EU CHIST-ERA 2012 call – C3N

Context- and Content-adaptive Communication Networks

macaco - Mobile context-Adaptive CAching for COntent-centric networking

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University of Toulouse, INPT-ENSEEIHT, IRIT

3rd CHIST-ERA Project Seminar

March 5, 2014. Istanbul, Turkey

MACACO - Context and Motivation

The smartphone phenomena

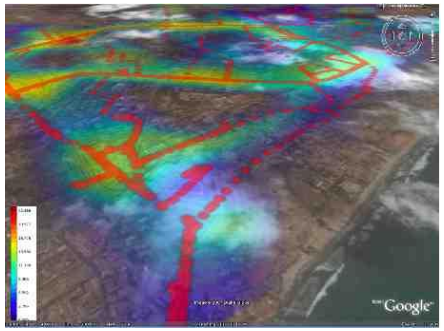
Smartphones have the potential to be:

visually-aware
sonically-aware
always-connected
directionally-aware
location-aware
motion-aware

+

In 2013, 4.1 billion users worldwide

=



- New potential for wireless and pervasive applications
  - Wireless Social networking, global sensing, content distribution …
- Increasing volume of mobile data between 2014-2018
  - "…worldwide mobile data traffic will increase nearly **11-fold** over the next four years and reach **an annual run rate of 190 exabytes** (10^{18}) by 2018…"
  - 54% of mobile connections will be 'smart' connections by 2018

[Cisco VNI Global Mobile Data Traffic Forecast (2013-2018)]

macaco New demands: **Increased data usage**

The New York Times

Customers Angered as iPhones Overload AT&T

By JENNA WORTHAM
Published: September 2, 2009

Slim and sleek as it is, the iPhone is really the Hummer of cellphones.

Data offloading solutions are required to deal with such increasing volume of mobile data traffic.

IEEE SPECTRUM

The Great Radio Spectrum Famine

Mobile broadband is consuming spectrum. Serving up more won't be easy

By Mitchell Lazarus
Posted 30 Sep 2010 | 15:14 GMT

Data offloading :
use Wi-Fi/small cell access instead of 3G if possible

iPhone overload: Dutch T-Mobile issues refund after 3G issues

It's not just AT&T-Mobile in the Netherlands offers the iPhone and it's now …

by Iljitsch van Beijnum - June 7 2010, 4:15pm RST

Of the three mobile network operators in the Netherlands, only T-Mobile sells the iPhone. And only T-Mobile has a large part of its customer base irate from lack of 3G data access, dropped calls, and calls going directly to voicemail even with full 3G coverage.

ars technica

Focus and intuition

- Current data offloading solution:
  - Use WiFi connectivity if available and if not, use 3G.
- Our focus : a more intelligent data offloading strategy
  - Build data offloading mechanisms that take advantage of **context** and **content information**

- Intuitions:
  - to **extract** and **forecast** the behaviour of mobile users in the three-dimensional space of **time, location** and **interest**
    - **'what', 'when' and 'where'** users are pulling data from the network
  - to **pre-fetch** the identified data and **cache** it at an earlier time
    - at the mobile terminals or at the edge nodes of the network

Project contributions

1. To acquire real world data sets to model mobile node behaviour in the three-dimensional space : Originality

2. To derive appropriate models for the **correlation between user interests and their mobility** : Originality

3. To derive simple and efficient prediction algorithms to forecast the **node's mobility and interests** : Originality

4. To output data pre-fetching mechanisms
   1. To integrate content-centric caching approach with social context awareness and opportunistic resource availability : Originality

5. To design a federated testbed for (no commercial interest):
   1. Content and context data collection
   2. Assessment of off-loading solutions

MACACO Project organization

Project Consortium

- 6 international partners
  - INRIA coordination
  - 5 European partners and 1 Brazilian Institution
    - INRIA, N7, SUPSI, UOB, CNR, UFMG
  - 4 funded and 2 non-funded institutions
  - Funding organizations: ANR, SNSF, EPSRC

