



Inter-Networking Research Group

# Improving Internet Speed A Comparison of Round-Trip Timer Algorithms

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## Motivation and Goals

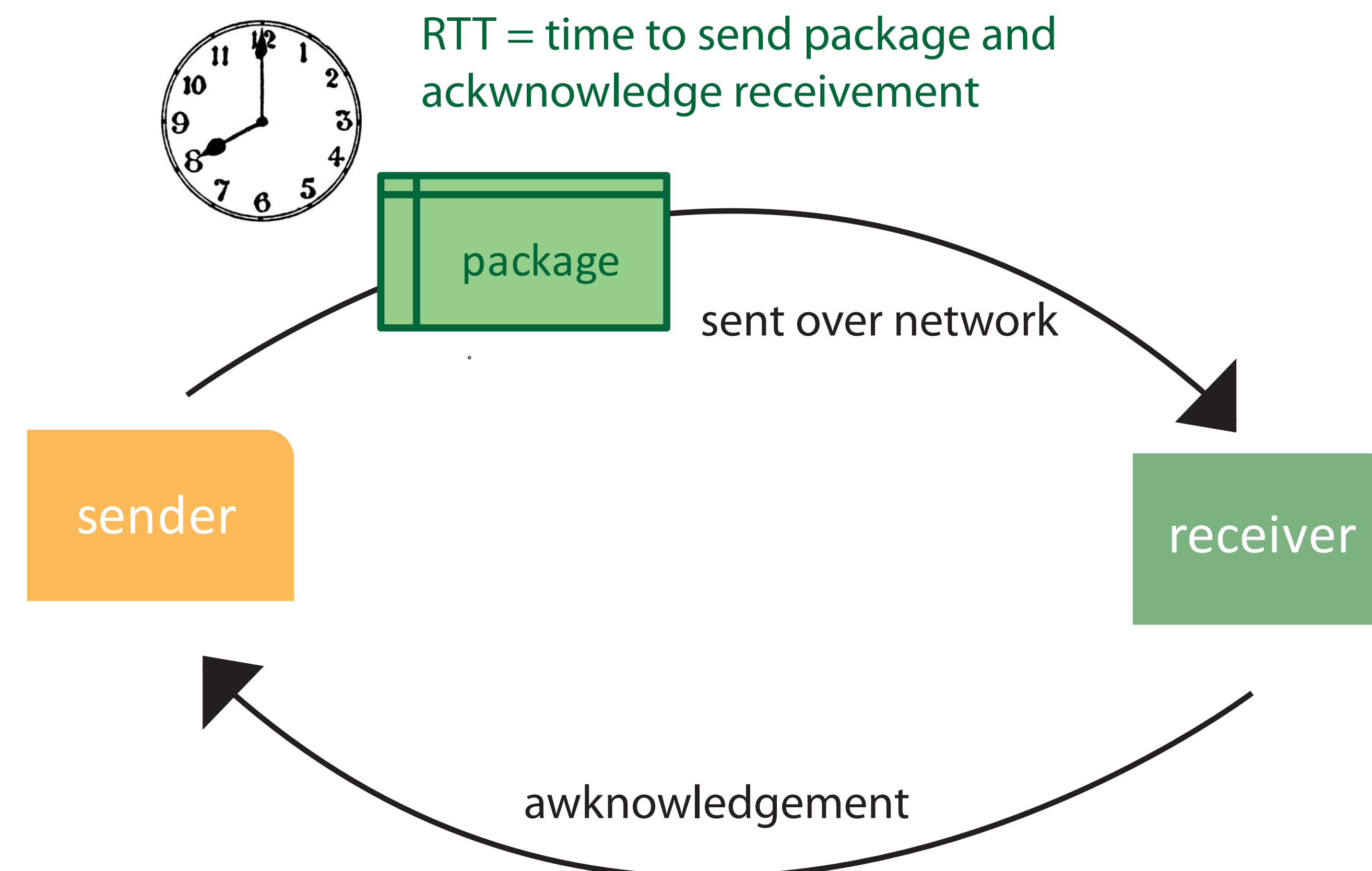
► Round-Trip Timer (RTT) is difficult to approximate exactly due to fluctuations and sudden drops and spikes

