

Performance Evaluation of Mobile Network Technologies for Reliable M2M-Applications in Automation

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„Leistungsfähigkeit von Internetzugangstechnologien für zuverlässige M2M Anwendungen“

- ❑ Short description: M2M@work
- ❑ Project duration: 01.04.2013 - 31.07.2015
- ❑ Research facility:
 - Institut für industrielle Informationstechnik (inIT) der Hochschule Ostwestfalen-Lippe
 - Institut für Automation und Kommunikation e.V. Magdeburg
- ❑ Committee accompanying the project. :

SIEMENS

**PHENIX
CONTACT**

ZVEI:
Die Elektroindustrie

regiocom

MAC
System Solutions

Innominate
Security Technologies

SBSK
DATEN + INFORMATIONSSYSTEME

Gefördert durch:



Bundesministerium
für Wirtschaft
und Energie

aufgrund eines Beschlusses
des Deutschen Bundestages

1. Introduction

- Definition of M2M
- Requirement of industrial automation applications

2. Model Approach

3. Measurement setup

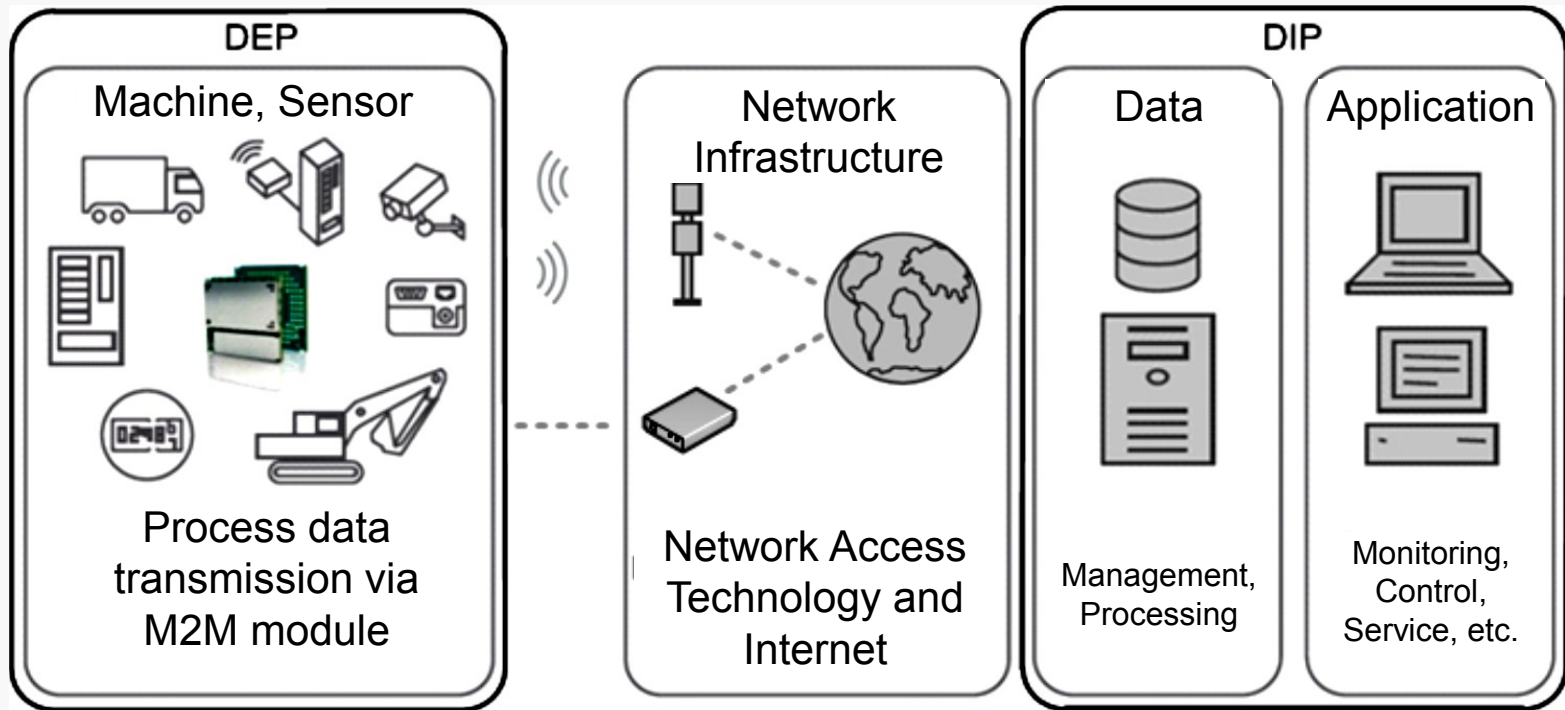
4. Measurement results

5. Conclusion

Machine-to-Machine Communication

□ Typical structure of M2M Application*

- DEP: **Data-End-Point**
- DIP: **Data-Integration-Point**



*Denzin, F.: "M2M im GSM-Netz: Anforderungen an Mobilfunkterminals". M2M Kompetenztage, 2010

Requirement of industrial automation applications

- Requirements from the perspective of the industrial automation application

Applications	Transmission Time [ms]	Packet loss rate	Classification
Mobile Operator, Safety	10 – 20	10^{-9}	Very Critical
Control of machine and closed-loop control	10 – 20	10^{-9}	Critical
Open-loop control	20 – 30	10^{-9}	Critical to Uncritical
Mobile operation and monitoring	> 100	10^{-3}	Uncritical
Monitoring and Diagnostics	> 100	10^{-4}	Uncritical

