



**HPS Topical Meeting, Augusta 2004**

**Adequate Technologies for  
Wireless Real-time Dose Rate Monitoring  
for Off-site Emergency Management**

**Rainer Dielmann**

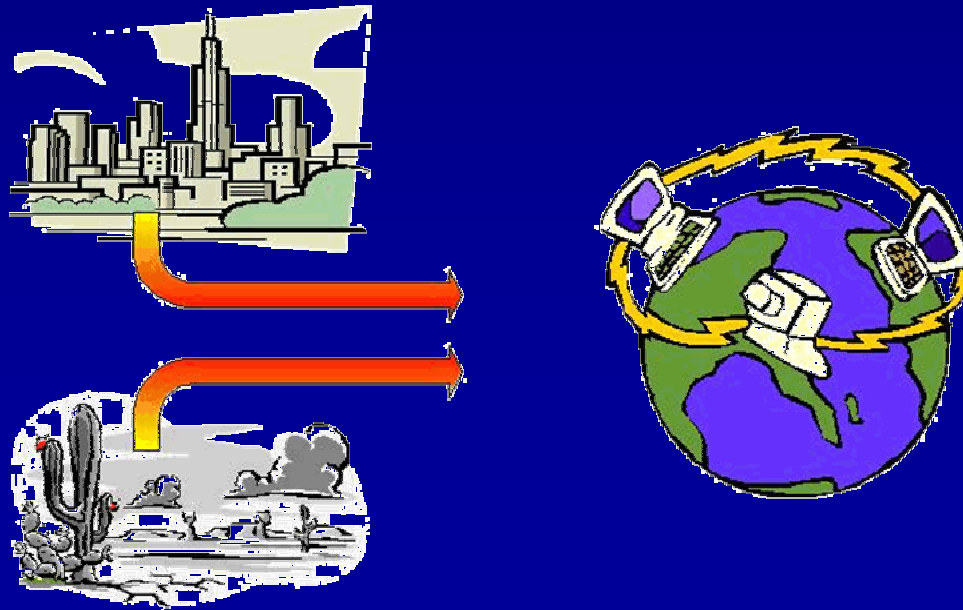
**Genitron Instruments GmbH, Germany**

<b>Rainer Dielmann</b>	<b>phone : +49-69-97651423</b>	<b>rdielmann@genitron.de</b>
<b>Walter Bürkin</b>	<b>phone : +49-69-97651415</b>	<b>wbuerkin@genitron.de</b>
<b>Bill Tucker</b>	<b>phone : 770-642-8529</b>	<b>phoenixsales@mindspring.com</b>

# Purpose of Work :

Development of wireless technologies adequate for autonomous environmental monitoring systems, specially for

- Emergency preparedness
- Continuous surveillance



# Summary / Overview

- **Design objectives of wireless systems for NS/EP (National Safety / Emergency Preparedness)**
- **Requirements for dose rate monitoring systems**
- **Pros and cons of available technologies**
- **Experience with field deployed systems**
- **A mobile monitoring system for emergency use**

# **Wireless Systems for Emergencies : What are the Problems ?**

- Commercial public lines may be busy. How can availability of the transmission link be guaranteed ?**
- Electrical power may be down in large area, interfering with communication infrastructure**
- Mobility needs light-weight and battery-operated equipment**
- Equipment must be quickly to set and easy to use**

# Lots of Money is Invested in Wireless Infrastructure for NS/EP



**Main design objective : Human communication !**

**Useability for environmental monitoring ?**

# Different Design Objectives

**Environmental monitoring**

**vs.**

**Emergency personnel communications**

**Low baudrate**

**High baudrate required for multimedia / video transmission**

**Simple connection scheme**

**Speech requires complex connection schemes (point-point / multipoint)**

**Ultra low power is advantageous**

**1 day battery operation is sufficient**

# Design Objectives for Environmental Monitoring Systems

- Efficient operation under normal conditions (continuous monitoring)
- Reliable operation in emergencies