- Funding ~1M€ for a total effort of 277 MM

Agence Nationale de la Recherche ANR

EPSRC Engineering and Physical Sciences Research Council

FNSNF Swiss National Science Foundation

Consortium

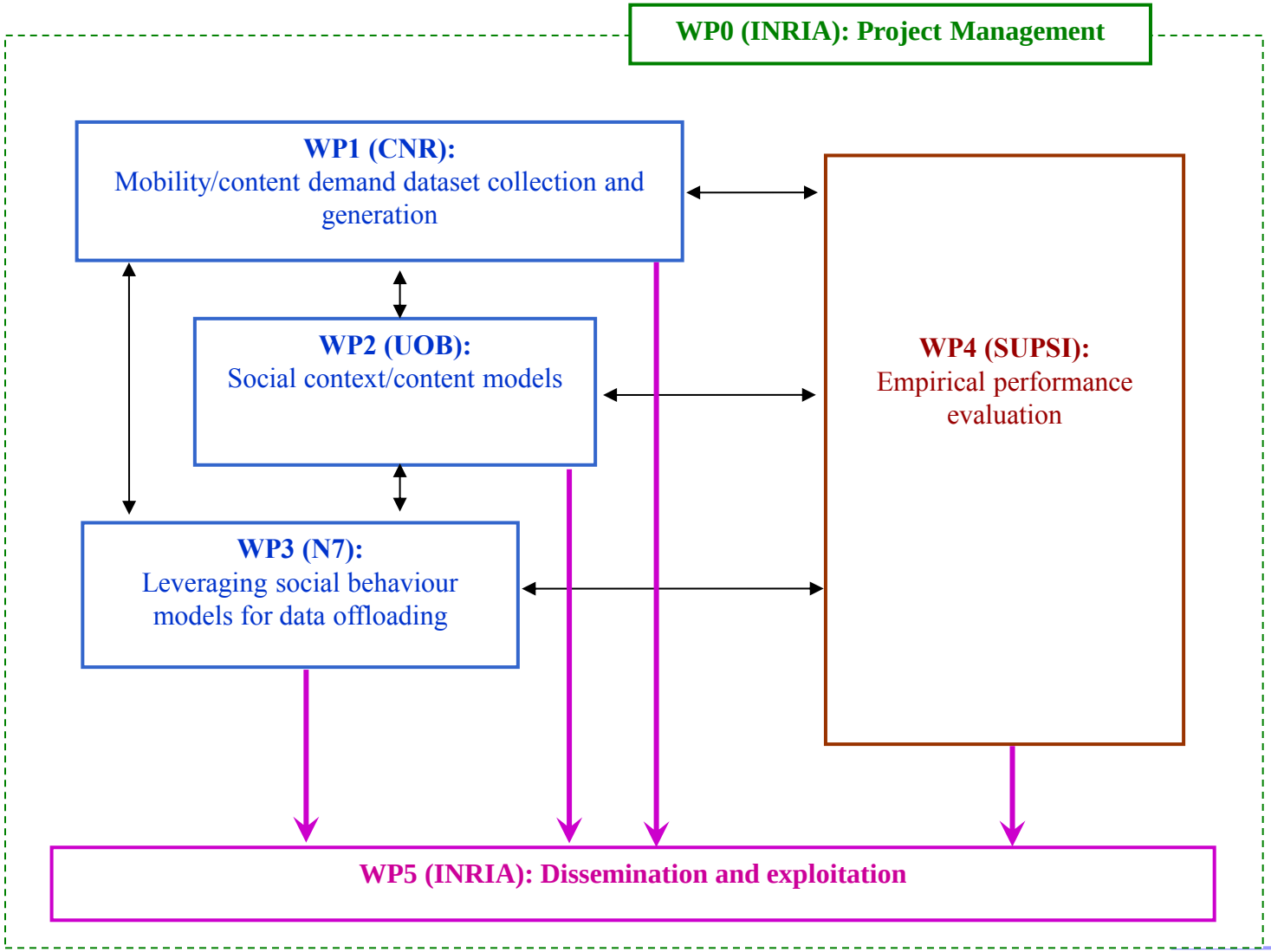
Brazil

UFMG

Pedro O. Vaz de Melo

MACACO organization

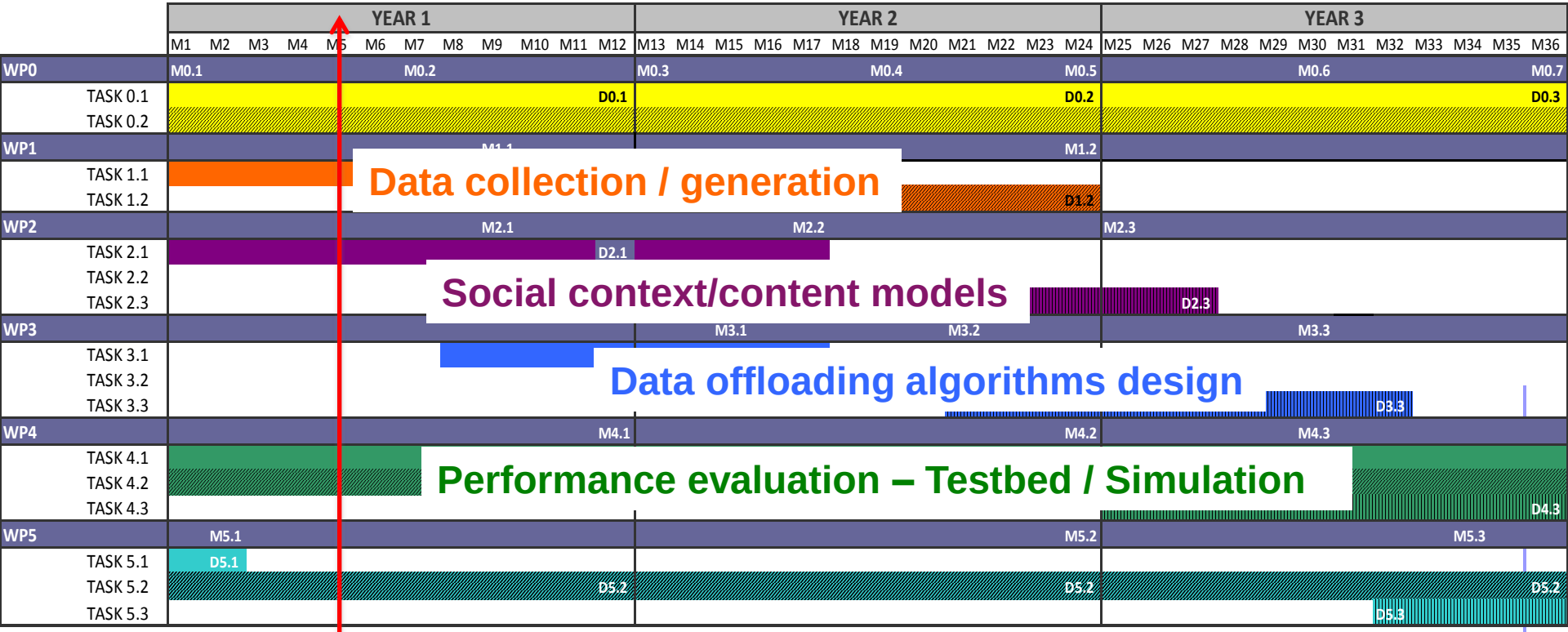
- Duration: 36 months, 6 Work Packages



MACACO consortium : partner skills

	INRIA	N7	UOB	SUPSI	CNR	UFMG
Data collection			■			
Large scale data generation					■	
Context prediction models			■			■
Social network analysis	■				■	■
Opportunistic protocol	■	■		■		
Protocol performance evaluation	■	■		■	■	■
Testbed experimenting		■	■	■		
Protocol standardization	■			■		