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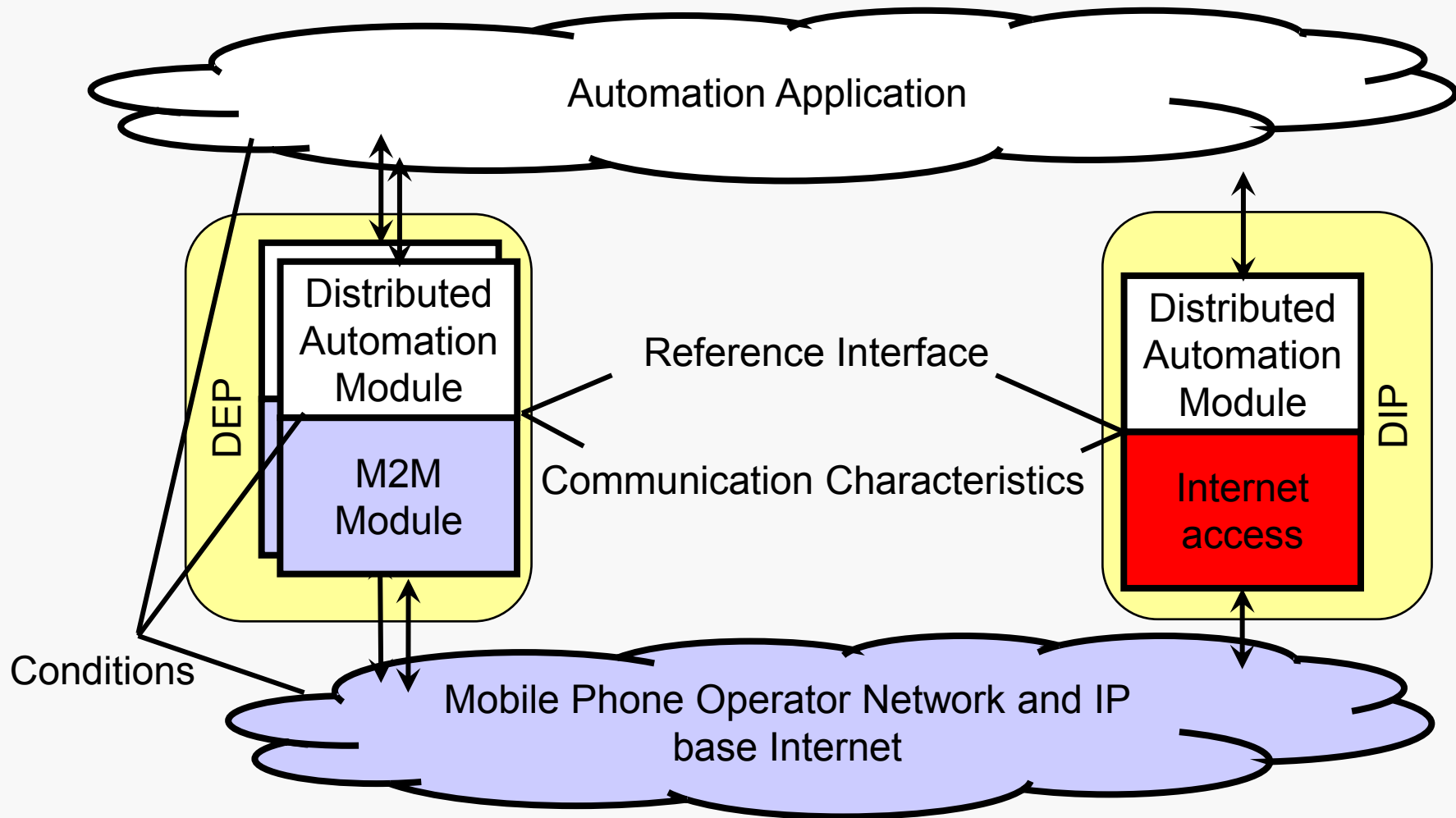