**"One size fits all"**

**Not possible !**

# Requirements for Dose Rate Monitoring Systems

	Continuous monitoring of facility or backcountry	Mobile emergency monitoring systems
Area coverage	+++	+++
Low regular fee for communication	+++	-
Availability in emergencies	+...+++	+++
Light weight / high mobility	+	+++
Ease of use, quick setup	+	+++
Independancy of mains power	+	+++

# Wireless Technologies Overview

**Public cellular networks (CDMA, GSM, GPRS, UMTS)**

**Satellite solutions**

**TETRA, P25**

**Standardized local networks (WLAN, Bluetooth)**

**ShortLINK, SRD radios (Short Range Devices)**

**SkyLINK wireless environmental monitoring**

# Public Cellular Networks (CDMA, GSM, GPRS, UMTS)

**Coverage** : Good in urban area, poor in rural area

**Availability in emergencies** :

- Big area power blackout will influence availability
- WPS (Wireless Priority Service) available for NS/EP personnel (USA only)
  - 5 priority levels
  - Next free channel goes to highest priority caller
  - 25% of base station capacity avail. for WPS users

# GSM Coverage USA



# Satellite Solutions



**Coverage :**

**Very good**

**Availability in emergencies :**

**Very good**

**Operation cost :**

**Very high**

**Battery operation :**

**A few days**

# TETRA, P25

**TETRA :** Terrestrial Trunked Radio (European std.)

**P25 :** Project 25 (Telecommunications Industry Association, TIA, USA only)

**Topology:** Single basestation or multicell network

**Coverage:** Will be good in cities (if available)

**Availability in emergencies :** Very Good

Setup of infrastructure very expensive, no commercial interest. Depends on government funding !

# Standardized Local Networks (WLAN, Bluetooth)

**Frequency :** 2.4 GHz

**Coverage :** WLAN : max 1000 m / 3000 ft  
Bluetooth: max 100 m / 300 ft

**Battery operation :** A few days (WLAN)

**Technologies optimized for high throughput, not for distance !**

# ShortLINK, SRD radios

- Frequency :** 868 MHz (EU), 902 MHz (US)  
up to 500 mW
- Area coverage :** Up to 5 km / 3 mi distance
- Availability in emergencies :** Very good
- Operation cost :** Low (no regular fee)
- Battery operation :** A few years possible
- Mobility :** Very good

# SkyLINK Wireless Environmental Monitoring

<b>Frequency :</b>	<b>400...500 MHz, P = 10 mW</b>
<b>Topology :</b>	<b>Star, 1 base station + n unidirectional transmitters</b>
<b>Area coverage :</b>	<b>Up to 100 km / 60 mi distance</b>
<b>Availability in emergencies :</b>	<b>Very good</b>
<b>Operation cost :</b>	<b>Low (no regular fee)</b>
<b>Battery operation :</b>	<b>Up to 10 years</b>
<b>Mobility :</b>	<b>Very good</b>

# Pros and Cons Comparison

	Public Cellular networks	Satellite solutions	WLAN Bluetooth	ShortLINK SRD radios	TETRA P25	SkyLINK
Coverage (urban area)	+++	+++	---	-	+...+++	+...++
Coverage (rural area)	-	+++	---	-	-...+	++
Availability in emergencies	(+++) using WPS	+++	+++	+++	+++	+++
Annual operation cost (TCO)	-	---	+++	+++	?	+++
Mobility / Size	+++	+	+	+++	+	+++
Ease of use	+	+	-	+++	+	+++
Independancy of mains power	+	-	-	+++	+	+++

# Experience Report

**Establishment of an early warning system around the KURSK, KALININ and BALAKOVA NPPs in RUSSIA and connection to MOSCOW crisis center**