► Wanted to develop an algorithm which better approximated RTT using a new technique

► Implemented and compared three methods, the original RTT approximator - Jacobson's Algorithm, ours- the Experts Algorithm, and a third Eifel Algorithm which claims to improve RTT

► Want to prove that our method is the best approximator

## Round -Trip Timer

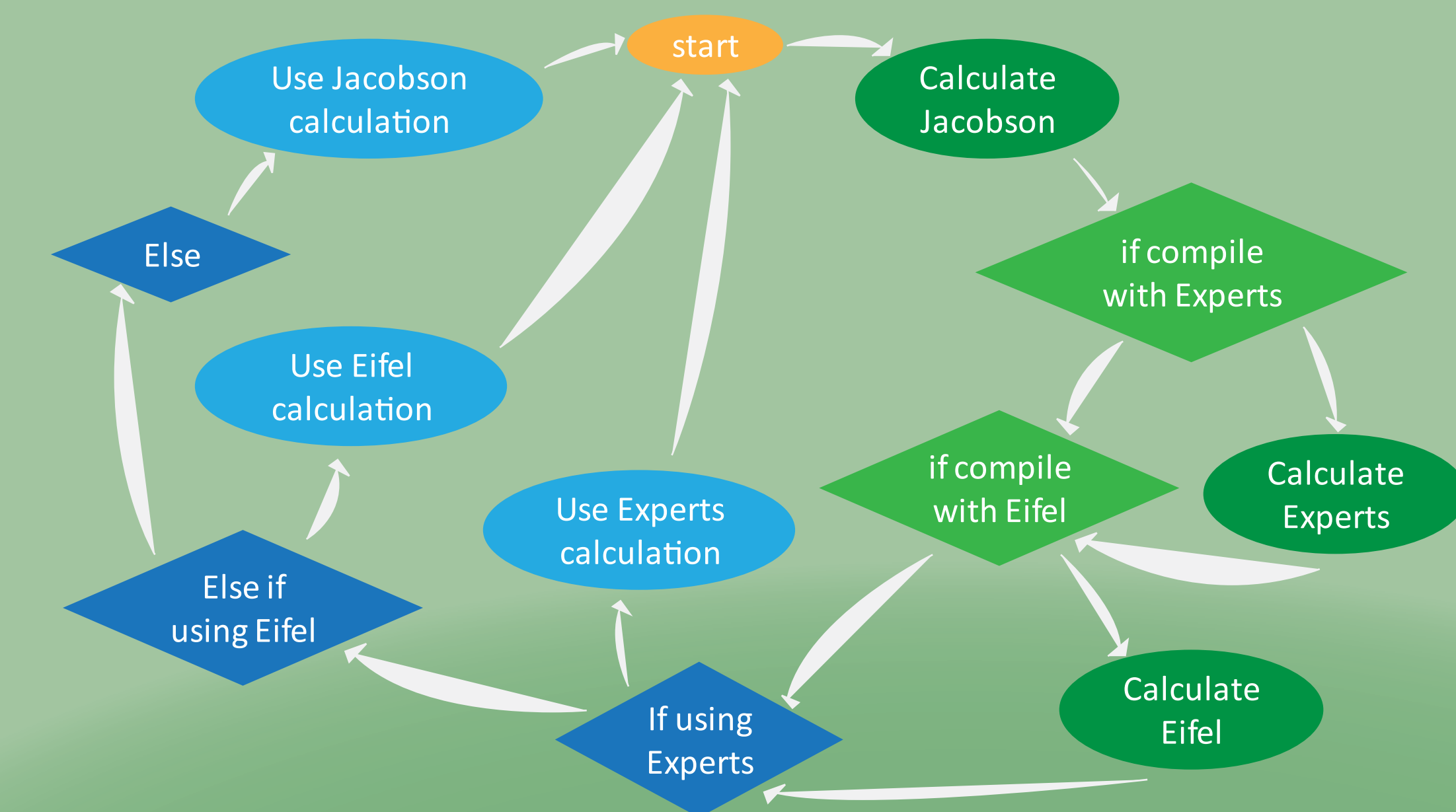


want to optimize the time taken in sending packages  
too **small** time interval: package not fully sent  
too **large** time interval: waste time

