Selex Systems Integration GmbH
Company Presentation

Dr. Monika Pfeifer
Manager Marketing & Sales
Leader in Weather Radar Technology and Meteorological Systems

Key Figures
- Turnover: ~ 30 Mio. €
- > 90% export
- Employees: ~ 155 staff, mainly engineers, meteorologists and skilled technicians
- Over 250 radars installed in 60 countries on all continents
- R&D in Hardware & Software
- Own Labs and Test Ranges
- Own Production and Training Facilities
- 24 hr permanent operation
- Unattended operation
- ISO 9001 certified since 1996
Leader in Weather Radar Technology and Meteorological Systems

Mission

• Technological Leadership in Weather Radar and Integrated Meteorological Systems

Products

• Doppler Weather Radar Systems in C-, S- and X-Band
• Wind Shear Detection Systems
• Meteorological display and analysis software
• Integrated Meteorological Systems (Radar Networks, Sensor Fusion)
Company History

**Service & Support**
Provide service and support for ATS radars produced by Raytheon and Alenia

**METEOR 200**
- Internal design and sale of 1st Generation Doppler radar systems

**METEOR 360**
- 2nd Generation of Doppler weather radar systems introduced to the market. Over 100 systems delivered

**METEOR 500 / 1500**
- 3rd Generation of Doppler weather radar systems introduced to the market. Includes magnetron and klystron transmitters.

**METEOR 600 / 1600**
- 4th Generation of Doppler weather radar systems introduced to the market. Includes magnetron and klystron transmitters.

**1961**
- Gematronik founded

**1984**
- Gematronik joins Alenia / Finmeccanica Group

**1992**
- Gematronik acquired by AMS Ltd. Becomes part of ATMAS Division

**1993**
- Gematronik is fully acquired by Finmeccanica Group and renamed SELEX Sistemi Integrati

**1998**
- Meteorological Centre of Excellence within Finmeccanica Group

**2001**
- METEOR 50DX
  - New generation of dual polarized mobile weather radar systems using X-Band

**2005**
- METEOR 50DX

**2006**
- METEOR 50DX

**2009**
- METEOR 50DX

**Integrated Solutions**
- Service Provider
- Hardware Provider
- Turnkey Systems
- Integrated Solutions
**METEOR SYSTEM - Highlights**

**System**
- Design rights & capabilities on key components & technologies
- Perfect integration and optimisation
- Full support expertise on component-, interface- and system-level

**Hardware**
- Antenna with rapid-scan pedestals & drives
- Transmitter with solid-state modulators
  ( ~ 130 systems up to now)
- Graceful degradation (M635C only)
- More than 100 digital receivers installed, ultra-low noise, wide dynamic range

**Software**
- A network-centric design makes all sub-systems transparent to the outside world
- Maintenance and software upgrades from all remote locations

**SDR - Software-designed architecture:**
METEOR SYSTEM - Highlights II

**Highest Data Acquisition Rates:**
- High-speed scanning antennas
- Solid-state modulator enable optimum pulse width/repetition rates
- Maximum performance of digital receiver and data processing

**Norms**
- Compliance to latest EU Directives:
  - Improved mechanical safety: Risk analysis and safety system acc. ISO 12100 ensures max. human safety during maintenance.
  - Production complies to latest Environmental EU Directives, i.e. 2002/95/EC (RoHS)
  - Only MAK certified radar available

**Quality**
- QM-System acc. to ISO 9001 in place since 1996 as first weather radar manufacturer
- High-skilled technicians and engineers
Worldwide Customer Base

- >250 weather radar systems
- >60 countries worldwide
- Single systems
- Country-wide networks

**Customers**
- NWS: 52%
- Aviation: 25%
- Research: 10%
- Military: 9%
- Misc: 4%

**Americas**
- Argentina
- Barbados
- Belize
- Bermuda
- Brazil
- Canada
- Colombia
- Dominican Rep.
- Guadeloupe
- Guyana
- Martinique
- Mexico
- Trinidad & Tobago
- USA
- Venezuela

**Europe**
- Austria
- Bulgaria
- Estonia
- Germany
- Italy
- Netherlands
- Portugal
- Serbia
- Turkey
- Belarus
- Czech Rep.
- Finland
- Iceland
- Latvia
- Norway
- Romania
- Spain
- Ukraine
- Belgium
- Denmark
- France
- Ireland
- Malta
- Poland
- Russia
- Switzerland

