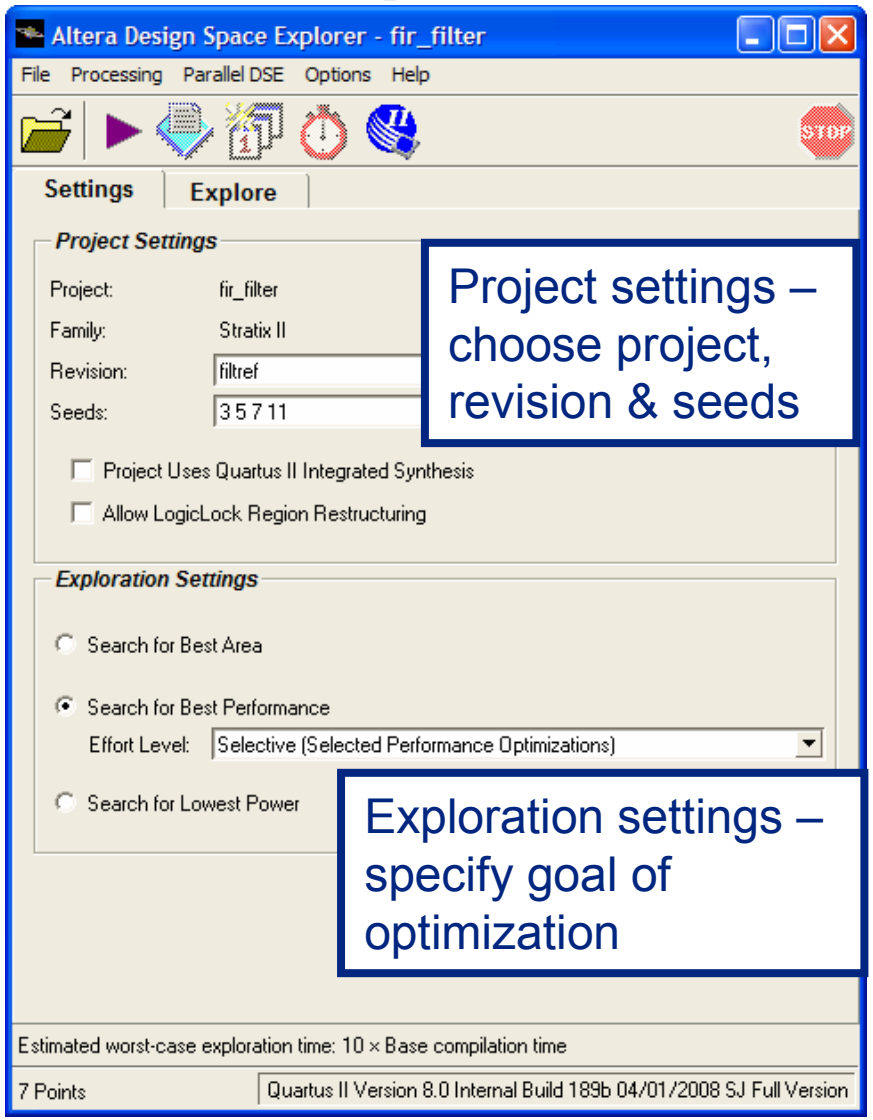
Quartus II Software Design Series : Optimization

Quartus II Optimization Aides
- Design Space Explorer

Design Space Explorer (DSE)

