Smelly APIs in Android ICC

2nd presentation

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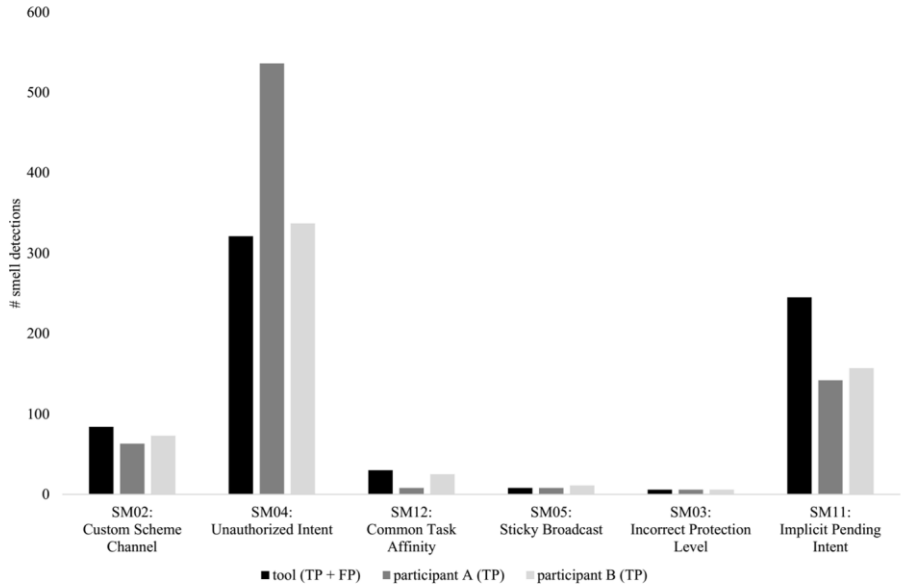
Recap

- Further aspect of security smells need to be analyzed
- Part of effort to spread awareness of security issues in android apps
- Evaluate efficiency and correctness of linting tool
- “Human” factors (contributors etc.): How do they affect security?
- Assess if location of smells shows any patterns

Manual analysis

- High success rate of Tool with 3 smells.
- Interpretation of smells varies from one developer to another.
- Tool correctly reported 48% of cases.
- Comparison of automatic analysis and manual analysis
- False positives



Source: P. Gadient et al.

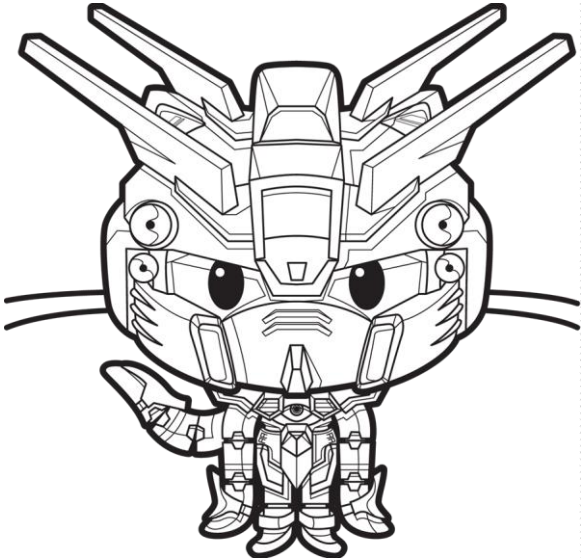
Contributor affiliation

- F-Droid repo parser written in C#.
- Parses repo index XML for repo URLs.
- Extract all contributors from repo with Octokit API.

