2.3: Comparison between today's and target Architectures of Telcos

Today		Target	
Rigid	Each evolutionary requirement involves development of multiple components, interfaces, platforms, etc.	Flexible	It is possible to modify or add new functionalities rapidly.
Slow	Development of a new application takes months or years.	Fast	Development of a new application takes weeks instead of months or years.
Closed	Limited integration with external environments.	Open	It is simple to integrate internal, applications with external entities.
Complex	Heterogeneous technologies, obsolescence, lack of standards, high redundancy.	Standardised	Use of homogeneous architectural models.
Expensive	High Capex (for new service development) and high Opex (to ensure running of IT).	Cost-Effective	Capex and Opex are optimised.

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Preliminary User Research

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3.1 Architecture Design Requirements

Example of a Flowchart for a system, in Figure 3.1, created with <https://www.draw.io> and then exported as “PDF” crop format (a true vector image that can be scaled to no end, with no pixels or distortion).

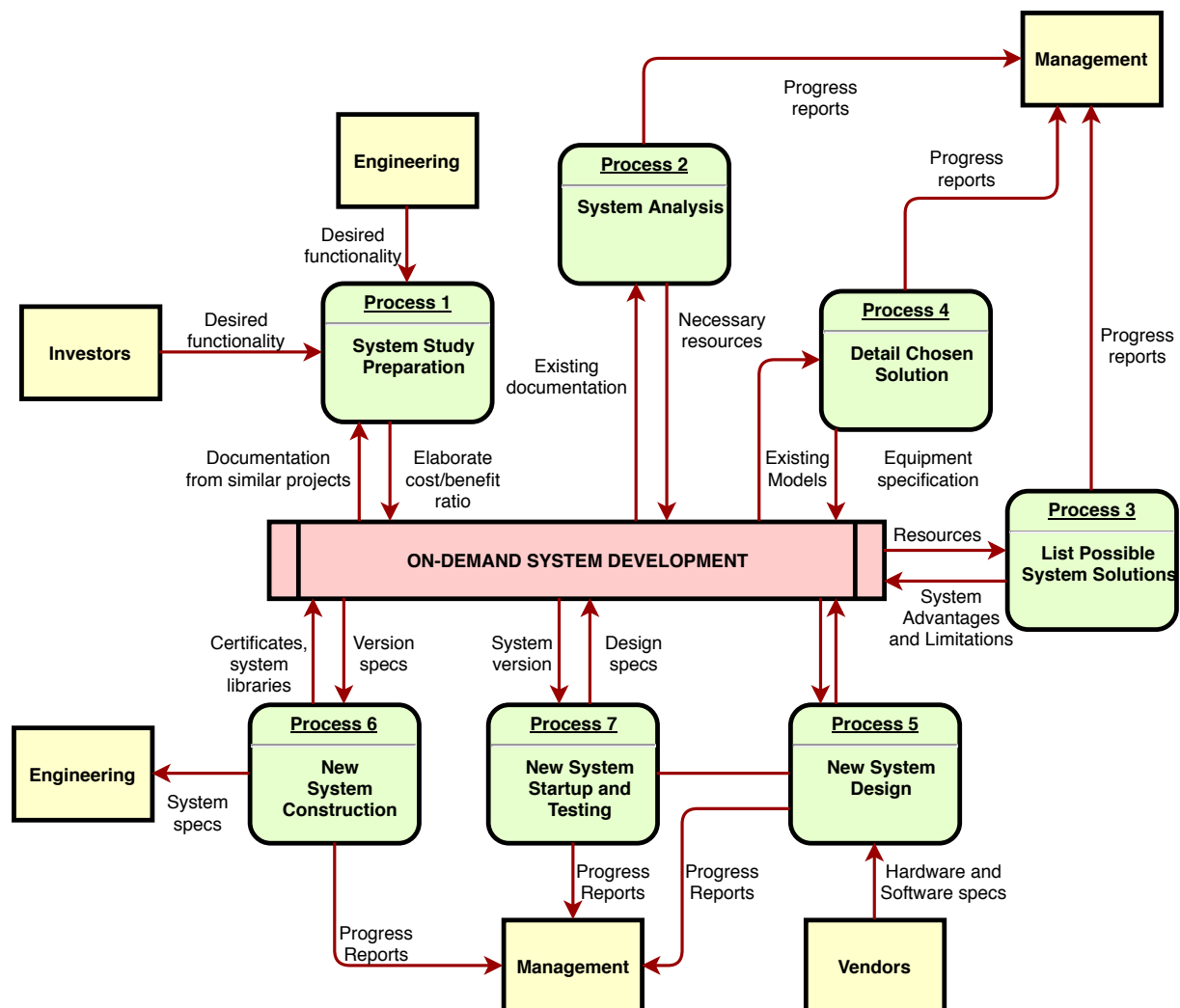


Figure 3.1: System Processes

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ornare, erat elit consectetur erat, id egestas pede nibh eget odio. Proin tincidunt, velit vel porta elementum, magna diam molestie sapien, non aliquet massa pede eu diam. Aliquam iaculis. Fusce et ipsum et nulla tristique facilisis. Donec eget sem sit amet ligula viverra gravida. Etiam vehicula urna vel turpis.