**Date of Installation :** October 2000

**Technology :** SkyLINK wireless system + GammaTRACER probes

# Pictures of NPPs



NPP of Kalinin, Russia

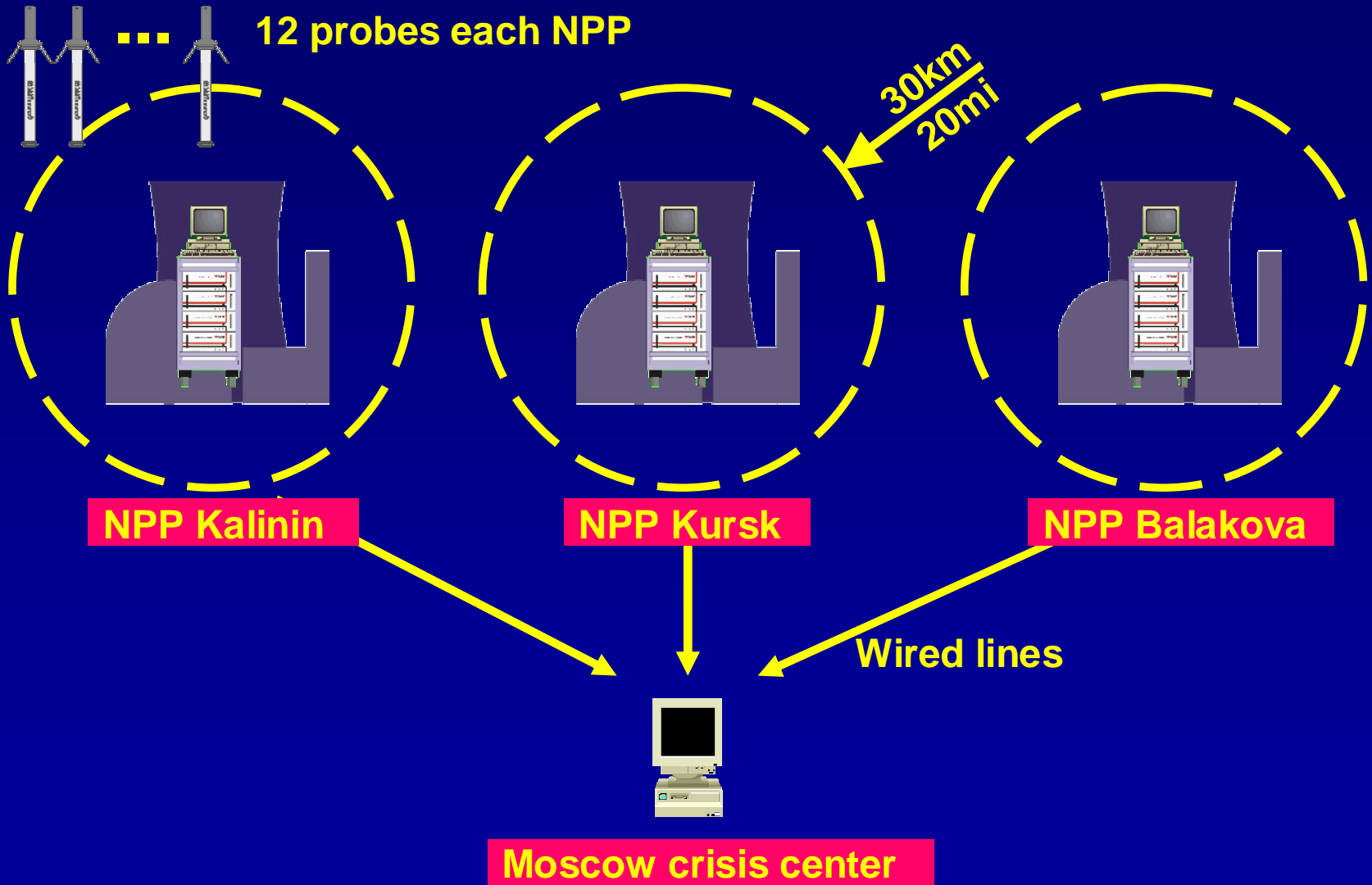


NPP of Balakovo, Russia



NPP of Kursk, Russia

# System Topology



# Installation Details

**Installation of probes :**

**NPP personnel installed  
12 probes in 2 days**

**Installation of base station  
and IT infrastructure :**