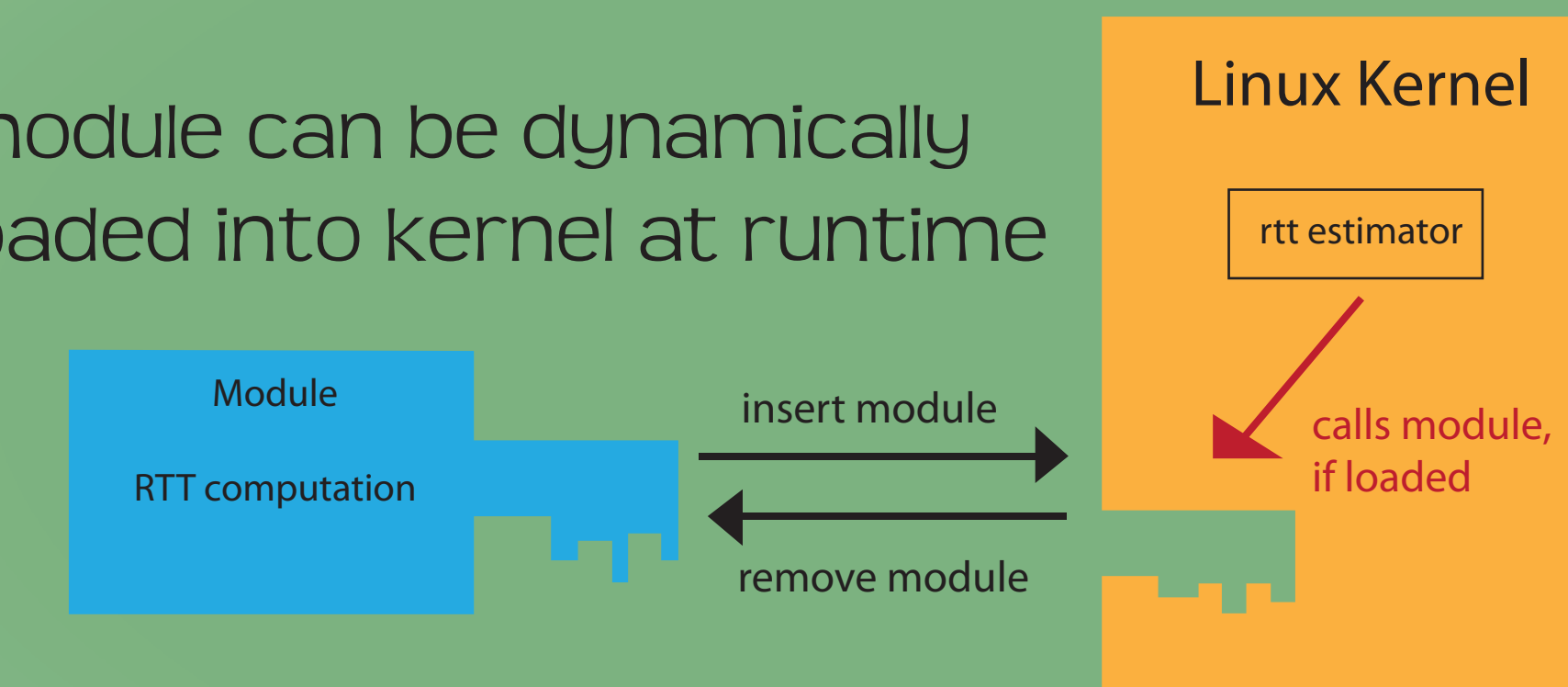
## Implementation

### RTT Computational Cycle

- kernel can compute all three estimations at runtime
- only one result is used



module can be dynamically loaded into kernel at runtime



## 3 Algorithms

### Jacobson

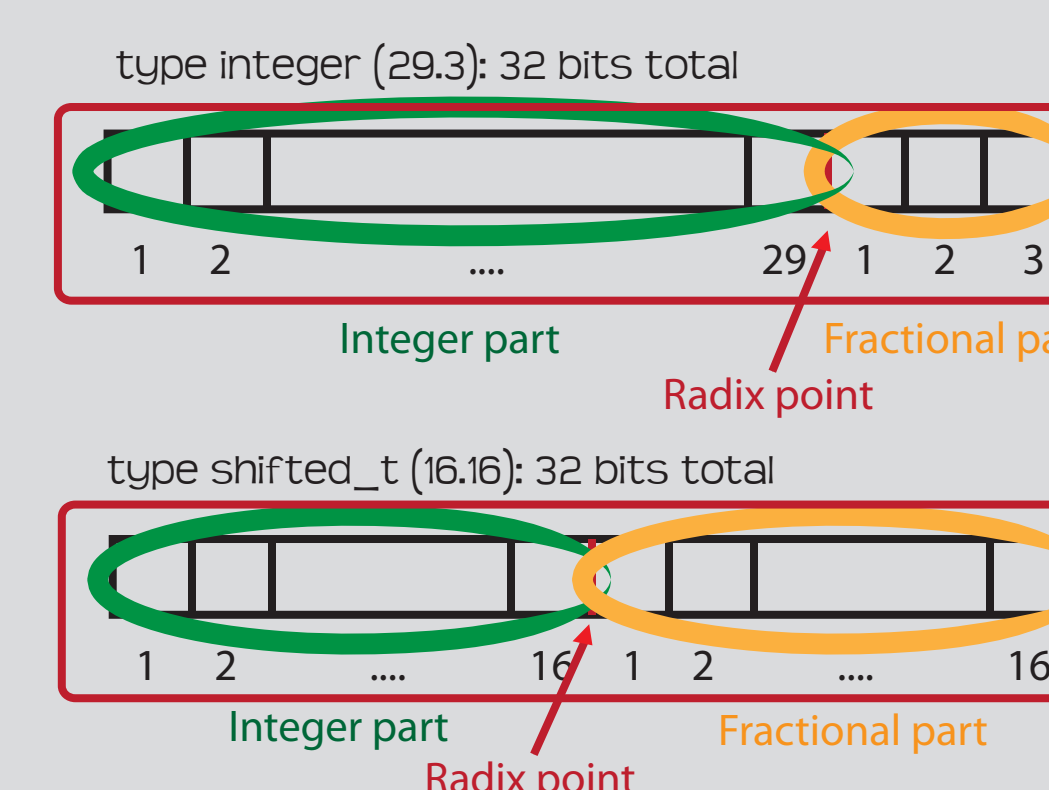
- Developed by Jacobson in 1988
- Original RTT implementation in all standard systems
- Simple arithmetic - addition, subtraction, multiplication
- Use bit shifting to perform simple multiplications
- Numbers stored as basic 29.3 integers

