

# HICUM - Update

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[www.iee.et.tu-dresden.de/iee/eb/eb\\_homee.html](http://www.iee.et.tu-dresden.de/iee/eb/eb_homee.html)

## Outline

- Availability in simulators
- Model support
- Roadmap (migration and future development)

## Availability in Simulators

simulator	code made available	implement. ongoing	test phase	release	comments
<b>ELDO-RF</b>				<b>10/99</b>	available to customers
<b>SPECTRE-RF</b>				<b>10/99</b>	<ul style="list-style-type: none"> <li>• documentation being cleaned up</li> <li>• CNXT version = ref. for release</li> </ul>
<b>ADS</b>				<b>7/00</b>	<ul style="list-style-type: none"> <li>• combination with ICCAP</li> <li>• excess phases: ADS related issue</li> </ul>
<b>Smart-SPICE</b>				<b>11/00</b>	<ul style="list-style-type: none"> <li>• combination with UTMOST</li> </ul>
<b>APLAC</b>		<b>x (?)</b>			target release date: 11/00
<b>HSPICE</b>			<b>x</b>		<ul style="list-style-type: none"> <li>• combination with AURORA</li> </ul>
<b>Xpedion</b>	<b>x</b>				code sent as per request
<b>SABER</b>	<b>x</b>				code sent as per request
<b>TEKSPICE</b>					in cooperation with MAXIM
<b>DEVICE</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	reference simulator (except HB)

# Model support

## Software and general maintenance (CMC)

- support of implementation in circuit simulators
    - timely bug fixing
    - provide and maintain “original” model code; version control of “original” model code
    - testing and qualification of implementation - options:
      - provide test parameters and data to EDA companies
      - test at CEDIC (depending upon simulator license)
    - model documentation
      - parameter list and default values (zeroed and test); OP output in simulators
      - physical background of the model and its equations
  - support of parameter extraction  
(provide generic, i.e. not tool specific, support for implementing parameter extraction sequence in commercial software packages)
  - maintain web-site
- ⇒ full-time service that has to be paid for to ensure certain quality
- ⇒ hire a person for this job (post-doc, ...)
- contingent on commitment for funding (from CMC or other sources)
- Cost estimate:
  - loaded labor cost: US \$50k (at the present exchange ratio)  
(need to pay reasonable salary, otherwise loose person to industry)
  - travel expenses: US \$6k (to attend 4 CMC meetings/year)

**Note:** effort and cost are basically the same as for MOS models ...

# Model development support

## Semiconductor industry

- present cooperation partners (and contacts)
  - Alcatel (E. Gerhardt)
  - Atmel (W. Kraus)
  - Conexant (M. Matloubian, P. Zampardi)
  - IBM (D. Hame, J. Johnson, K. Newton, ...)
  - Infineon (P. Brenner, J. Berkner, ...)
  - Maxim (S. Simpkins, D. Harper, ...)
  - Motorola (C. McAndrew)
  - Silicon Wave
  - STM (A. Juge, D. Celi, ...)
- Activities include projects in the areas of
  - modeling
    - establishing geometry scalable parameter extraction and model parameter generation; transfer and implementation of appropriate test structures.
    - predictive and statistical modeling
    - extraction of “pilot” parameter sets
    - *extensions: suggestions of improvements and participation in development are encouraged and welcome* - will continue to do coordination
  - circuit design
    - courses on modeling and response to application relevant questions
    - benchmark circuit design
  - process development
    - feedback and debugging via special test structures and physics-based parameter extraction
    - model parameter prediction for next generation processes

⇒ most of the time is presently being spent on the above tasks

# Documentation

[www: eigroup.org/cmc](http://www.eigroup.org/cmc) and [iee.et.tu-dresden.de/iee/eb/eb\\_homee.html](http://iee.et.tu-dresden.de/iee/eb/eb_homee.html)

- Model description
  - www: updated equations and default values for parameters; new OP data suggestion
  - complete CMC presentation of Dec. 98 can be obtained from: [mschroter@iee.org](mailto:mschroter@iee.org)
- Model parameter extraction
  - www: generic extraction procedure (incl. basic idea of some test structures)
  - www: overview on recommended measurements
  - detailed description of test structures (for cooperation partners)
  - detailed description of geometry scalable parameter extraction (for cooperation partners)
- Experimental results on many different processes
  - see www: geometry scalable models for production processes
  - see www: fitted on single transistors (mostly CMC data sets)

# Roadmap

Migration path: options, suggestions, and overview on “investment”

- ... from single transistor fitting to geometry scalable modeling capability
    - implement appropriate test structures (also useful for process monitoring and debugging)
    - implement multiple geometry parameter extraction sequence (similar to CMOS)
  - ... from SGPM to HICUM - assuming geometry scalable modeling capability
    - understand (physical) background of HICUM to maximize its usefulness
    - incremental additional effort for extracting model-specific parameters of HICUM
    - library generation: parameters of both models can be generated at the same time (e.g., by TRADICA)
  - ... from SGPM to HICUM - assuming single transistor fitting
    - understand how to simplify HICUM
    - implement simplified, fitting based, parameter extraction sequence
- ⇒ documentation and courses are available to facilitate the migration and to support associated activities  
(limited information on single-transistor-fitting though)

# Model development

(mostly industrially funded activities)

- SiGe HBTs (both types)
  - issues in >50GHz processes
  - incorporation of features from SiGeM (s. Prof. Rein's group at RUB) where possible
- III-V HBTs
  - measurement based verification for industrial processes
  - electrothermal modeling
- VNP modeling
  - verification of suitability; parameter extraction and TRADICA capability  
(initial results for minority charge and transit time model (s. D. Celi/STM, 1998) are encouraging)
- Parameter extraction
  - develop improved/new methods and improve reliability of extraction
- Simple version (Level0)
  - finalize and implementation
  - parameter extraction: either from Level2 data or directly on single devices; i.e. no extra effort for user



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