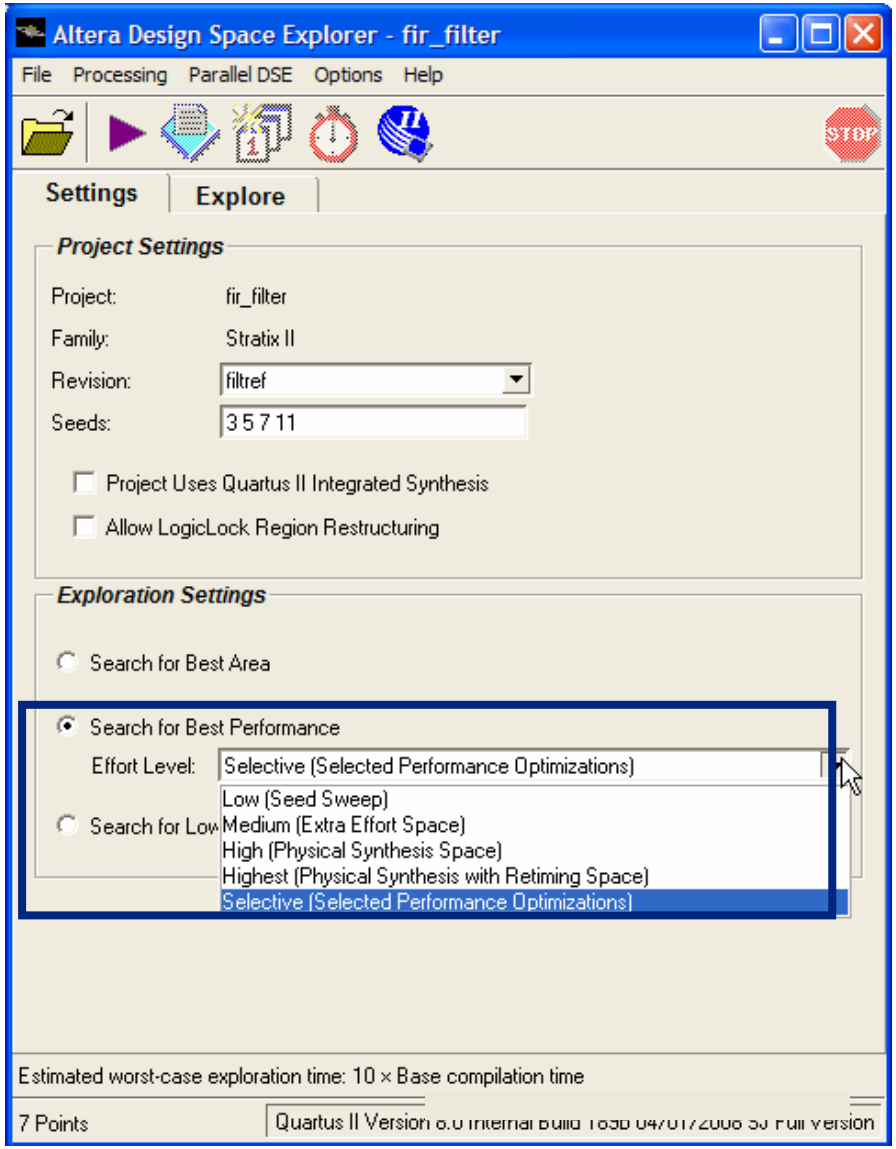
- Provides single interface to explore various optimization settings
  - Runs multiple compilations while changing options
  - Restores base project & settings after DSE finishes
- Archives results
  - Every test compile
  - Base compilation & best test compile only
- Opening
  - Start menu
  - Tools menu in Quartus II software
  - Command prompt
    - `quartus_sh --dse [options]`

DSE Graphical Interface



- Seed
  - Initial placement of logic during fitting
  - Seed numbers equal different initial configurations
  - Varying seed may vary final results
    - 0-10% improvement