And here another diagram of a network (Figure 3.2) created with <https://www.draw.io> and then exported as “PDF” crop format.

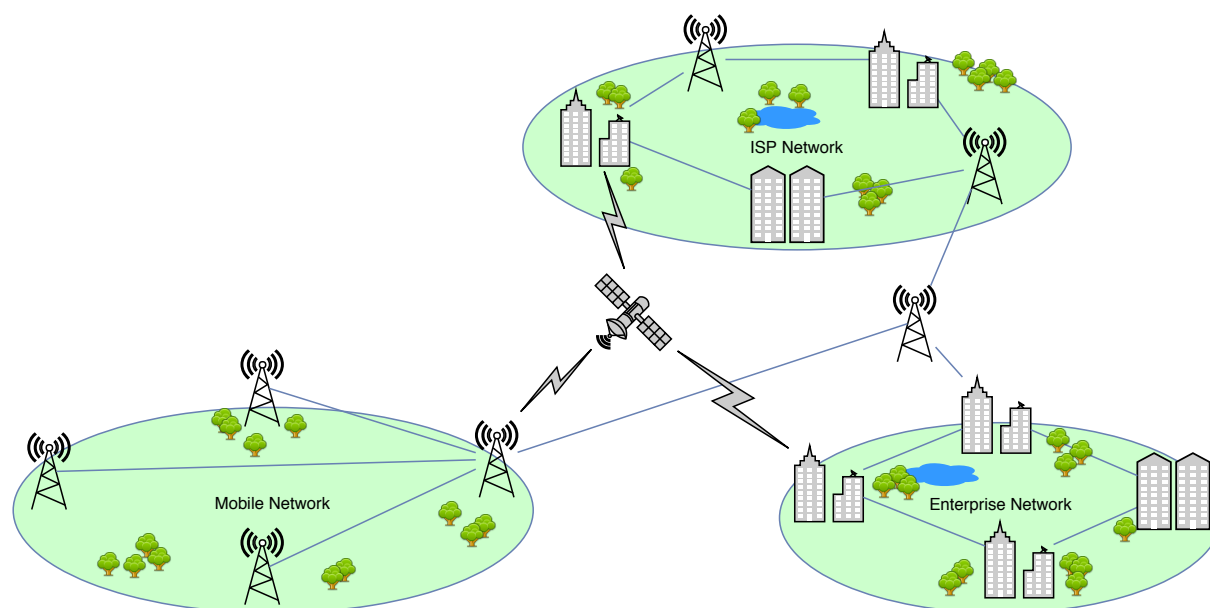


Figure 3.2: Network Diagram

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Web-streaming: The client application should support streaming media using Hypertext Transfer Protocol (HTTP) protocols.

Multi-source streaming: The client application should support multi-source streaming media, i.e., “simultaneous” streaming of media content components from a network, supported/complemented by Content Distribution Network (CDN)/Cloud Computing (CC) services.

Support content Metadata Description: The client application should support content metadata description in a format similar or compliant with MPEG Dynamic Adaptive Streaming over HTTP (DASH) [11].

Scalable and Adaptive Media Contents: The system should support on-demand streaming of scal-

able and adaptive contents based on SVC.

Heterogenous End-User Devices: The client application should be compatible with current and future generations of end-user devices form factors, irrespective of their performance, screen size and resolution.

Access Network independency: The solution should provide the expected service over different types of access networks supported by the end-user devices, such as Wireless Local Area Networks (LANs) (IEEE 802.11) or cellular data networks such as General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS), Long Term Evolution (LTE), etc.

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3.2 Architecture Design Requirements

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Listing 3.1: Example of a MPD file.