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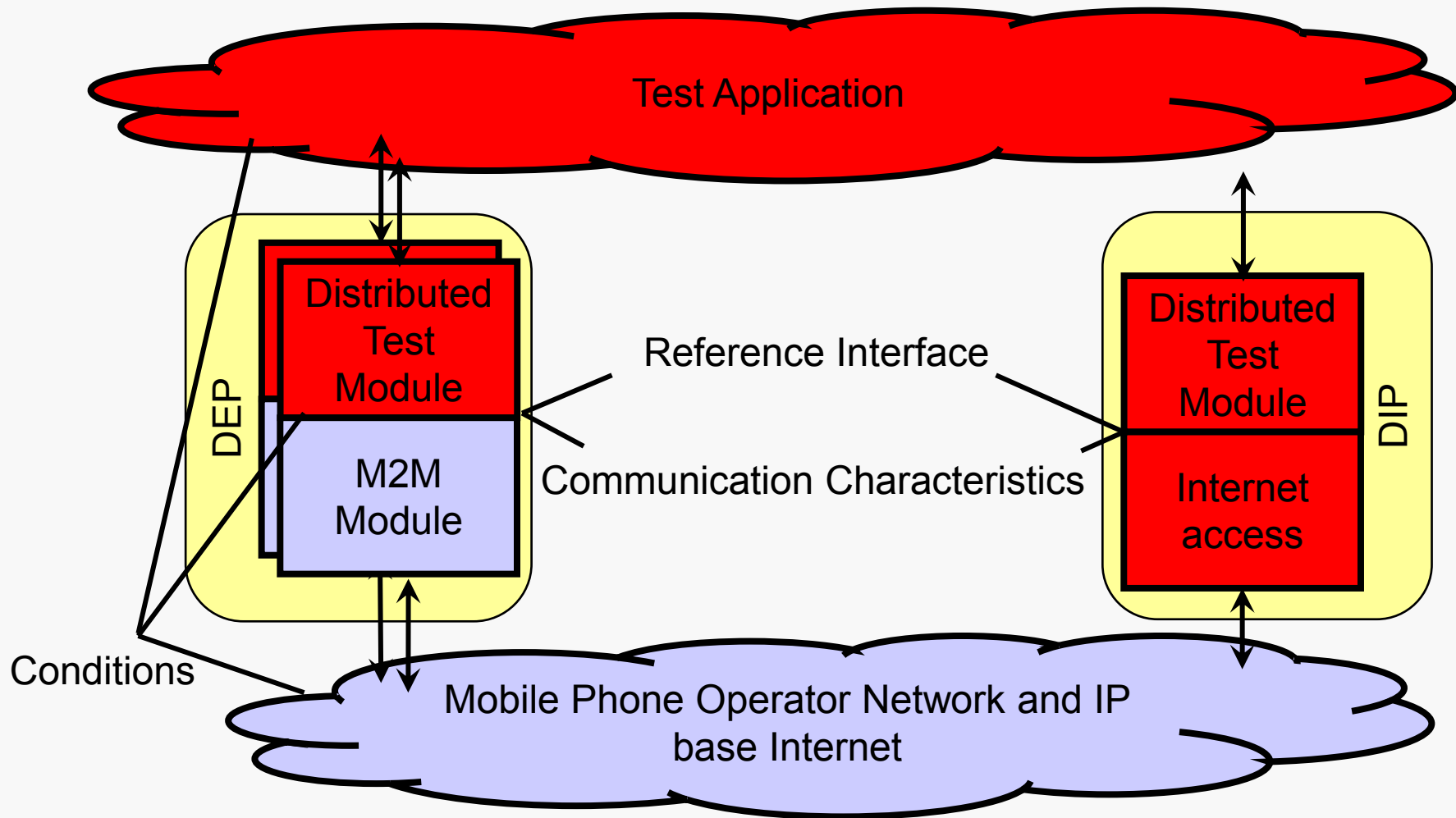
Model requirements