Project timeline



Nov 2013
Kickoff, Paris

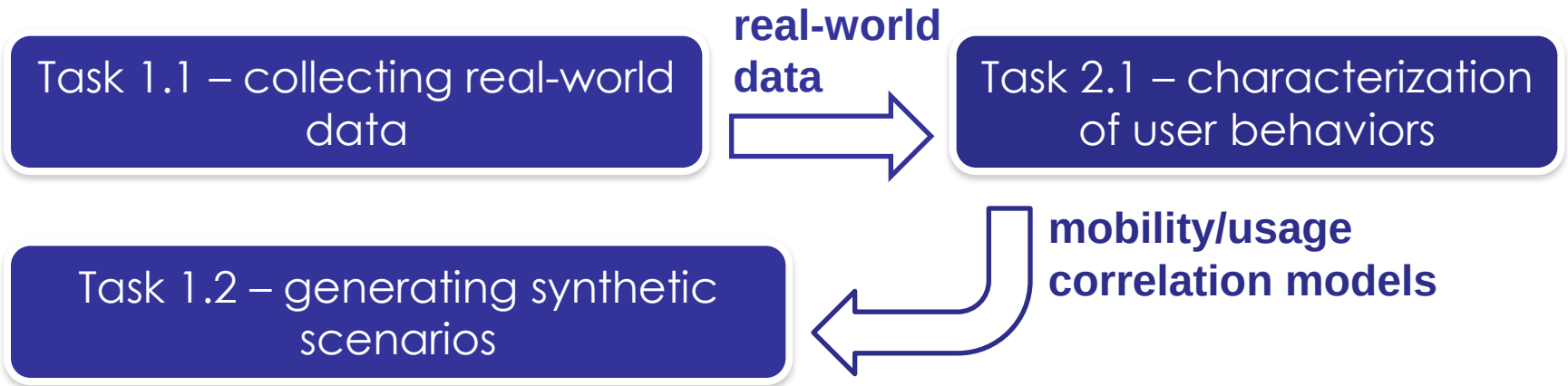
Nov 2014

Nov 2015

Project Seminar, Istanbul -> Focus on WP1 in this presentation

WP1 – CNR-IEITT, Marco Fiore

- **Goal**: providing datasets coupling mobile users' movement patterns & service demand *(unavailable to date!)*
  - Collection of a significant **real-world** data sample
    - Small-scale (~100 smartphones with dedicate monitoring software)
  - Generation of **synthetic** mobility/usage datasets
    - Large-scale (order-of-thousand simulated users in urban scenarios)



Data collection

- To configure smartphones to continuously collect user's context and content information
  - Context = location, networking environment (3G, WiFi, BT), motion (accelerometer, proximity)
  - Content = apps that have created traffic in up and downlink, native browser URLs

- The testbed may be composed by users:
  - Using the acquired MACACO smartphones
  - Using their own smartphones with the deployed application installed
    - Incentivizing Android users (work colleagues, students, family, etc) to participate of the testbed
  - The same application for the two cases
  - In the 5 countries of MACACO

Progress on WP1 – data collection

Discussion started at Kickoff meeting on 11/24/2014

Current status :

- Software developments for data collection:
  - First beta version of the **data collection application** for Android smartphones is available
  - Client – server application for **uploading** gathered data
- Tested on 3 types of smartphones for reliability
  - Samsung Galaxy S3, Wiko Stairway and Motorola Moto G
- Remaining tasks in software development
  - Finalize tests and improve user interface
  - Extend application to be shared on the Android Marketplace for different smartphones
  - Enforce data privacy rules

Data collection phase

- Volunteers recruiting
  - Students
    - Simple to recruit at universities,
    - Has specific habits, with a very predictable social structure
    - Should not only concentrate on them
  - Colleagues, friends
    - Different habits depending on profession.
    - Not a very homogeneous population : maybe harder to analyze
- Find appropriate incentivizing method
  - Students : Application that provides in-school services (class schedule, student phone repository, …)
  - Colleagues, friends ? … open question.