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <StreamInfo version="2.0">
3   <Clip duration="PT01M0.00S">
4     <BaseURL>videos/</BaseURL>
5     <Description>svc_1</Description>
6     <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="401.90"
7       width="176" height="144" id="L0">
8       <BaseURL>svc_1/</BaseURL>
9       <SegmentInfo from="0" to="11" duration="PT5.00S">
10        <BaseURL>svc_1-L0-</BaseURL>
11      </SegmentInfo>
12    </Representation>
13    <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00"
14      bandwidth="1322.60"
15      width="352" height="288" id="L1">
16      <BaseURL>svc_1/</BaseURL>
17      <SegmentInfo from="0" to="11" duration="PT5.00S">
18        <BaseURL>svc_1-L1-</BaseURL>
19      </SegmentInfo>
20    </Representation>
21  </Clip>
22 </StreamInfo>
```

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4

Speed Dating

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4.1 Development Process

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- Technology Research and Related Works
- Requirements Gathering and Study
- Design of the Architecture
- Implementation Process
- Testing and Functional Validation

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4.2 Development Environment

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa.

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gorithm
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Algorithm 4.1: Time Control Strategy

```
begin
  nextBitrate  $\leftarrow$  nextDownloadLevel
  nextBitrate  $\leftarrow$  GetNextBitrate()
  cpuLoad  $\leftarrow$  GetCpuLoad()
  bitrateDelta  $\leftarrow$  getBitrateDelta(currentBitrate, nextBitrate)
  if bitrateDelta > maxThreshold then
    | SetBitrate(nextBitrate)
  if minThreshold < bitrateDelta < maxThreshold and numAttempts < 2 then
    | numAttempts  $\leftarrow$  numAttempts + 1
  else if minThreshold < bitrateDelta < maxThreshold and numAttempts = 2 then
    | numAttempts  $\leftarrow$  0
  else
    | SetBitrate(nextBitrate)
  if 0 < bitrateDelta < minThreshold and numAttempts < 3 then
    | numAttempts  $\leftarrow$  numAttempts + 1
  else if 0 < bitrateDelta < minThreshold and numAttempts = 3 then
    | SetBitrate(nextBitrate)
```

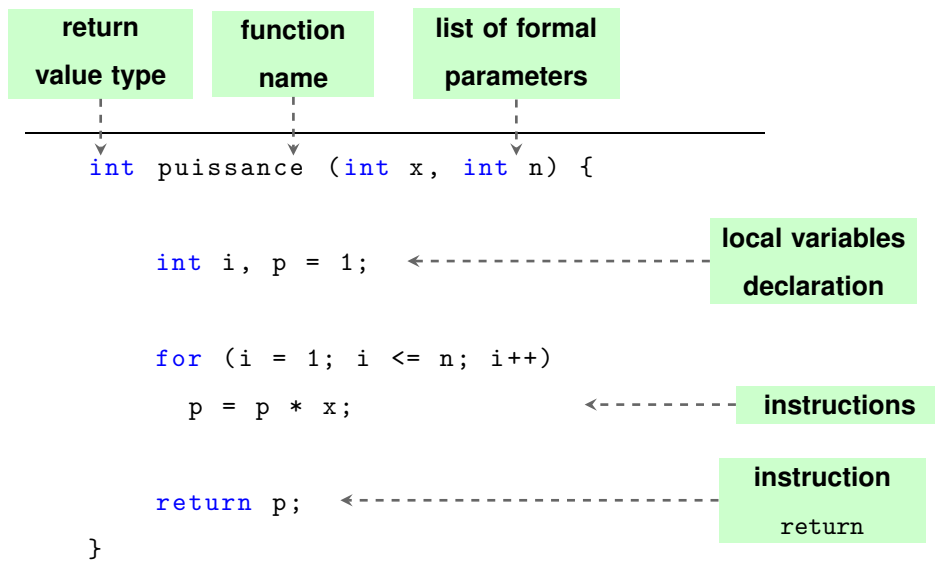
Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna..

4.3 Client Application

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa. Aliquam lorem. In hac habitasse platea dictumst. Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies.

Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna.

Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Cras vehicula varius turpis.



Listing 4.1: A listing with a Tikz picture overlayed

And here another method (Listing 4.1) for mixing (overlay) a picture with a listing of code.

4.3.1 User Interface

Donec semper turpis sed diam. Sed consequat ligula nec tortor. Integer eget sem. Ut vitae enim eu est vehicula gravida. Morbi ipsum ipsum, porta nec, tempor id, auctor vitae, purus. Pellentesque neque. Nulla luctus erat vitae libero. Integer nec enim. Phasellus aliquam enim et tortor. Quisque aliquet, quam elementum condimentum feugiat, tellus odio consectetur wisi, vel nonummy sem neque in elit. Curabitur eleifend wisi iaculis ipsum. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. In non velit non ligula laoreet ultrices. Praesent ultricies facilisis nisl. Vivamus luctus elit sit amet mi. Phasellus pellentesque, erat eget elementum volutpat, dolor nisl porta neque, vitae sodales ipsum nibh in ligula. Maecenas mattis pulvinar diam. Curabitur sed leo..

Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis.

4.3.2 Vivamus luctus elit sit amet mi

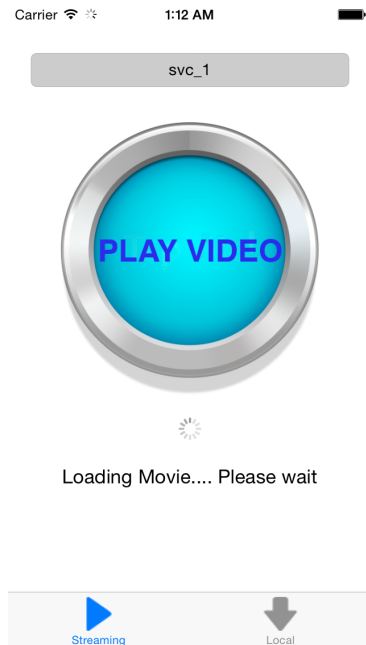
Nulla facilisi. In vel sem. Morbi id urna in diam dignissim feugiat. Proin molestie tortor eu velit. Aliquam erat volutpat. Nullam ultrices, diam tempus vulputate egestas, eros pede varius leo, sed imperdiet lectus est ornare odio. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Proin consectetur velit in dui. Phasellus wisi purus, interdum vitae, rutrum accumsan, viverra in, velit. Sed enim risus, congue non, tristique in, commodo eu, metus. Aenean tortor mi, imperdiet id, gravida eu, posuere eu, felis.

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urna nibh ut arcu. Aliquam in lacus.

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ures

Figures 4.1(a) and 4.1(b) proin at eros non eros adipiscing mollis.



(a) Media Loading Window



(b) Play-out Session UI

Figure 4.1: Complete User Interface

Vestibulum ante ipsum primis in faucibus orci luctus et ultrices posuere cubilia Curae; Nulla placerat aliquam wisi. Mauris viverra odio. Quisque fermentum pulvinar odio. Proin posuere est vitae ligula. Etiam euismod. Cras a eros.

5

Sterio System

Contents

5.1	Maecenas vitae nulla consequat	25
5.2	Proin ornare dignissim lacus	26

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi commodo, ipsum sed pharetra gravida, orci magna rhoncus neque, id pulvinar odio lorem non turpis. Nullam sit amet enim. Suspendisse id velit vitae ligula volutpat condimentum. Aliquam erat volutpat. Sed quis velit. Nulla facilisi. Nulla libero. Vivamus pharetra posuere sapien. Nam consectetur. Sed aliquam, nunc eget euismod ullamcorper, lectus nunc ullamcorper orci, fermentum bibendum enim nibh eget ipsum. Donec porttitor ligula eu dolor. Maecenas vitae nulla consequat libero cursus venenatis. Nam magna enim, accumsan eu, blandit sed, blandit a, eros.

5.1 Maecenas vitae nulla consequat

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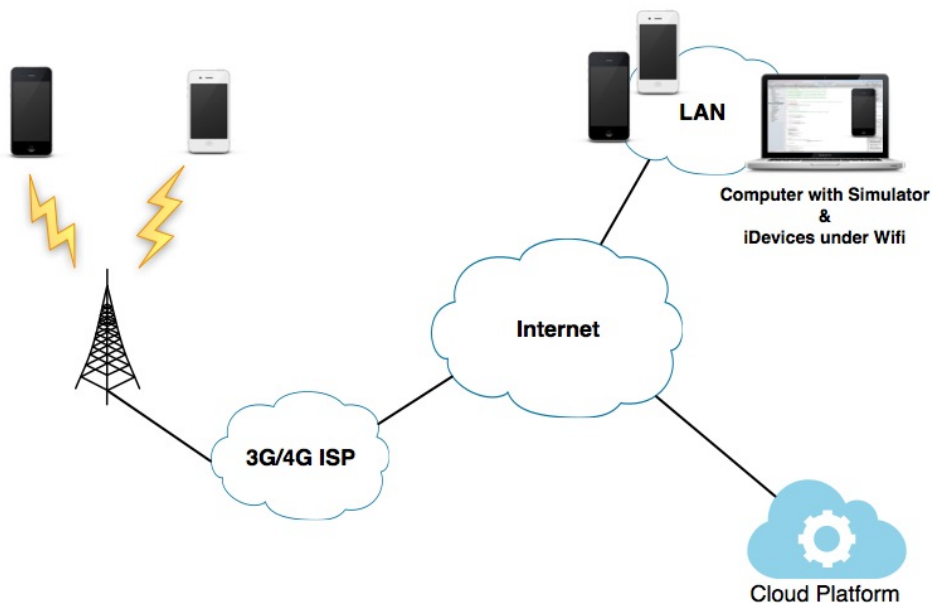


Figure 5.1: Test Environment

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede Table 5.1 used in the tests. The Network Link Conditioner allows to force/simulate fluctuations in fixed network segments.

Table 5.1: Network Link Conditioner Profiles

Network Profile	Bandwidth	Packets Dropped	Delay
Wifi	40 mbps	0%	1 ms
3G	780 kbps	0%	100 ms
Edge	240 kbps	0%	400 ms

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede.

5.2 Proin ornare dignissim lacus

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Et “optimistic” nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui G_j , nec ligula et lorem consequat ullamcorper p ut mauris eu mi mollis luctus j , porttitor ut, Equation (5.1), uctus posuere justo:

N_j Is the number of times peer j has been optimistically unchoked.

n_j Among the N_j unchokes, the number of times that peer j responded with unchoke or supplied segments to peer p .

$C_{r[j]}$ The cooperation ratio of peer j . If peer j never supplied peer p , the information of $C_{r[j]}$ may not be available.