**Asia**
- China
- India
- Indonesia
- Kazakhstan
- Korea
- Macao
- Malaysia
- Singapore
- Taiwan
- Thailand
- Uzbekistan

**Middle East**
- Iran
- Iraq
- Kuwait
- Qatar
- Saudi Arabia

**Africa**
- Cameroon
- Congo
- Mali
- Mozambique
- Libya
- Reunion
- Senegal
- South Africa
- Togo
- Tunisia
Some Weather Radar Installations Worldwide

Zoufplan, Italy
Ken Ting, Taiwan
Adelaide, Australia
Surabaya, Indonesia
Barbados
Røst, Norway
Momuy, France
Vishaka-Pattinam, India
Beijing, China
SL Petersburg, Russia
**Product**

- Full Doppler Weather Radar in X-band
- Magnetron Transmitter (55 kW)
- Antenna sizes: 1,2 / 1,8 / 2,4m
- Dual Polarization as standard feature
- Full Support of Rainbow and Ravis Software Packages

**Benefits**

- Ultra compact Design
- Suitable for Mobile Applications
- Minimized Installation Efforts
- Operational w/o radome up to 155 Km/h
- Capability for radar network integration
- Dual Polarization leads to improved precipitation measurement results

**Applications**

- Gap-Filler in Radar Networks
- Hydrological Applications
- Research Applications

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Trailer Solution enables 360° Scans without Lifting Unit

• The mobile solution is based on a trailer, which fulfills EU directives for street hangers (weight, height, width)
• The application Software can be accessed locally (via Laptop/LAN) and remotely (UMTS/Edge or WiFi)
• A Generator allows for independent operation of up to 24 Hours
METEOR – Polarimetric Operation

Advantage: enhance data quality, algorithms developed in cooperation with CSU

Technology

• Dual Channel Dual Polarization Configuration (DCDP)
• “Simultaneous-Transmit-And-Receive (STAR)”
• Proven design: >50 DP systems under contract

Data Sets

• ZDR (Differential Reflectivity)
• PhiDP (Differential Phase Shift)
• KDP (Specific Differential Phase Shift)
• RhoHV (Pol. Correlation Coefficient)
• LDR (Linear Depolarisation Ratio)

Benefits

• Better clutter elimination
• Improved precipitation estimates
• Better correction of rainfall attenuation
• Classification of hydrometeors
Full “Radar-over-Elevation”, no Rotary Joints
## Key Performance Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency Range</td>
<td>9.36 – 9.38 GHz or</td>
</tr>
<tr>
<td></td>
<td>9.30 – 9.35 GHz</td>
</tr>
<tr>
<td>Peak Power (at Magnetron Output)</td>
<td>75 KW</td>
</tr>
<tr>
<td>Beam Width (1.8m standard, 2.4m)</td>
<td>1.3°, 1.0°</td>
</tr>
<tr>
<td>Antenna Gain</td>
<td>42.5, 44.5 dB</td>
</tr>
<tr>
<td>Pulse Modes</td>
<td>4</td>
</tr>
<tr>
<td>Pulse Width (PW), configurable</td>
<td>0.33 – 2.0 μs or</td>
</tr>
<tr>
<td></td>
<td>0.83 – 3.3 μs</td>
</tr>
<tr>
<td>Range Resolution @ Short Pulse</td>
<td>50 - 500 m</td>
</tr>
<tr>
<td>Pulse Repetition Frequency (PRF)</td>
<td>250 – 2500 Hz</td>
</tr>
<tr>
<td>Operational Range</td>
<td>100 km</td>
</tr>
<tr>
<td>Maximum Unambiguous Velocity @ 5:4</td>
<td>+/- 80 m/s</td>
</tr>
<tr>
<td>MDS @ Long Pulse</td>
<td>-113 dBm</td>
</tr>
<tr>
<td>Sensitivity (dBZ) @ LP &amp; 100km</td>
<td>~ -11 dBZ</td>
</tr>
<tr>
<td>Sensitivity (mm/hr) @ LP, 100km</td>
<td>~ 0.002 mm/h</td>
</tr>
</tbody>
</table>