- ❑ A user of an industrial communication system expects a **certain process value** at a **certain interface** within a **defined time frame** without any **errors** under **defined conditions**.
- ❑ Currently there is **no general M2M standard** available for industrial automation which fits to all communication tasks.
- ❑ A **unified interface** between communication and application is **not available**.
- ❑ The **model must be independent** of a certain M2M technology and the **model must be open** for future developments in M2M communications.
- ❑ The **model** should represent the **conditions of reality** as **accurate** and **complete** as possible and necessary.

Model approach

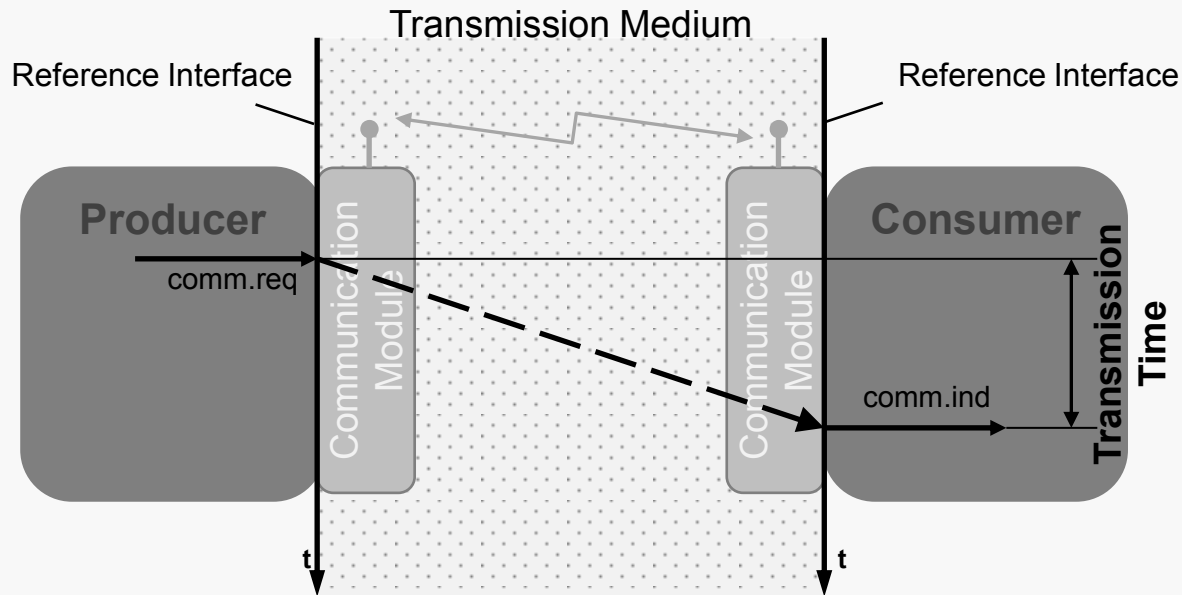


Model approach



Characteristic parameter

Transmission Time:



Packet Loss Rate:

