

# The usage of mainstream technologies for public safety and security (PSS) networks

Master's Thesis  
Helsinki University of Technology

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1

## Background

- Replacement of over-aged analogue systems
- TETRA is the only ETSI standard for PSS users
- Economic downturn
  - Governments are forced to cut expenses
  - Operators are seeking for new markets
- Technology comparisons done in Scandinavia and Germany
  - Different conclusions
- Main PSS-user requirements are related to group calls
  - Thesis concentrates on group call functionalities

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2

# GSM versus TETRA

## Pros of GSM with ASCI features:

- + Existing radio coverage
- + Cheap mainstream network elements
- + Sharing of resources

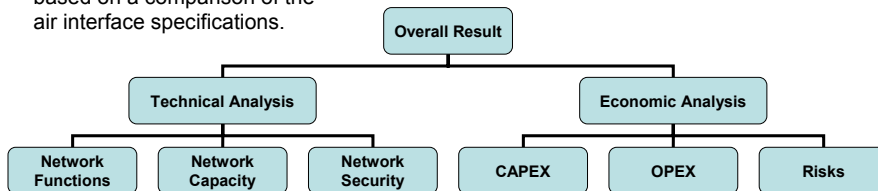
ASCI = Advanced  
Speech Call Item

## Cons of GSM with ASCI features:

- Missing functionality
  - Group messaging
  - Group scanning
  - Speech item priority
  - Direct mode
  - Base station fallback
  - Shifting group call area
- Security arguments
  - Limited authentication
- Technology risk

# Analytic Hierarchy Process

Technical analysis is partly based on a comparison of the air interface specifications.



## Discussed scenarios:

1. New network based on TETRA technology
2. Existing GSM network completely upgraded with ASCI features
3. Existing GSM network partly upgraded with ASCI features (due to cell overlapping)



# Push-To-Talk Functionality

Basically a point to multi-point communication

The end-users expect the same functionality as for conventional PMR systems (open channel).

No keyboard dialling on active groups.

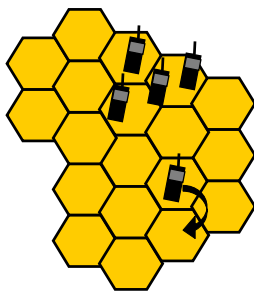
Quasi-transmission trunking requires fast call set-up times (<0.5s), otherwise open channel communication has to be used.

Group call set-up times:	TETRA:	<0.5s
	GSM ASCI:	2...5s

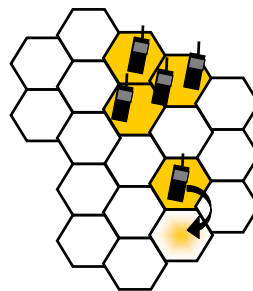
# Shifting Group Call Area

Traffic channels are only allocated to sites, where group members are located.

Cell changes have to be supported.



Fixed group call area



Shifting group call area

# Technical Analysis

The results are clearly in favour of TETRA

## Network functions:

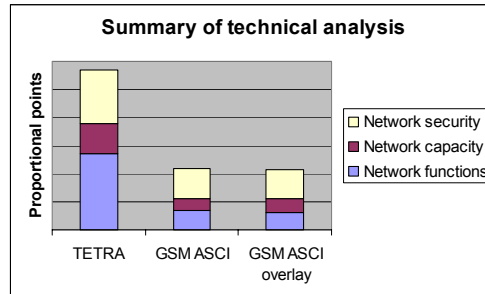
Priority scanning, speech item priority, group messaging, direct mode and base station fallback are not supported by GSM ASCI.

## Network capacity:

Call set-up times and shifting group call area have major impact.

## Network Security:

Authentication and AIE are partly omitted for GSM ASCI.

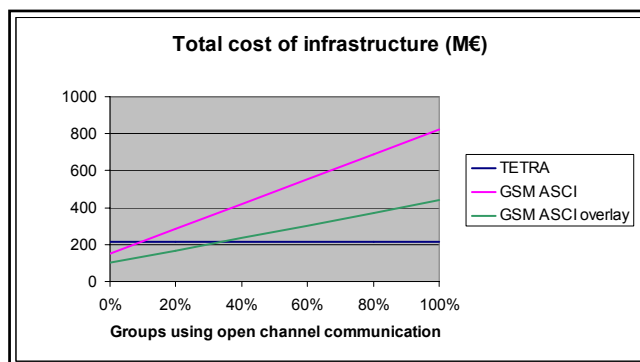


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7

# Open Channel versus Trunking



The graph shows network CAPEX assuming an average group call area of 400km<sup>2</sup>.

If call set-up times do not fulfil the requirements, open channels have to be used.

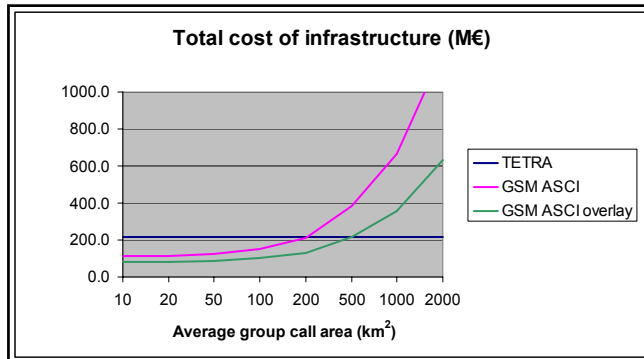
⇒ Low channel efficiency increases CAPEX and OPEX dramatically!

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8

# Effect of Group Call Area



The graph shows network CAPEX assuming that 25% of the groups use open channel communication.

If shifting group call area is not supported, the group calls need to be transmitted also on sites without group members.

⇒ Low channel efficiency increases CAPEX and OPEX dramatically!

# Risk Considerations

## Main risks on GSM ASCI mobile terminals:

No mature products are existing.

Possible SW upgrade of existing terminals cause high costs.

Major features are missing (DMO, scanning, fast handover and packet data).

Infrastructure risks are mainly caused by non-existing functionalities and network rollout capabilities.



GSM ASCI terminal



TETRA terminal

# Economic Analysis

## CAPEX:

- End-user equipment
- Network infrastructure (additional transceivers for GSM ASCI)

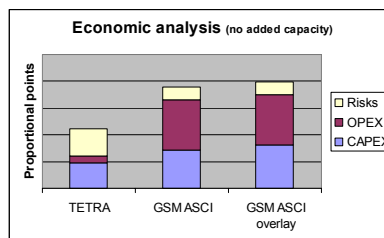
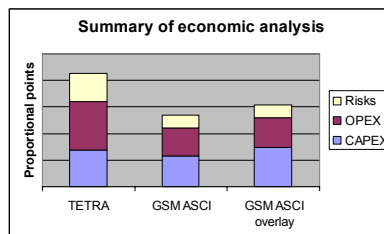
## OPEX:

- Transmission costs
- Site costs

## Risks:

- Network infrastructure
- Mobile terminals
- Dispatching stations

2<sup>nd</sup> scenario describes the performance, if the existing GSM capacity is sufficient to carry the traffic caused by PSS users.



# Summary & Conclusions

Technical advantages of TETRA are functionalities which are not available in mainstream (also not in the near future).

Economic advantages of TETRA are mainly based on:

- Low bandwidth
- Large cells
- Shifting area group call
- Fast call set-up times

**Study compares only group calls which cause ~80% of the load in PSS networks.**