**3 days each NPP (incl.  
training)**



# Result After 3 Years Operation

**Function of probes :** 100 %

**Availability of communication :** 100 %

**Cost for maintenance / transmission fee :** 0  
(battery exchange required in 2004)

**Comment of Rosenergoatom :**

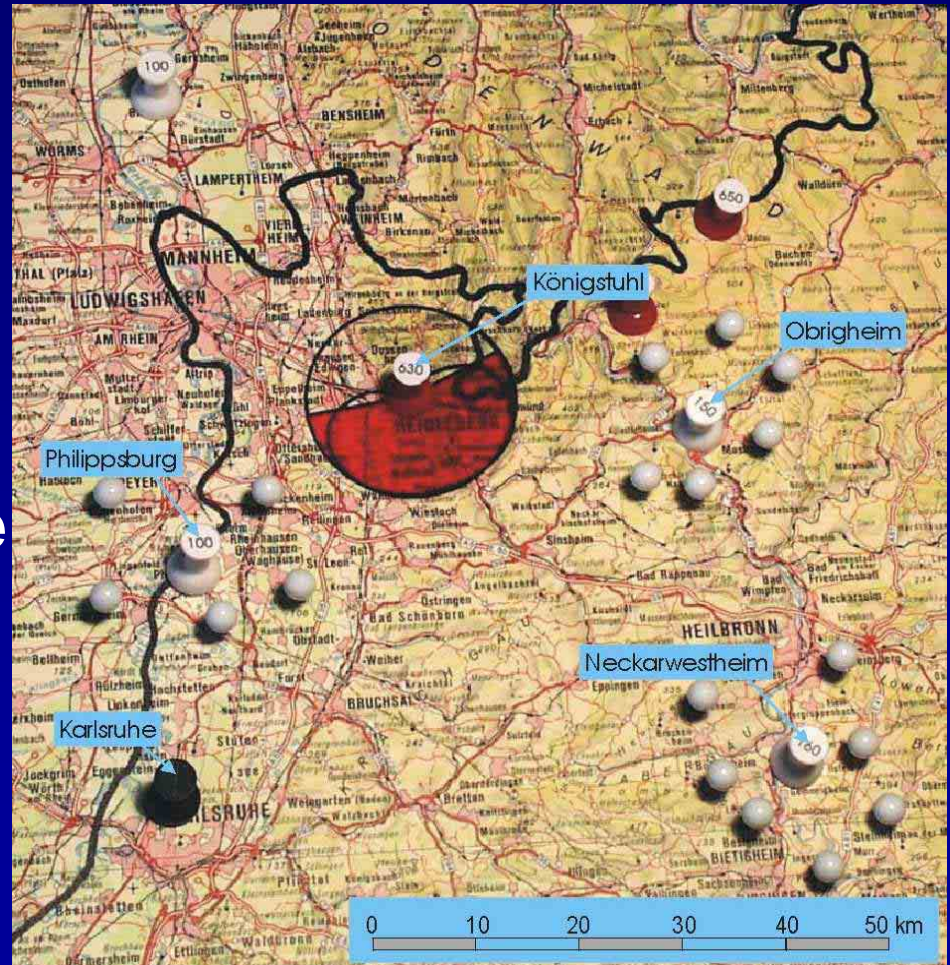
„... In the same time period other systems installed at the other Russian NPPs periodically failed, due to power supply problems“