$$PLR = \frac{N_{PL}}{N_{TX}} = \frac{N_{TX} - N_{Rx}}{N_{TX}} = 1 - A$$

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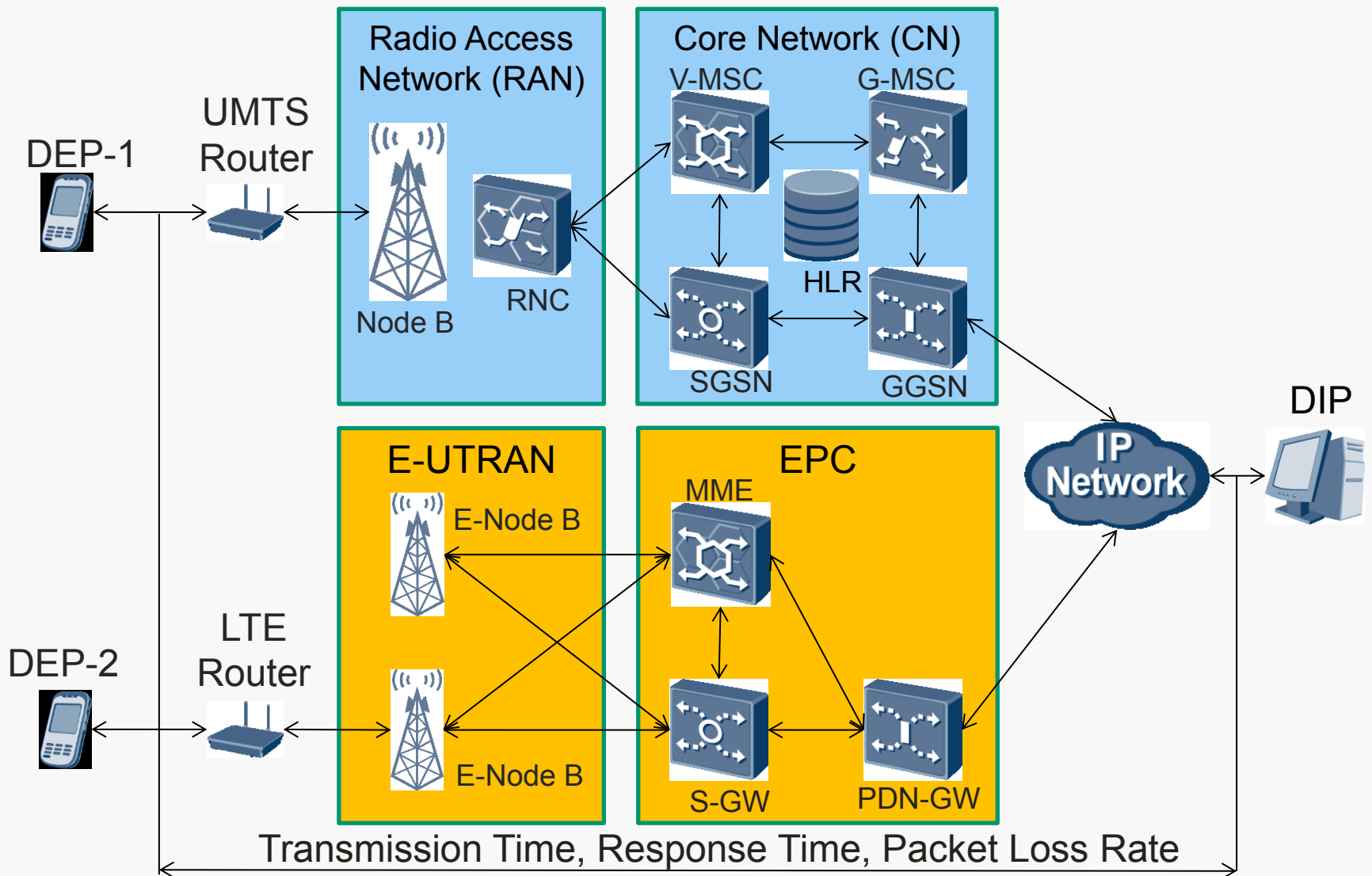
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Measurement Setup