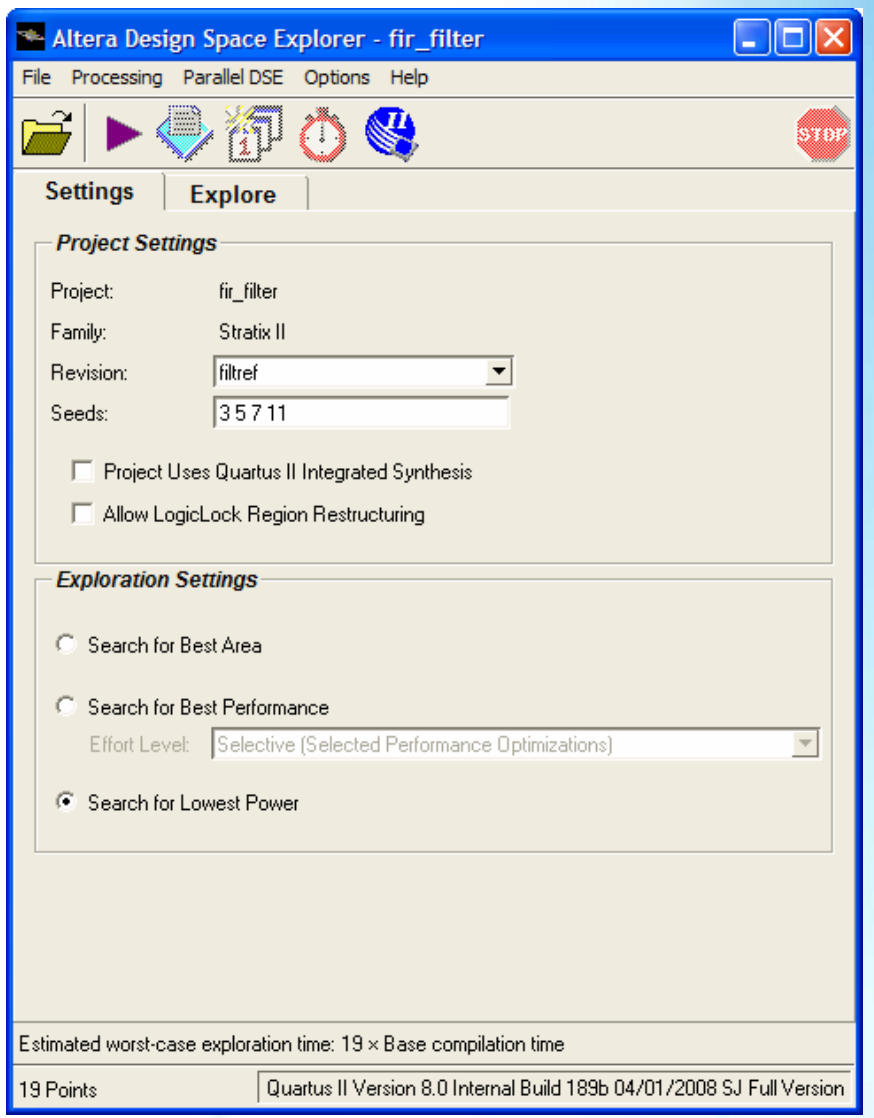
Exploration Settings



- Area mode
  - Support for smallest area given certain fmax
  - Find minimum area result
- Performance mode
  - Low **(seed setting)**
  - Medium **(extra effort space)**
  - High **(physical synthesis space)**
  - Highest **(physical synthesis with retiming space)**
  - Selective **(selected performance optimizations)**

Exploration Settings (cont.)