Organizational setup

- Timeline related to WP1.1
  - March 2014 : Version 1.0 of data collection application
  - April 2014 – May 2014: Data collection at N7, UOB and SUPSI
- Timeline related to WP2.1 and WP1.2
  - Mai-Nov. 2015: large scale simulation using traces of WP1.1

- Manpower WP1.1
  - **3-month internship** at N7 for data application development finalization (March-May 2014 at N7)
  - **3-month PhD** at N7 support for supervision and roll out of data collection testbed, first analysis (May-July 2014 at N7)
- Manpower WP1.2
  - **12-month post-doc** at INRIA to work on large scale simulation
- Manpower WP2.2
  - **PhD recruitment** at UOB to start in May or June 2014
- Manpower WP3
  - **12-month post-doc** at N7 to start in October 2014

Milestone of 1st year

- WP5, Task 5.1 (month 2; **December 2013**)
  - Website finalization
- WP1, Task 1.1 (month 5, **February 2014**; month 9, **May 2014**)
  - Progress in real-world data collection
- WP2, Task 2.1 (month 9; **May 2014**)
  - Progress in the characterization, usage and protection of user behaviour
- WP1, Task 1.1 (month 12; **October 2014**)
  - Report on real-world data collection
- WP2, Task 2.1 (month 12; **October 2014**)
  - Report on user behaviour modelling
- WP4, Task4.1 (month 12; **October 2014**)
  - Progress in the empirical evaluation framework
- WP0 Tasks 0.1 and 0.2 (month 12, **October 2014**)
  - CHIST-ERA annual scientific report

Collaborative set-up

- Orange Labs invitation as Industrial Advisor
  - In progress

- We will build upon our experience with FP6 Haggle, MOTEL (**SUPSI internal project**), and FP7 SCAMPI testbeds.

- PRIVA'MOV project (IMU LABEX), **Marco Fiore (CNR) implication**
  - *Goal:* to develop and deploy a privacy-aware crowdsensing platform to collect mobility traces from real users equipped with android tablets
  - Collaboration already started
  - MACACO will share data collection and analysis experiences with PRIVA'MOV participants

Issues encountered if any

- **No specific issues have been encountered so far.**

- Main risk highlighted in the proposal are related to a delayed real-world data collection