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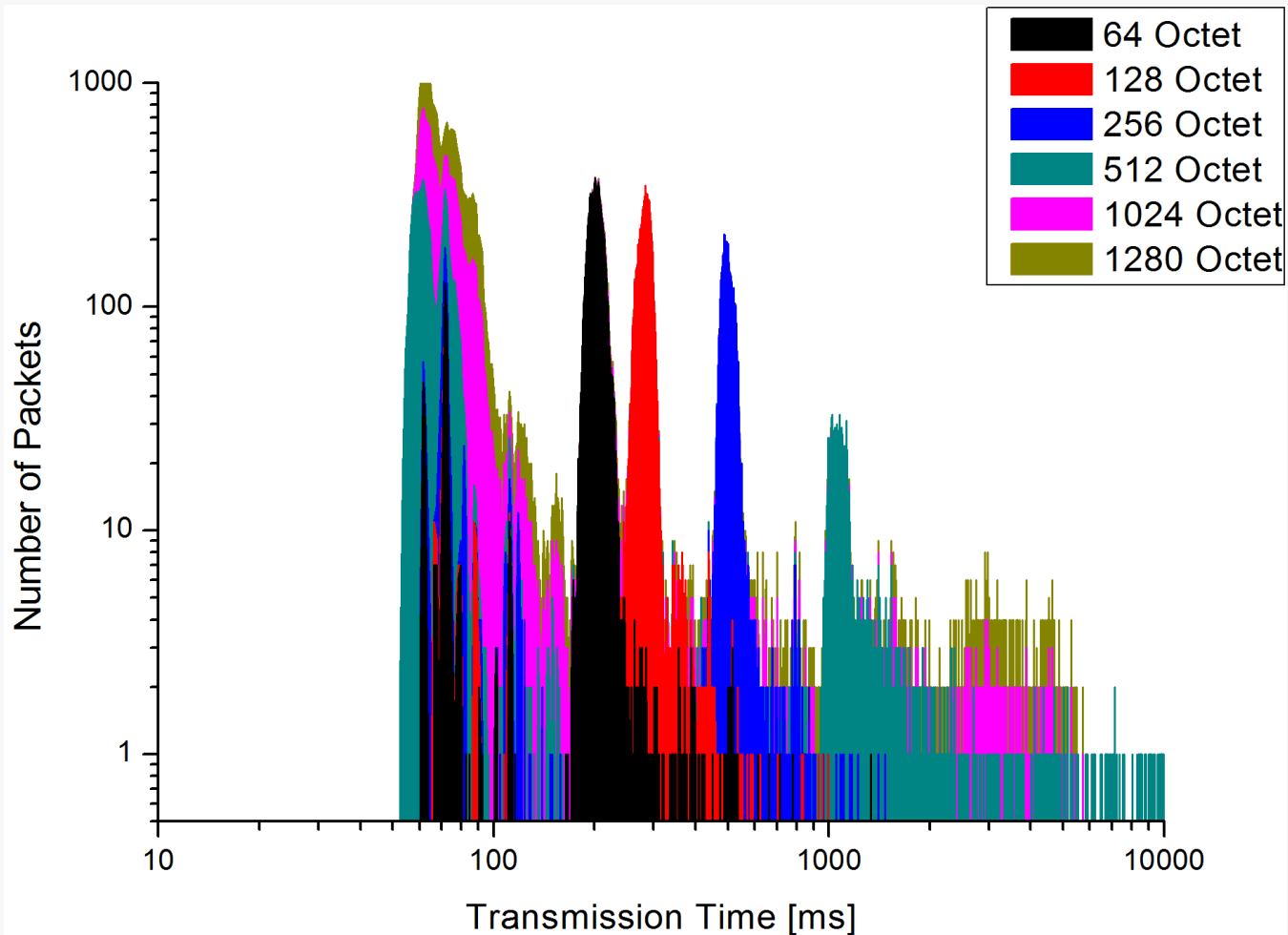
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4. Measurement results