$C_{r(max)}$ The maximum cooperation ratio of peer p 's neighbors, i.e., $C_{r(max)} = \max(C_r)$.

$$G_j = \begin{cases} \frac{n_j C_{r[j]}}{N_j} & \text{if } n_j > 0 \\ \frac{C_{r(max)}}{N_j + 1} & \text{if } n_j = 0 \end{cases} \quad (5.1)$$

Cursus $C_{r(max)}$ conubia nostra, per inceptos hymenaeos j gadipiscing mollis massa $N_j = 0$, unc ut dui eget nulla venenatis aliquet $G_j = C_{r(max)}$.

Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ullamcorper. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa.

Both Figures 5.2(a) and 5.2(b) Phasellus eget nisl ut elit porta “perfect” tincidunt. Class aptent taciti sociosqu ad litora torquent per conubia nostra.

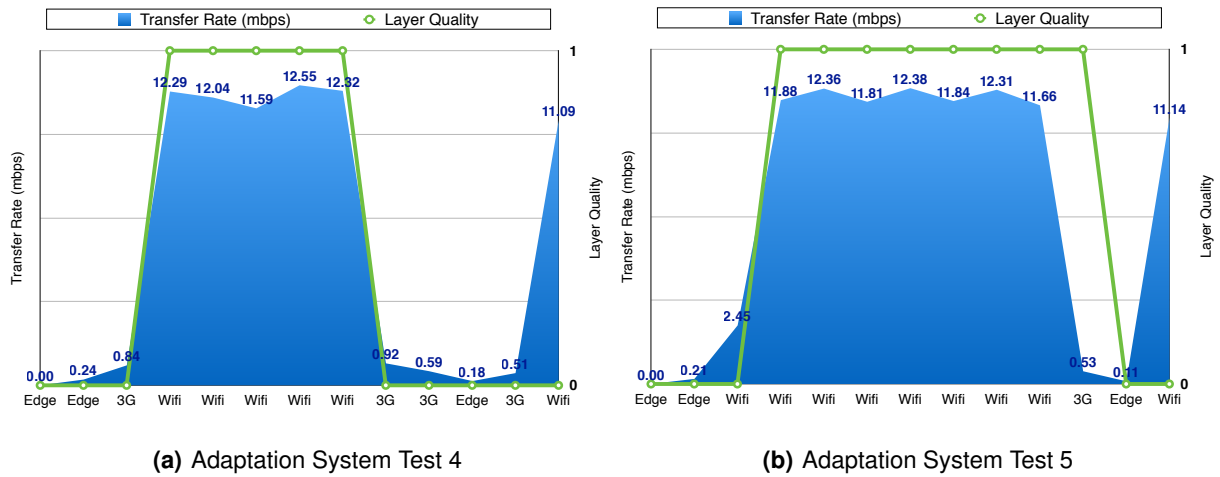


Figure 5.2: Adaptation System Behavior Test

Cras sed ante. Phasellus in massa. Curabitur dolor eros, gravida et, hendrerit ac, cursus non, massa. Aliquam lorem. In hac habitasse platea dictumst. Cras eu mauris. Quisque lacus. Donec ipsum. Nullam vitae sem at nunc pharetra ultricies. Vivamus elit eros, ullamcorper a, adipiscing sit amet, porttitor ut, nibh. Maecenas adipiscing mollis massa. Nunc ut dui eget nulla venenatis aliquet. Sed luctus posuere justo. Cras vehicula varius turpis. Vivamus eros metus, tristique sit amet, molestie dignissim, malesuada et, urna.

6

Evaluation

Contents

6.1	Conclusions	31
6.2	System Limitations and Future Work	32

Pellentesque vel dui sed orci faucibus iaculis. Suspendisse dictum magna id purus tincidunt rutrum. Nulla congue. Vivamus sit amet lorem posuere dui vulputate ornare. Phasellus mattis sollicitudin ligula. Duis dignissim felis et urna. Integer adipiscing congue metus.

Rui Cruz
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Chapter
with an in-
troductory
text

6.1 Conclusions

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6.2 System Limitations and Future Work

Aliquam aliquet, est a ullamcorper condimentum, tellus nulla fringilla elit, a iaculis nulla turpis sed wisi. Fusce volutpat. Etiam sodales ante id nunc. Proin ornare dignissim lacus. Nunc porttitor nunc a sem. Sed sollicitudin velit eu magna. Aliquam erat volutpat. Vivamus ornare est non wisi. Proin vel quam. Vivamus egestas. Nunc tempor diam vehicula mauris. Nullam sapien eros, facilisis vel, eleifend non, auctor dapibus, pede.

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Code of Project

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Listing A.1: Example of a XML file.

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <StreamInfo version="2.0">
3   <Clip duration="PT01M0.00S">
4     <BaseURL>videos/</BaseURL>
5     <Description>svc_1</Description>
6     <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="401.90"
7       width="176" height="144" id="L0">
8       <BaseURL>svc_1</BaseURL>
9       <SegmentInfo from="0" to="11" duration="PT5.00S">
```

```

10         <BaseURL>svc_1-L0-</BaseURL>
11     </SegmentInfo>
12 </Representation>
13 <Representation mimeType="video/SVC" codecs="svc" frameRate="30.00" bandwidth="1322.60"
14     width="352" height="288" id="L1">
15     <BaseURL>svc_1/</BaseURL>
16     <SegmentInfo from="0" to="11" duration="PT5.00S">
17         <BaseURL>svc_1-L1-</BaseURL>
18     </SegmentInfo>
19 </Representation>
20 </Clip>
21 </StreamInfo>