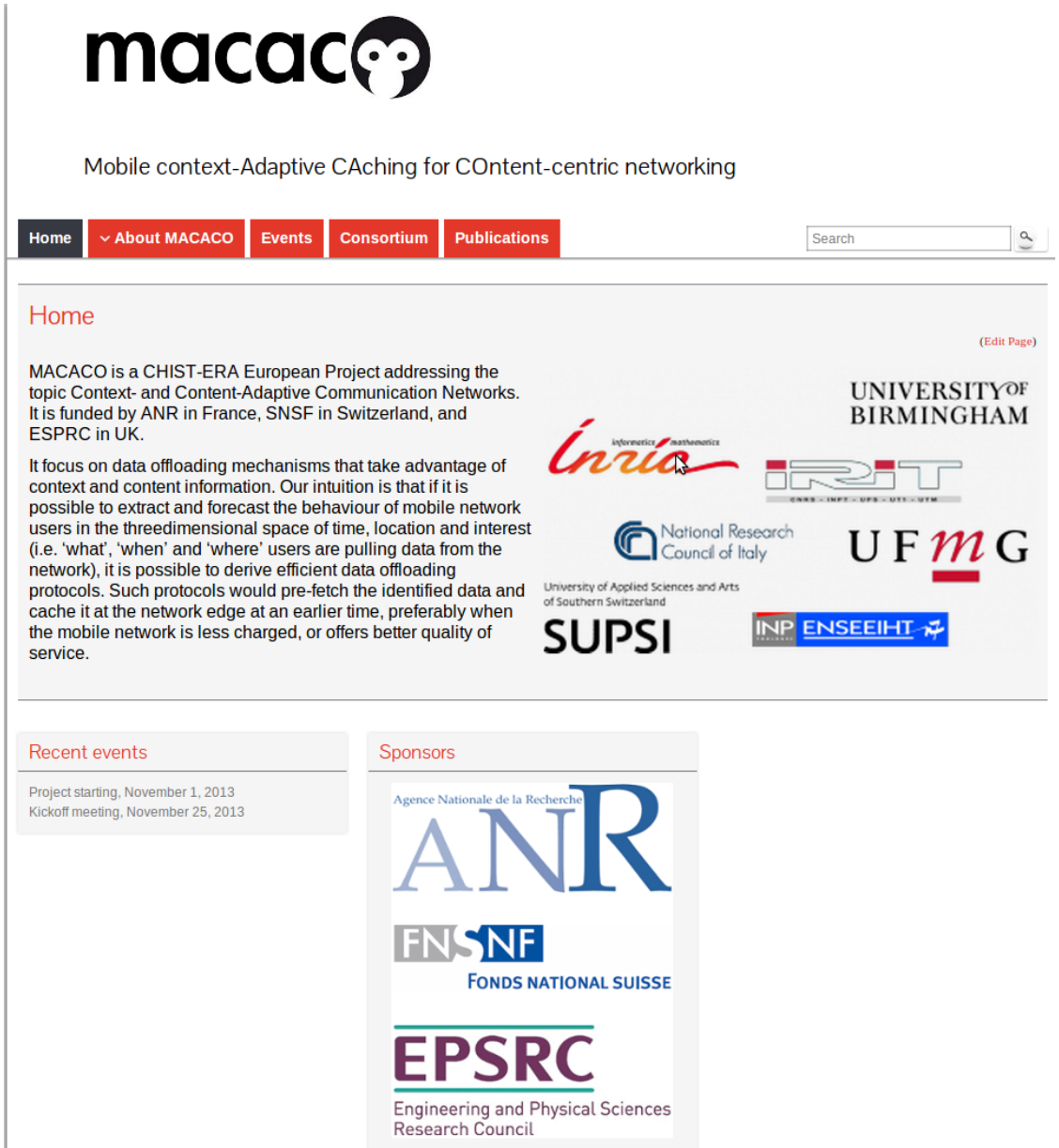
- Currently, the outcome of Task 1.1 of WP1 is in line with the proposed timetable.

Thus, the data collection phase should be started as expected in the upcoming months.

MACACO publications

1. D. Naboulsi, R. Stanica, M. Fiore, *Classifying Call Profiles in Large-scale Mobile Traffic Datasets*, **IEEE INFOCOM**, April 2014
2. Eduardo Mucelli Rezende Oliveira, Aline Carneiro Viana, *Routine-based network deployment for data offloading in metropolitan areas*. **IEEE WCNC,** April 2014
3. Eduardo Mucelli Rezende Oliveira, Aline Carneiro Viana, *From Routine to Network Deployment for Data Offloading in Metropolitan Areas. **INRIA RR-8452**. 2014*.
4. Eduardo Mucelli Rezende Oliveira, Aline Carneiro Viana, Routine-based Network Deployment, **IEEE INFOCOM Student workshop**, April 2014
5. Anna Förster, Alexander Förster, Kamini Garg, Silvia Giordano and Luca M. Gambardella; "MOTEL: Mobility Enabled Wireless Sensor Network Testbed", **Ad Hoc & Sensor Wireless Networks, Old City Publishing**, 2014.
6. Kamini Garg, Silvia Giordano and Anna Förster; "A Study to Understand the Impact of Node Density on Data Dissemination Time in Opportunistic Networks"; **HP-MOSys,** November 2013.
7. Matteo Zignani, Michela Papandrea, Sabrina Gaito, Silvia Giordano and Gian Paolo Rossi; "On the key features in human mobility: relevance, time and distance"; **IEEE PERCOM,** March 2014
8. Steven Mudda, Silvia Giordano; "Mobile P2P Queries over Temporal Data"; **IEEE PerMoby,** March 2014.
9. Alan Ferrari, Daniele Puccinelli, Silvia Giordano; "Code Offloading on Opportunistic Computing"; **Demonstrations track, IEEE PERCOM,** March 2014

MACACO web site: *macaco.inria.fr*



Any questions?