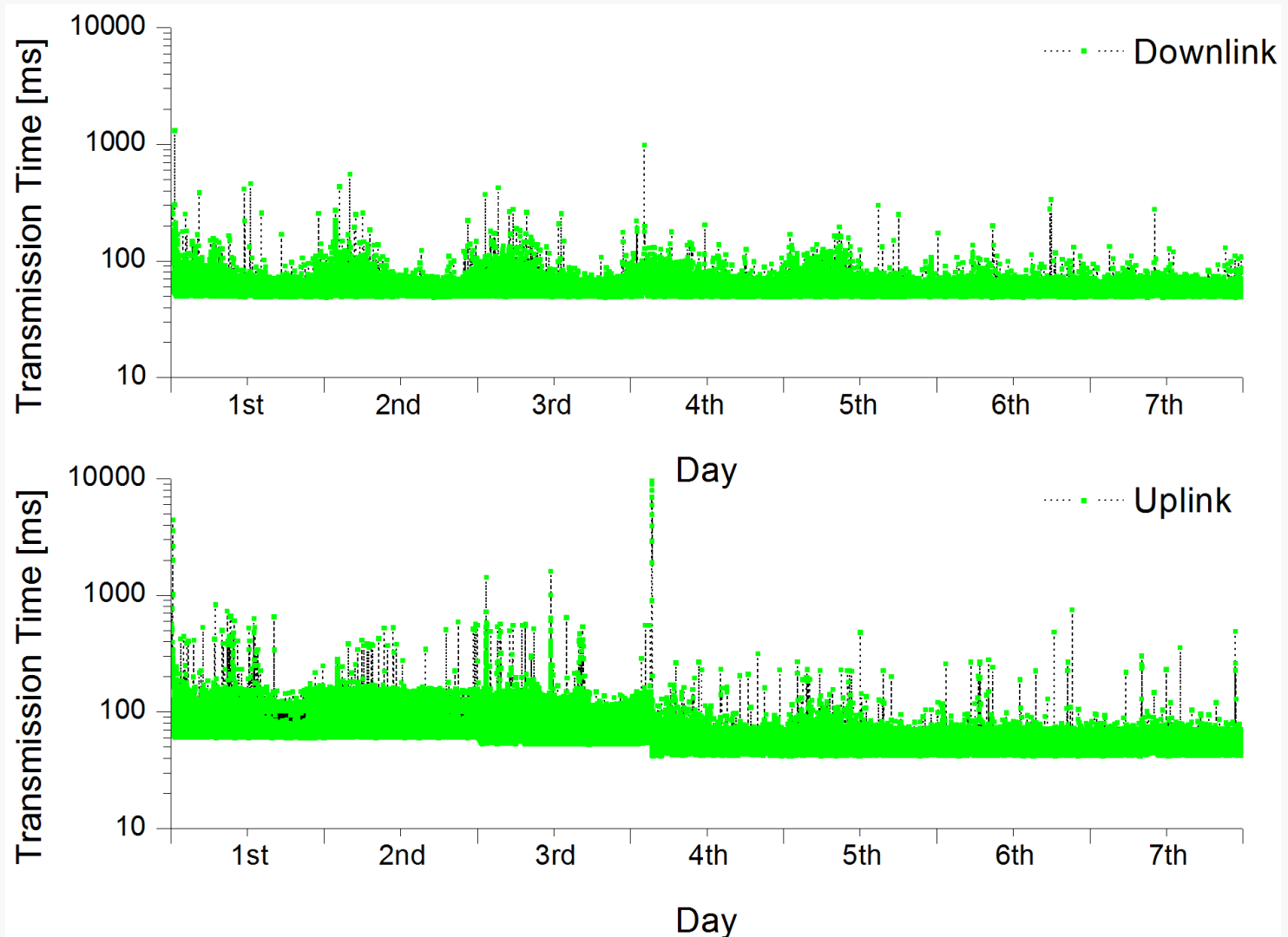
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Measurement results UMTS: Packet Length

- Transmission time in uplink direction (from DEP to DIP)
- Transmission interval: 1 s



Measurement results UMTS: Duration 1 Week

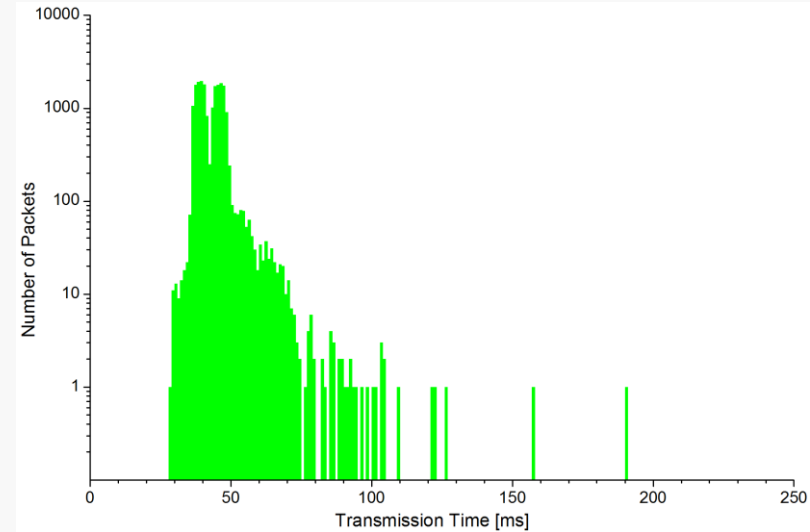
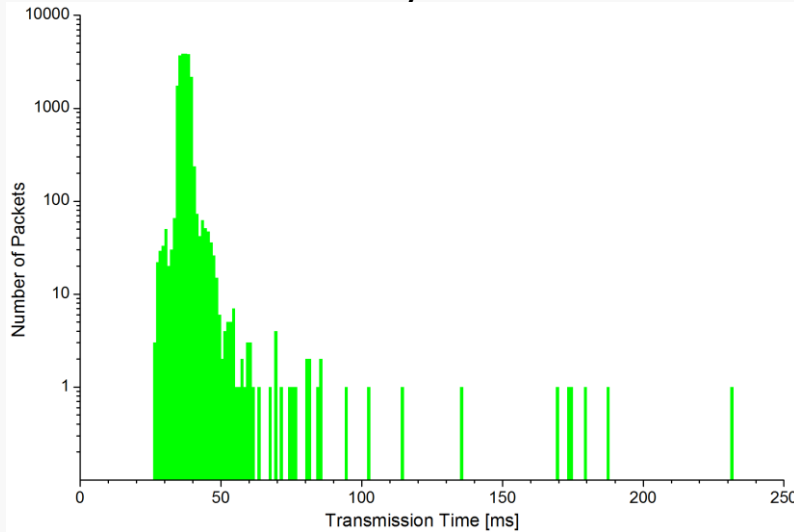