```

Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam.

Listing A.2: Assembler Main Code.

```

1  ; *****
2  ; * Constantes
3  ; *****
4
5  ON      EQU 1 ; contagem ligada
6  OFF     EQU 0 ; contagem desligada
7  INPUT   EQU 8000H ; endereço do porto de entrada
8          ;(bit 0 = RTC; bit 1 = botão)
9  OUTPUT  EQU 8000H ; endereço do porto de saída.
10
11
12 ; *****
13 ; * Stack
14 ; *****
15
16 PLACE   1000H
17 pilha:   TABLE 100H ; espaço reservado para a pilha
18 fim_pilha:
19
20 ; *****
21
22 PLACE   2000H
23
24 ; Tabela de vectores de interrupção
25
26 tab:     WORD   rot0
27
28 ; *****
29 ; * Programa Principal
30 ; *****
31
32 PLACE   0
33
34 inicio:
35     MOV BTE, tab ; incializa BTE
36     MOV R9, INPUT ; endereço do porto de entrada
37     MOV R10, OUTPUT ; endereço do porto de saída
38     MOV SP, fim_pilha
39     MOV R5, 1 ; inicializa estado do processo P1
40     MOV R6, 1 ; inicializa estado do processo P2
41     MOV R4, OFF ; inicializa controle de RTC
42     MOV R8, 0 ; inicializa contador
43     MOV R7, OFF ; inicialmente não permite contagem
44     EIO ; permite interrupções tipo 0

```

```

45     EI                ; activa interrupções
46
47 ciclo:
48     CALL P1           ; invoca processo P1
49     CALL P2           ; invoca processo P2
50     JMP ciclo         ; repete ciclo
51
52 ; *****
53 ;* ROTINAS
54 ; *****
55
56 P1:
57     CMP R5, 1         ; se estado = 1
58     JZ P1_1
59     CMP R5, 2         ; se estado = 2
60     JZ P1_2
61 sai_P1:
62     RET               ; sai do processo.
63
64
65 P1_1:
66     MOVB R0, [R9]     ; lê porto de entrada
67     BIT R0, 1
68     JZ sai_P1         ; se botão não carregado, sai do processo
69     MOV R7, ON        ; permite contagem do display
70     MOV R5, 2         ; passa ao estado 2 do P1
71     JMP sai_P1
72
73 P1_2:
74     MOVB R0, [R9]     ; lê porto de entrada
75     BIT R0, 1
76     JNZ sai_P1        ; se botão continua carregado, sai do processo
77     MOV R7, OFF       ; caso contrário, desliga contagem do display
78     MOV R5, 1         ; passa ao estado 1 do P1
79     JMP sai_P1

```

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ulla corpor. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos.