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## Environmental Conditions

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature range with radome</td>
<td>- 25 to + 45</td>
<td>°C</td>
</tr>
<tr>
<td>Temperature range without radome</td>
<td>- 10 to + 35</td>
<td>°C</td>
</tr>
<tr>
<td>Relative humidity maximum (non-condensing)</td>
<td>10 to 95</td>
<td>%</td>
</tr>
<tr>
<td>Permissible operational wind load without radome</td>
<td>155</td>
<td>km/h</td>
</tr>
<tr>
<td>Permissible operational wind load with radome</td>
<td>200 In gusts</td>
<td>km/h</td>
</tr>
<tr>
<td>Precipitation rate</td>
<td>60</td>
<td>mm/h</td>
</tr>
<tr>
<td>Weather</td>
<td>Fog, rain, hail, thunderstorm</td>
<td></td>
</tr>
<tr>
<td>Atmosphere</td>
<td>Saline, corrosive</td>
<td></td>
</tr>
<tr>
<td>Installation height</td>
<td>Sea level to 3 km</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Qty</td>
<td>Country</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----</td>
<td>-----------</td>
</tr>
<tr>
<td>METEOR 50DX</td>
<td>1</td>
<td>Iceland</td>
</tr>
<tr>
<td>METEOR 50DX</td>
<td>3</td>
<td>France</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>France</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>UK</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>Japan</td>
</tr>
<tr>
<td>METEOR 50DX</td>
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<td>Russia</td>
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<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>Brazil</td>
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<td>METEOR 50DX</td>
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<td>Germany</td>
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<tr>
<td>METEOR 50DX mobile</td>
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<td>Germany</td>
</tr>
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<td>METEOR 50DX mobile</td>
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<td>Swiss</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>Libya</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>2</td>
<td>South Africa</td>
</tr>
<tr>
<td>METEOR 50DX</td>
<td>1</td>
<td>Colombia</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>4</td>
<td>Italy</td>
</tr>
<tr>
<td>METEOR 50DX mobile</td>
<td>1</td>
<td>Italy</td>
</tr>
<tr>
<td>METEOR 50DX</td>
<td>1</td>
<td>China</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>23</strong></td>
<td><strong>SYSTEMS</strong></td>
</tr>
</tbody>
</table>
Projects and Impressions
South Africa

- Modernization of SAWS Weather Radar Network
  - Current radars >15 years old
    - C-Band
  - Contract includes:
    - 10 S-Band systems
    - 2 X-Band mobile systems
    - Dual Polarization
    - Rainbow state-of-the-art processing software
    - Centralized control and monitoring of entire network

S-Band installation in Bethlehem
Key Successes 2009 - Frankfurt/Munich Airport

- Low Level Wind Shear Alert System to enhance aviation safety at:
  - Frankfurt Airport
  - Munich Airport
  - Integration of X-Band Radar (M50DX) and LIDAR
  - Duration: 2009 – 2012
  - Cooperation with Lockheed Martin
• Location: Colombia, Antonio Narino Airport
• Type: Fixed Installation
• Altitude: 1834m
X-band data of Grimsvotn eruption

Grimsvotn eruption on 22-May 2011: Ash data (mostly)

MODIS image 13:05 UTC
METEOR 50DX

- Location: France, Sait-Andre-Les-Alpes
- Type: Fixed Installation
- Altitude: 1775m
The Mission: Measure the cloud physical process of the main precipitation systems in Brasil

The Schedule: 2010 to 2013

50DX Locations: Different climate regimes all over Brazil

„The mobile 50DX has meanwhile traveled about 3500km. I would like to say that the 50DX is very robust and the collected data are very good. This dataset will be a reference for climate studies in Brazil and I hope in 10 years people will still be using this dataset. We are very happy with the 50DX and it was 'certified' to work in Brazilian conditions. The weather in Belem was extremely hot and wet and the radar never stopped."