Difficulties:

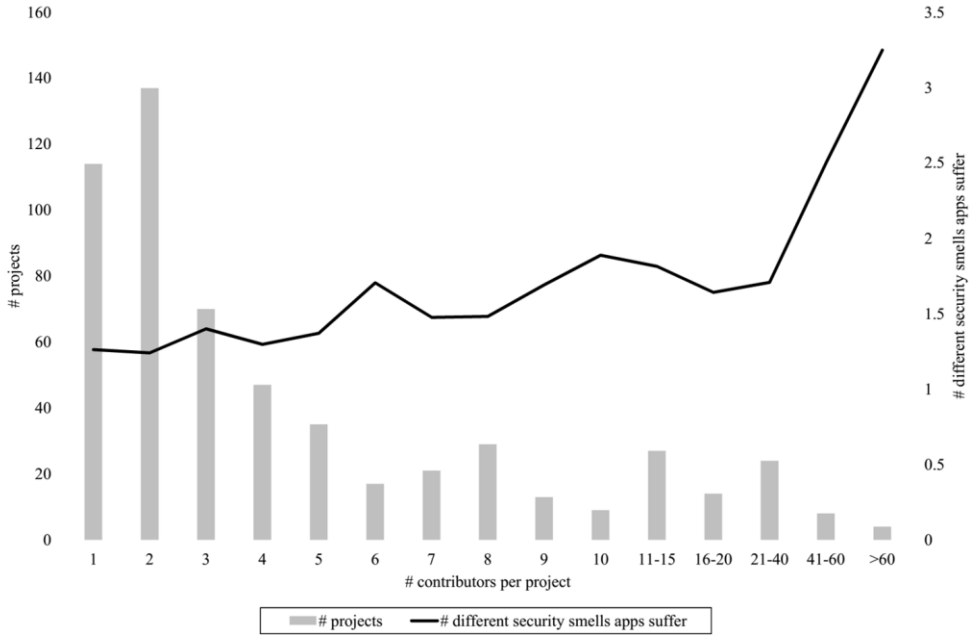
- Rate limitation of API (5000 per h.)
- Not all projects use Github or have source available

Some contributors worked on >10 projects.



Contributor affiliation

- Analysis of data shows correlation between # of contributors and # of smells.
- Trend: More contributors -> more smells.
- Most apps have team size of 1-2 developers



Contributor affiliation

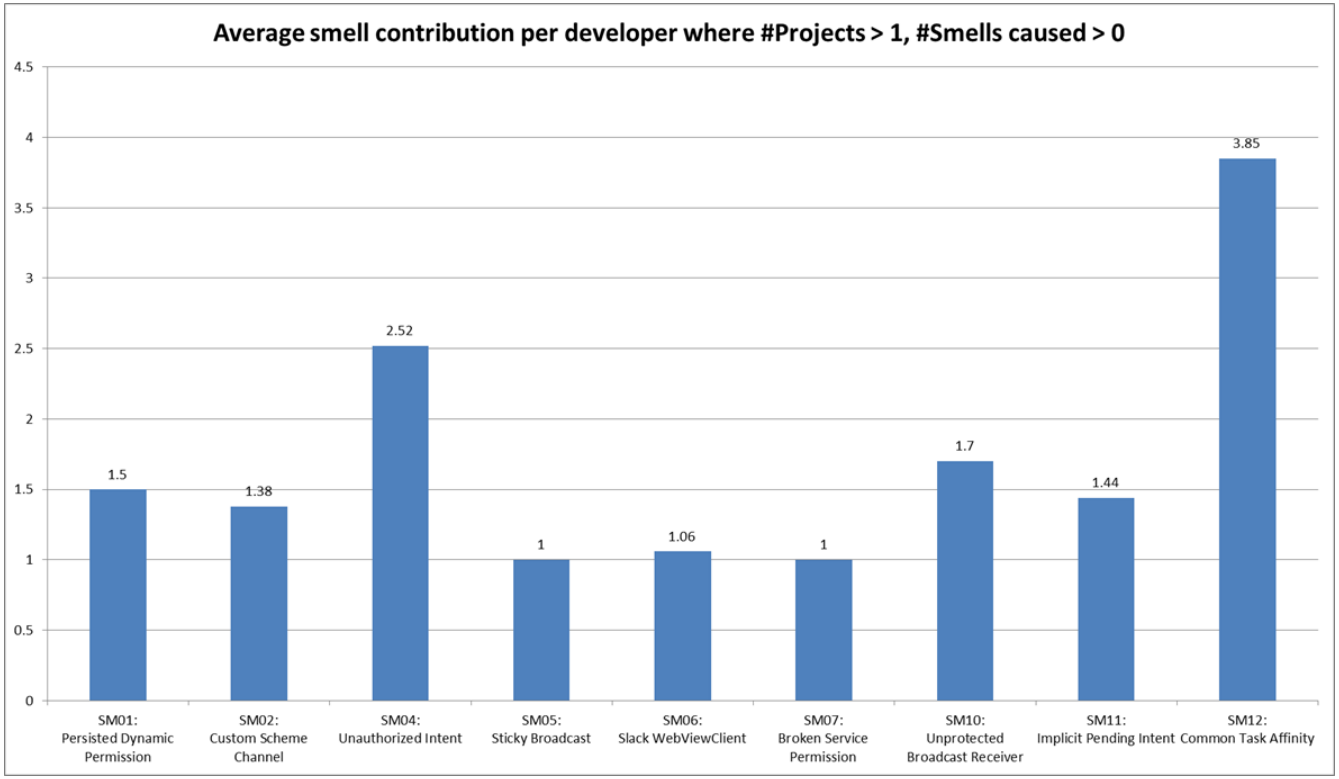
- Further evaluation: Does a developer make the same mistake across multiple projects?
- Data from project contributors put into relation to smells present per project.
- Output: List of smells caused for each developer.