This inline MATLAB code `for i=1:3, disp('cool'); end;` uses the `\mcode{}` command.¹

Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci.

Listing A.3: Matlab Function

```

1 for i = 1:3
2     if i >= 5 && a ~= b           % literate programming replacement
3         disp('cool');             % comment with some  $\pi x^2$ 
4     end
5     [i, ind] = max(vec);
6     x_last = x(1, end) - 1;
7     v(end);
8     ylabel('Voltage ( $\mu V$ )');
9 end

```

¹MATLAB Works also in footnotes: `for i=1:3, disp('cool'); end;`

Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci.

Listing A.4: function.m

```
1 % Copyright 2010 The MathWorks, Inc.
2 function ObjTrack(position)
3 % #codegen
4 % First, setup the figure
5 numPts = 300;           % Process and plot 300 samples
6 figure;hold;grid;       % Prepare plot window
7 % Main loop
8 for idx = 1: numPts
9     z = position(:,idx); % Get the input data
10    y = kalmanfilter(z);  % Call Kalman filter to estimate the position
11    plot_trajectory(z,y); % Plot the results
12 end
13 hold;
14 end % of the function
```

Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Phasellus eget nisl ut elit porta ullamcorper. Maecenas tincidunt velit quis orci. Sed in dui. Nullam ut mauris eu mi mollis luctus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos hymenaeos. Sed cursus cursus velit. Sed a massa. Duis dignissim euismod quam. Nullam euismod metus ut orci. Vestibulum erat libero, scelerisque et, porttitor et, varius a, leo.

Listing A.5: HTML with CSS Code

```
1 <!DOCTYPE html>
2 <html>
3   <head>
4     <title>Listings Style Test</title>
5     <meta charset="UTF-8">
6     <style>
7       /* CSS Test */
8       * {
9         padding: 0;
10        border: 0;
```



```

11     margin: 0;
12 }
13 </style>
14 <link rel="stylesheet" href="css/style.css" />
15 </head>
16 <header> hey </header>
17 <article> this is a article </article>
18 <body>
19     <!-- Paragraphs are fine -->
20     <div id="box">
21         <p>
22             Hello World
23         </p>
24         <p>Hello World</p>
25         <p id="test">Hello World</p>
26         <p></p>
27     </div>
28     <div>Test</div>
29     <!-- HTML script is not consistent -->
30     <script src="js/benchmark.js"></script>
31     <script>
32         function createSquare(x, y) {
33             // This is a comment.
34             var square = document.createElement('div');
35             square.style.width = square.style.height = '50px';
36             square.style.backgroundColor = 'blue';
37
38             /*
39              * This is another comment.
40              */
41             square.style.position = 'absolute';
42             square.style.left = x + 'px';
43             square.style.top = y + 'px';
44
45             var body = document.getElementsByTagName('body')[0];
46             body.appendChild(square);
47         };
48

```

```

49     // Please take a look at +=
50     window.addEventListener('mousedown', function(event) {
51         // German umlaut test: Berührungspunkt ermitteln
52         var x = event.touches[0].pageX;
53         var y = event.touches[0].pageY;
54         var lookAtThis += 1;
55     });
56     </script>
57 </body>
58 </html>

```

Nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper.

Listing A.6: HTML CSS Javascript Code

```

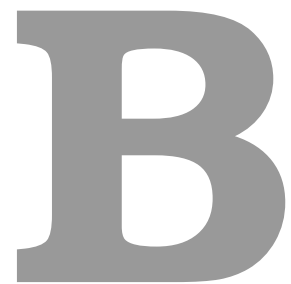
1
2 @media only screen and (min-width: 768px) and (max-width: 991px) {
3
4     #main {
5         width: 712px;
6         padding: 100px 28px 120px;
7     }
8
9     /* .mono {
10         font-size: 90%;
11     } */
12
13     .cssbtn a {
14         margin-top: 10px;
15         margin-bottom: 10px;
16         width: 60px;
17         height: 60px;
18         font-size: 28px;
19         line-height: 62px;
20     }

```

Nulla dui purus, eleifend vel, consequat non, dictum porta, nulla. Duis ante mi, laoreet ut, commodo eleifend, cursus nec, lorem. Aenean eu est. Etiam imperdiet turpis. Praesent nec augue. Curabitur ligula quam, rutrum id, tempor sed, consequat ac, dui. Vestibulum accumsan eros nec magna. Vestibulum vitae dui. Vestibulum nec ligula et lorem consequat ullamcorper.