Luiz Augusto Toledo Machado INPE/CPTEC; General Coordinator of the CHUVA Campaign
On the road in France

On the road in Libya

Off the road in Iceland

On the road in Brazil
Vulcanic Ash Tracking in Sicily

Measurement Campaign Arpa Piemonte, Italy

Vulcanic Ash Tracking in Island

50DX welcome ceremony South Africa
On the road in Poland

Special Site Inspection Nice Airport

Measurement Campaign Nice Airport

Fuel for the generator, South Africa
METEOR 50DX Summary

- Medium range high-power X-Band Weather Radar System
- Doppler, Dual Polarization
- Detection of rainfall, radial wind
- Classification of rainfall intensity, type, wind, turbulence
- Compact, robust, Mobile, easy to install

- Extremely sensitive
- High resolution
- Rapid update rate
- Precise Measurements, Tracking, Warnings & Nowcasting

Applications
- Gapfiller in country-wide meteorological networks
- Research and temporary research campaigns
- Sensor for hydrological systems (flood/river/urban area monitoring, water reservoirs, drainage systems)
- Sensor for aviation met systems in the terminal area (hazardous weather, wind shear, gusts)

Support
- Warranty (24 months)
- Training and operational support
- Tailored service contracts
Marine Radar becomes Weather Radar

- COTS mass produced
- Withstand hostile environments
- Easy maintenance
- Spare part availability
- Low cost

- Enhanced **sensitivity**
- Enhanced **resolution**
- Increased **range**
- 3 parabolic antenna systems
- Control Processor & Receiver
- RainView®
- RainView® Analyzer
X-Band Weather Radar System

**Sensitivity**
- Range: 50 – 100 km
- Rainfall detection
- Rainfall intensity classification
  - Light rain: 35-40 KM
  - Moderate rain: 60-70 KM
  - Heavy rain: 70-100 KM

**Benefits**
- Highly sensitive
- Street level rainfall data
- Real time accuracy
- Mobility & Ease of Use

**Applications**
- Local Media
- Outdoor Events
- Military
- Civil Protection
- Research
Outdoor Events – Méteo France

System
- RS60 and RS90
- RS90 developed in cooperation with MF for F1
- Mobile operations & high sensitivity

Events
- FIA Formula 1 (all races)
- International Roland Garros Tennis Open
- 24 hr Le Mans
- Ski World Cup in Val d’Isère
Military - Eurocorps

- NATO High Readiness Force
- RS60
- Mobile operations
- International deployment
RAINSCANNER demonstration project

- Research Project in collaboration with Prof. Sempere Torres (CRAHI, Barcelona)
- 6 months experiment of the RainScanner in Barcelona in summer/autumn 2011
- Demonstration of added value of high-resolution radar data for the storm water management in Barcelona
- Funding: Selex and public Catalan Agencies
Applications

- Observation & Prediction
- Reduce Impact
- Aviation Safety
- Civil Protection

SELEX
Systems Integration
Focus Area

Meteorology and Hydrology

Flash Flood Guidance Systems.
Seven Pillars …

Detection
Forecast
Warning
Decision Support
Information
Coordination
Action
Meteorological Software Rainbow 5
Rainbow 5 Highlights

**Operational**
- Rainbow 5 completely reprogrammed using stable and platform independent architecture: Windows, Linux, Unix etc…
- Tried & Tested: over 50 installations worldwide
- KNMI evaluation winner (2005): compared with Iris and Muran

**Features**
- Multi Document Interface (MDI): unlimited screens
- Complete radar management and control: local & remote
- Flexible scan definition

**Products**
- Over 50 meteorological products
- Unique algorithms: Dust Storm Detection (DSD)
- NEXRAD / TDWR style products: SWI
- Sophisticate aviation products: ASTERIX CAT 008
- Industry best nowcasting products: TITAN interface, STEPS interface
- Multiple sensor integration: AWOS, Lightning, LLWAS, LIDAR, Sounding
Rainbow® 5 – Product Overview

### Standard Group
- Severe Weather Analysis Display
- Significant Intensity
- Radial VCUT
- Multiple Layer PPI
- Flight Level MAX
- Flight Level CAPPI
- Point Visibility Analysis
- Vertical Profile of Reflectivity
- Layer Mean Reflectivity
- Spectrum at Max. Velocity
- Storm Relative Velocity
- Combined Moment Display
- Horizontal Wind
- Uniform Wind
- Volume Velocity Processing
- Velocity Azimuth Display
- BASE Reflectivity
- Volcanic Ash Tracking
- Volcanic Ash Detect. and Classification
- Dual Pol. Freezing Level Analysis
- Dust Storm Detection
- Hail Size Estimation
- Z-based Hail Detection
- Severe Weather Indicator
- Gust Front Detection
- Conv./Divergence Detection
- Tornado Vortex Detection
- Mesocyclone Detection
- Storm Structure Analysis