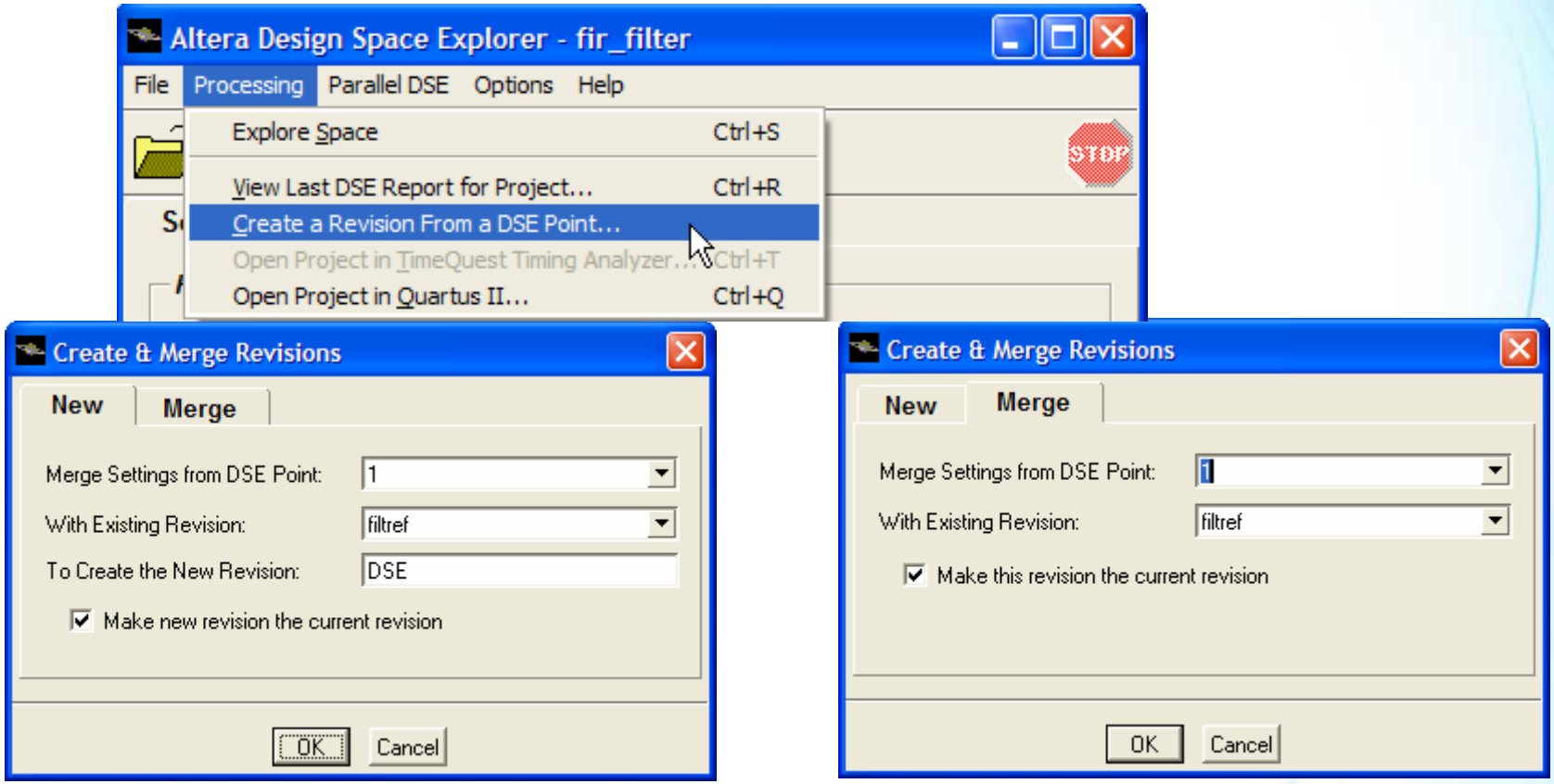
- Lowest power
  - Performs synthesis & fitting power optimizations
  - Runs PowerPlay power analyzer after each compile



Exploration Spaces

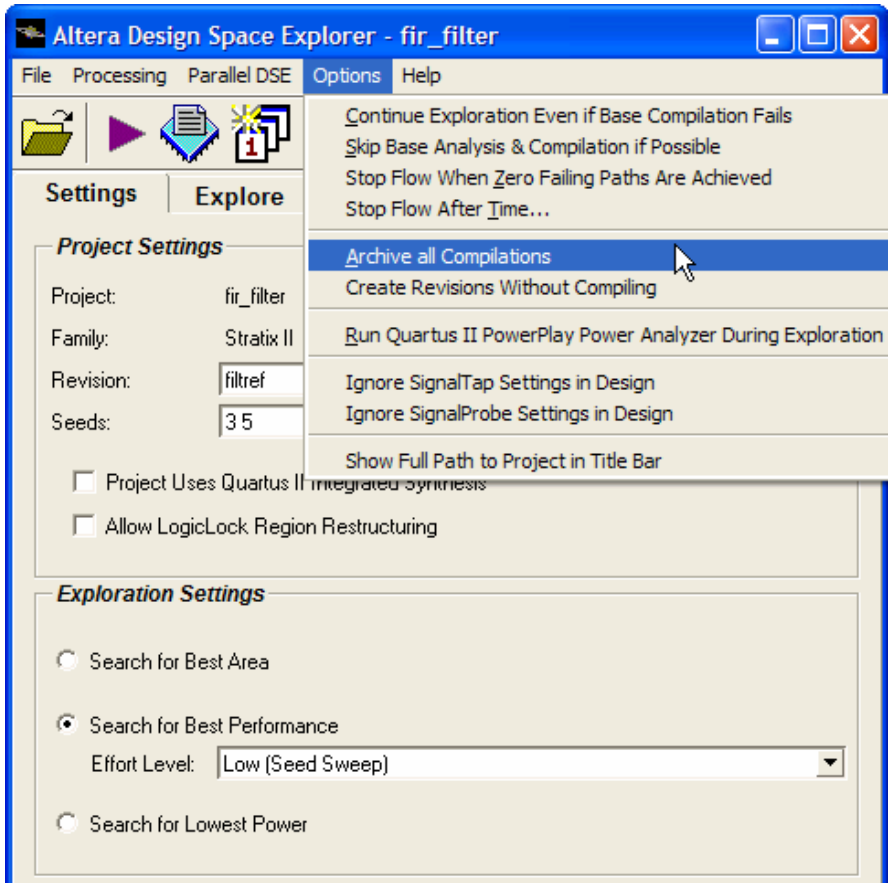
Search Type	Exploration Spaces					
	Seed Sweep	Extra Effort	Physical Synthesis	Retiming	Area Optimization	Custom
Analysis & Synthesis Settings						
Optimization technique	—	—	✓	✓	✓	✓
Perform WYSIWYG resynthesis	—	—	✓	✓	✓	✓
Perform gate-level register retiming	—	—	—	✓	—	✓
Fitter Settings						
Fitter seed	✓	✓	✓	✓	✓	✓
Register packing	—	✓	✓	✓	✓	✓
Increase PowerFit fitter effort	—	✓	✓	✓	—	✓
Perform physical synthesis for combinational logic	—	—	✓	✓	—	✓
Perform register retiming	—	—	—	✓	—	✓