Listing A.7: PYTHON Code

```
1 class TelegramRequestHandler(object):
2     def handle(self):
3         addr = self.client_address[0]          # Client IP-address
4         telgram = self.request.recv(1024)      # Recieve telgram
5         print "From: %s, Received: %s" % (addr, telgram)
6         return
```

A Large Table

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Table B.1: Example table

Benchmark: ANN	#Layers (1)	#Nets (2)	#Nodes* (3) = 8 · (1) · (2)	Critical path (4) = 4 · (1)	Latency (T_{iter}) (5)
A1	3–1501	1	24–12008	12–6004	4
A2	501	1	4008	2004	2–2000
A3	10	2–1024	160–81920	40	60 [†]
A4	10	50	4000	40	80–1200
Benchmark: FFT	FFT size [‡] (1)	#Inputs (2) = 2 ⁽¹⁾	#Nodes* (3) = 10 · (1) · (2)	Critical path (4) = 4 · (1)	Latency (T_{iter}) (5)
F1	1–10	2–1024	20–102400	4–40	6–60 [†]
F2	5	32	1600	20	40 – 1500
Benchmark: Random networks	#Types (1)	#Nodes (2)	#Networks (3)	Critical path (4)	Latency (T_{iter}) (5)
R1	3	10–2000	500	<i>variable</i>	(4)
R2	3	50	500	<i>variable</i>	(4) × [1; ⋯ ; 20]

* Excluding constant nodes.

[†] Value kept proportional to the critical path: (5) = (4) · 1.5.

[‡] A size of x corresponds to a 2^x point FFT.

Values in bold indicate the parameter being varied.

As Table B.1 shows, the data can be inserted from a file, in the case of a somehow complex structure. Notice the Table footnotes.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Morbi commodo, ipsum sed pharetra gravida, orci magna rhoncus neque, id pulvinar odio lorem non turpis. Nullam sit amet enim. Suspendisse id velit vitae ligula volutpat condimentum. Aliquam erat volutpat. Sed quis velit. Nulla facilisi. Nulla libero. Vivamus pharetra posuere sapien. Nam consectetur. Sed aliquam, nunc eget euismod ullamcorper, lectus nunc ullamcorper orci, fermentum bibendum enim nibh eget ipsum. Donec porttitor ligula eu dolor. Maecenas vitae nulla consequat libero cursus venenatis. Nam magna enim, accumsan eu, blandit sed, blandit a, eros.

And now an example (Table B.2) of a table that extends to more than one page. Notice the repetition of the Caption (with indication that is continued) and of the Header, as well as the continuation text at the bottom.

Table B.2: Example of a very long table spreading in several pages

Time (s)	Triple chosen	Other feasible triples
0	(1, 11, 13725)	(1, 12, 10980), (1, 13, 8235), (2, 2, 0), (3, 1, 0)
2745	(1, 12, 10980)	(1, 13, 8235), (2, 2, 0), (2, 3, 0), (3, 1, 0)
5490	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
8235	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
10980	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
Continued on next page		

Table B.2 – continued from previous page

Time (s)	Triple chosen	Other feasible triples
13725	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
16470	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
19215	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
21960	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
24705	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
27450	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
30195	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
32940	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
35685	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
38430	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
41175	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
43920	(1, 13, 10980)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
46665	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
49410	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
52155	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
54900	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
57645	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
60390	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
63135	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
65880	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
68625	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
71370	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
74115	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
76860	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
79605	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
82350	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
85095	(1, 12, 13725)	(1, 13, 10980), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
87840	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
90585	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
93330	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
96075	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
98820	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
101565	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
104310	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
107055	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
109800	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
112545	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
115290	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
118035	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
120780	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
123525	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
126270	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
129015	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
131760	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
134505	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
137250	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
139995	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
142740	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)
145485	(1, 12, 16470)	(1, 13, 13725), (2, 2, 2745), (2, 3, 0), (3, 1, 0)
148230	(2, 2, 2745)	(2, 3, 0), (3, 1, 0)

Continued on next page

Table B.2 – continued from previous page

Time (s)	Triple chosen	Other feasible triples
150975	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
153720	(1, 12, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
156465	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
159210	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
161955	(1, 13, 16470)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)
164700	(1, 13, 13725)	(2, 2, 2745), (2, 3, 0), (3, 1, 0)