Measurement results LTE

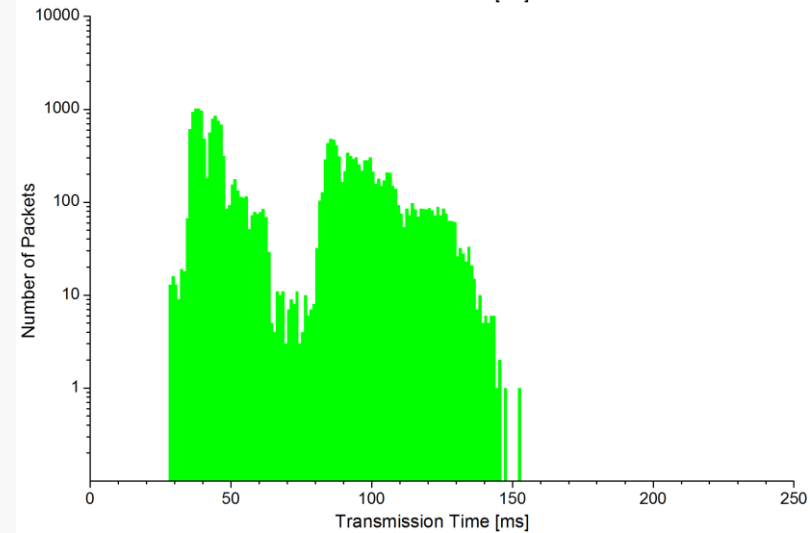
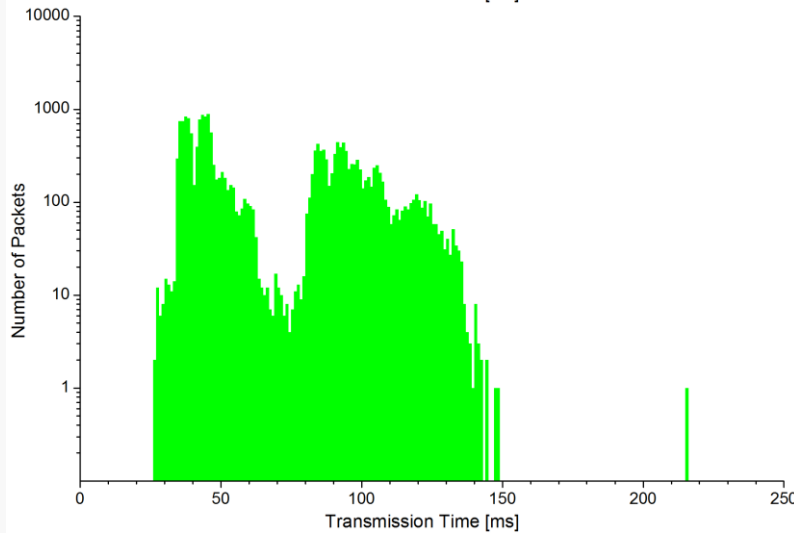
128 Byte

1024 Byte

100 ms



500 ms



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Promising developments:

- LTE Advanced, 5G, Machine-Type Communication