### Extended Group
- Sea Clutter Detect. and Correction
- Volcanic Ash Detection 3D
- Hydrometeor Classification
- 3D Clutter Correction
- PhiDP and KDP Derivation
- Dual-Pol based Attenuation Corr.
- Occultation Correction
- Vertical Profile Correction
- Bright Band Correction
- 3D Preprocessing

### Extended Group
- Echo Height
- Multi-Line Vertical Cross Section
- Vertical Cross Section
- Column Maximum
- Maximum Product
- Constant Altitude PPI
- Range Height Indicator
- Plan Position Indicator

### Phenomena Group
- Phenomena Group
- Layer Turbulence
- Runway Oriented Shear
- Vertical SHEAR
- Horizontal SHEAR
- SHEAR (3D, 2D)
- Shear Group

### Hydro Group
- River Subcatchment
- Raingauge-Radar Total
- Point Rainfall Total
- Rainfall Intensity Histogram
- Vertical Integrated Liquid
- Precipitation Accumulation
- Dual-Pol Surface Rainfall Intensity
- Surface Rainfall Intensity

### Nowcasting Group
- Lightning Risk Forecast
- Rain Tracking
- Centroid Tracking
- Feature Detect. & Warning

### Warning Group
- Warning Group
Rainbow® 5 Display: RainDART

- **Tools**
- **Radar Product Preview**
- **3D Display**
- **Product Views**
- **Product legend with up to 256 radar levels**
Echo Classification 3D Display

Hail reaching ground

Hail not reaching ground

Hail reaching ground
Severe Weather Indicator

Divergent region

Storm area

Convergent region

Storm
Volume: 600 km**3
Mass: 268956 tons
Min height: 2.51 km
Max height: 5.56 km
Max Z: 50.0 dBZ
Max V: 20.7 m/s
Max W: 6.7 m/s
Height of max Z: 4.43 km
Height of max V: 4.76 km
Height of max W: 4.81 km
CTR - Cell Centroid Tracking

CTR analysis reflectivity data to identify and track storm cells. With every new antenna scan the display of the identified cells is updated. The display contains:

- current cells
- trace image with cells of the previous scans
- forecast images
Zoomed CTR image with information about the forecasted cell.
FD&WARN can be applied to almost all product types. Different warning scenarios with individual warning parameter settings are possible.

A separate warning product shows all single warning regions merged into one image, e.g. here:
- dBZ (red shaded)
- HWIND (barbs)
- Con/Divergence (pink symbols)
8 Radar Precipitation Mosaic with Cross Correlation and Nowcasting
RainENCAST (Ensemble Nowcasting)

- STEPS – Short Term Ensemble Prediction System (Bowler et al., 2004, 2006)
- Jointly developed by UK Met Office and Australian Bureau of Meteorology
- is the fully licensed implementation of the STEPS algorithm (without NWP blending) into Rainbow® 5.
- produces an ensemble of precipitation forecasts by means of tracking. For the particular ensemble member forecasts, the following data variations are performed in order to obtain a random distribution of the data forecasts:
  - Variation of the input data (simulation of an observation error)
  - Variation of the tracking vectors (simulation of an inaccuracy of the tracking method)
  - Variation of the rain data with each forecast step, in order to simulate an unknown development of precipitation (initiation, intensification and decay)
Ensemble Nowcasting Rainfall Intensities:
Average rain data of the ensemble members for each forecast time step
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Average rain data of the ensemble members for each forecast time step
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Average rain data of the ensemble members for each forecast time step
ENPB: Ensemble Nowcasting Probabilities: 2D distribution of probability to exceed a particular rain threshold (for the forecast period specified).
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**ENPB:** Ensemble Nowcasting Probabilities: 2D distribution of probability to exceed a particular rain threshold (for the forecast period specified).
Thank you for your attention

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