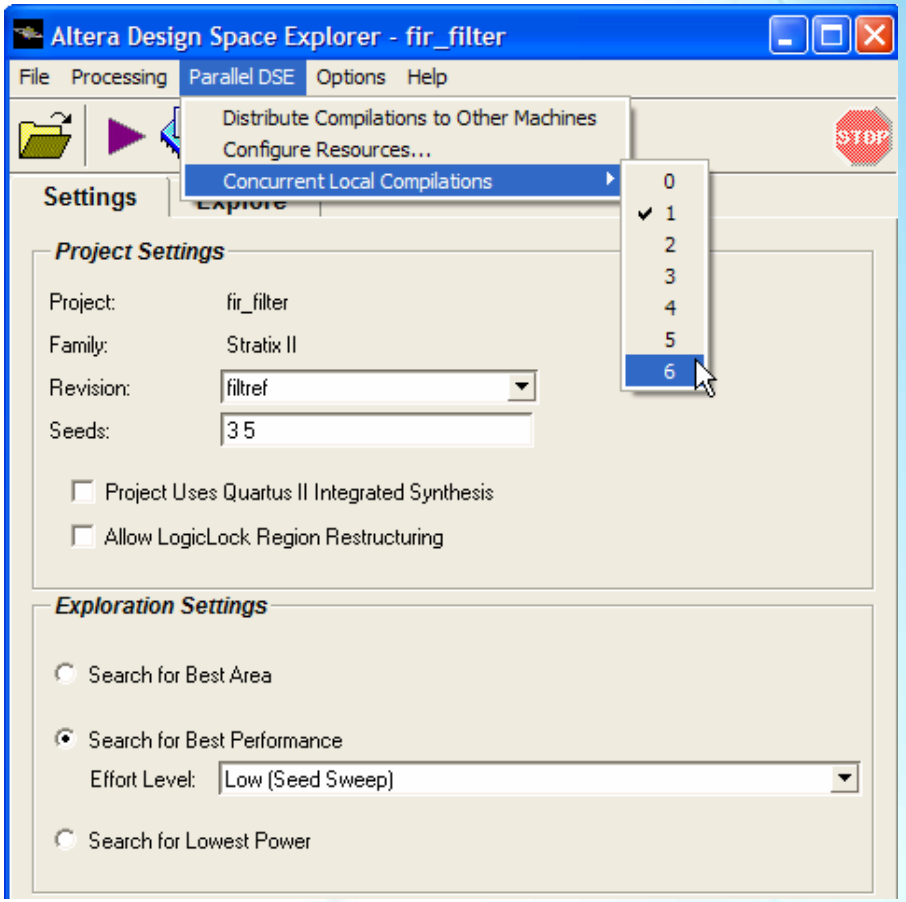
Create Revision from DSE Point



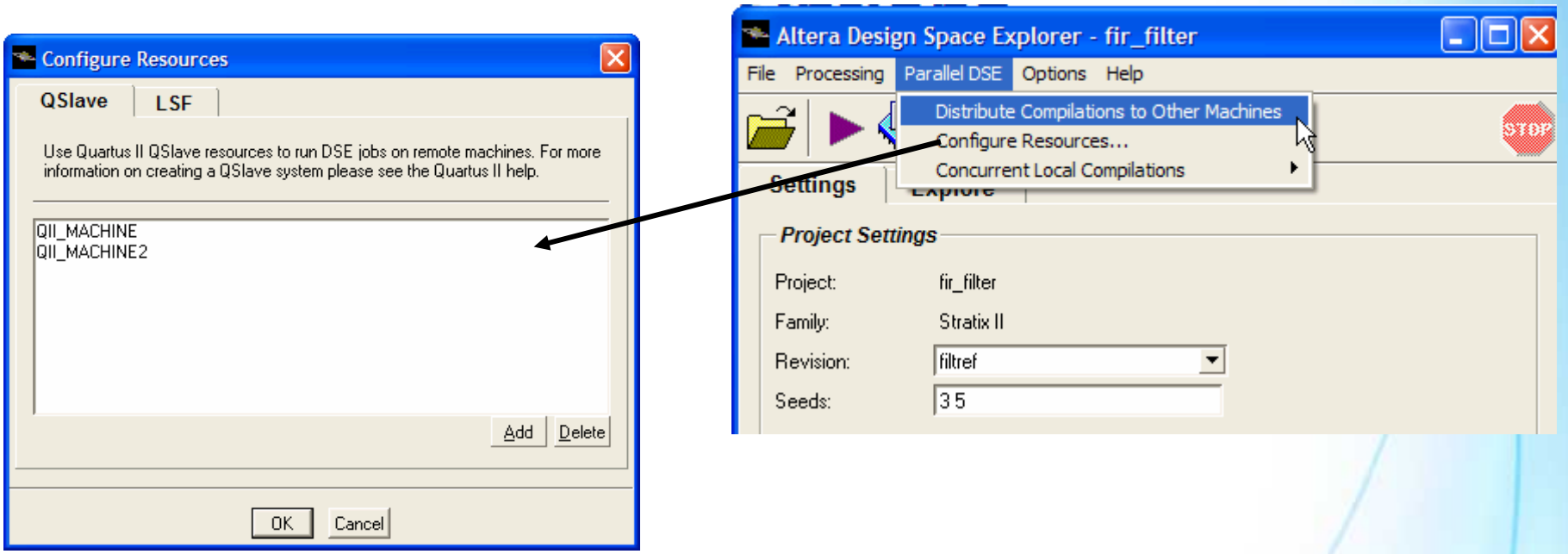
- Select DSE exploration point
- Merge settings with existing revision to create new revision

Other DSE Options





Distributed Computing



- May use existing preconfigured LSF resources
- Begin compilations on client machines
  - Set up clients as slaves
    - Run **`quartus_sh --qslave`** on client
  - Add slave names using configure Resources option
  - Compile in DSE

Running DSE from Command-Line

- Main command
  - `quartus_sh --dse -nogui [<options>]`
- Example options
  - -archive
  - -concurrent-compiles [0..6]
  - -custom-file <filename>
  - -decision-column <"column name">
  - -exploration-space <"space">
  - -ignore-failed-base
  - -ignore-signalprobe
  - -ignore-signaltap

Recommendations Using DSE

- Use with incremental compilation to target specific partitions
  - Set non-target partitions to empty or post-fit
- Run DSE at end of design cycle when optimizing
  - Large design changes may reduce effectiveness of selected exploration point
- Be patient!!
  - Multiple compilations & result comparisons
- Specify all necessary timing requirements
  - DSE uses requirements to compare results

Reference documents

- **Chapter 12. Design Space Explorer**
  - **Quartus II Handbook, Volume 2**
- http://www.altera.com/literature/hb/qts/qts_qii52008.pdf

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