### Experts

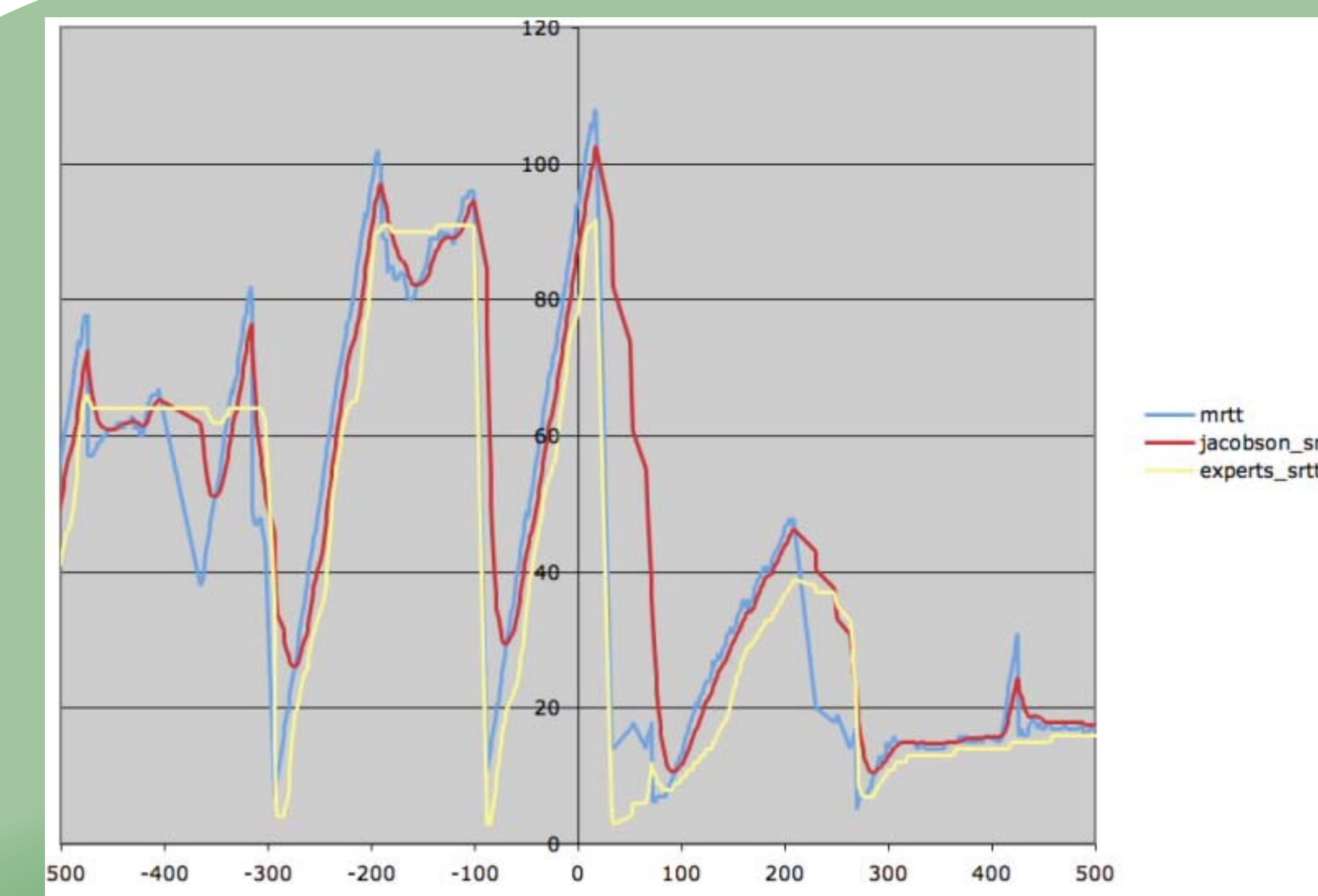
- Developed by Bruno Nunes, Kerry Veenstra, and Katia Obrackza in 2006
- Similar overall four step structure to Jacobson, with modified step two
- Complex arithmetic - exponential and logarithmic- needed to develop an entire math library
- Numbers stored as 29.3 integers

### Eifel

- Developed by Reiner Ludwig and Keith Sklower in 2000
- Arithmetic allows division of floating point numbers
- Needed to incorporate 16.16 integers and bit shifting so as not to lose the data



## Results



► Compare actual measured RTT with 3 estimation techniques

► Experts more closely approximates mrtt than Jacobson's original algorithm