# Other SkyLINK Installation Example :

Germany : Baden Württemberg County, NPP Remote surveillance network

45 probes  
GammaTRACER

80 km / 50 mi distance

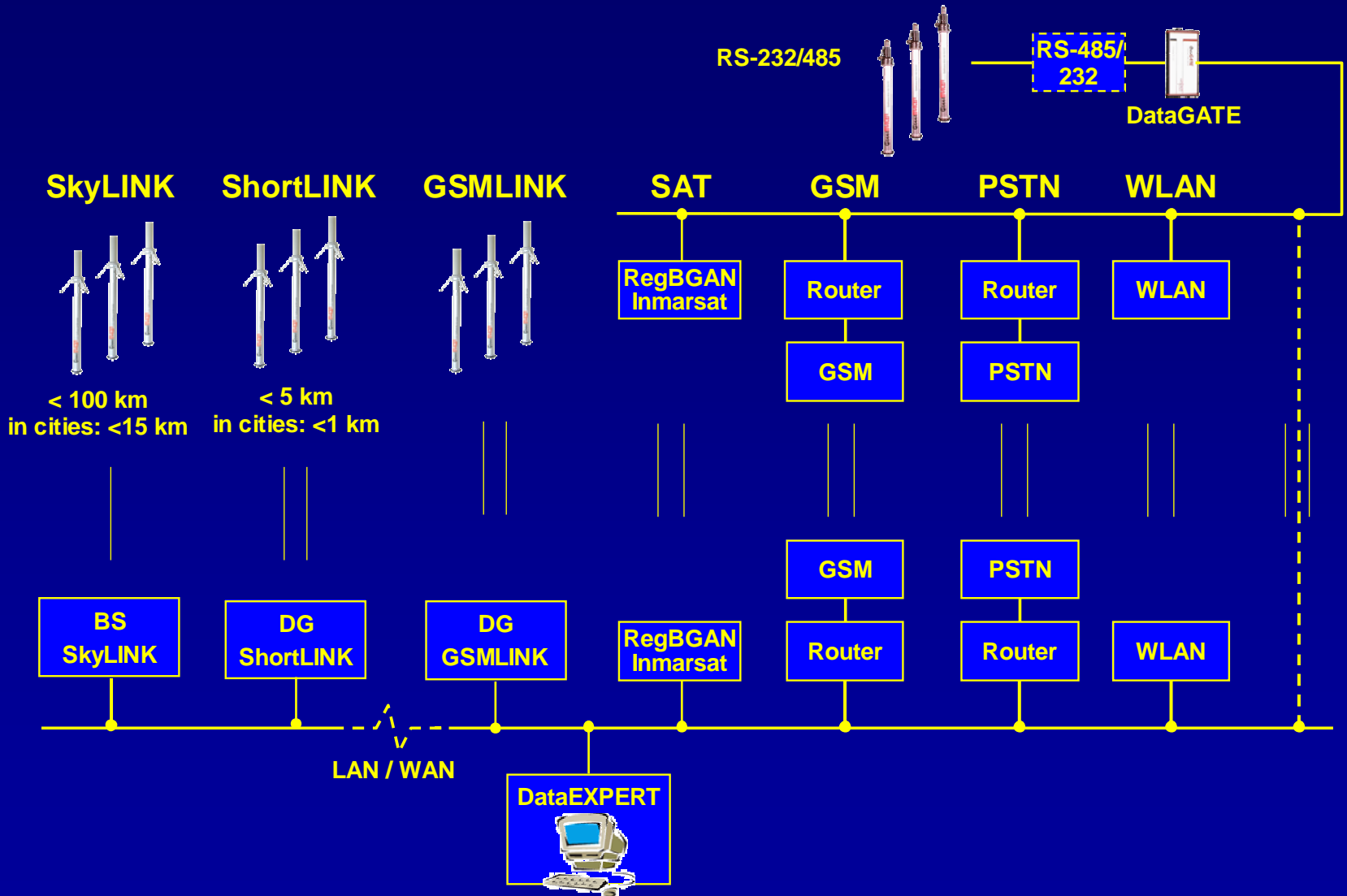


# GammaTRACER : Reliable Dose Rate Measurement in Harsh Environment



- Operation range is from  $-40^{\circ}\text{C}$  /  $-104^{\circ}\text{F}$  up to  $60^{\circ}\text{C}$  /  $140^{\circ}\text{F}$
- Instruments in operation : 1400 worldwide, 150 in USA
- Tested at 11<sup>th</sup> Intl. Intercomparison DOE / EML 1996/97

# GammaTRACER interface options



# SkyLINK compact : A Mobile System for Emergency Use

- Setup in 5 min
- Proper operation in cities :  
5...15 km (3...10 mi)
- Adaptable to any instrument



# Conclusion

- Technologies have different advantages
- To be chosen according to individual needs

**SkyLINK technology for both tasks :**

**Continuous monitoring and  
Emergency management in early and later phase**

**ShortLINK ideally suited, if only short distance  
required**

**Reliability proven in many installations !**