Difficulties:

- Could not see blame for smell for individual developers.
- Assumption: All developers responsible for every smell in project.

- Unibe Framework (Community Explorer) could have yielded similar results.

Contributor affiliation



App updates

- 33 projects had updates that introduced change in smells.
- Manual evaluation of these 33 projects incl. 3 updates.
- Time consuming due to manual work involved.

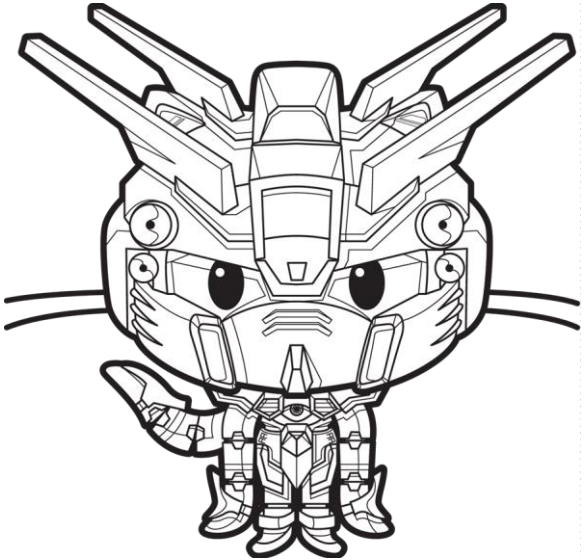
- Most updates focused on new functionality.
- Focus on new features and not security.
- Majority of apps introduced new security smells with update, dominant cause implementation of new ICC (Inter-component communication)
  - Data sharing or social interaction
- Developers should be careful with new updates.

Influence of project age and Activity

- Similar to contributor affiliation, C# tool that gets commit metadata:
  - Timestamp
  - Author
  - Commit message
- All commits saved using MongoDB and BSON.

Difficulties:

- Maximum MongoDB page size exceeded (projects with > 1k commits)
- DB fragmented into 5 pieces.
- Github API rate exceeded.



Influence of project age and Activity

- Analysis of extracted data shows that more mature apps tend to have more security issues than younger ones.
- Similarly, apps with more frequent updates tend to have more issues than ones with fewer.

Example: NewPipe

Unreported smells

- Manual analysis using GREP
  - Grep is a terminal application
  - **G**lobally **S**earch a **R**egular **E**xpression and **P**rint
- Regular expression used on codebase.
- Finds relevant code in project.

Difficulties

- Required a lot of manual evaluation, interpreting code for some smells non-trivial
  - Nested helper functions
  - Declaration of variables outside of functions
  - Arbitrary linebreaks

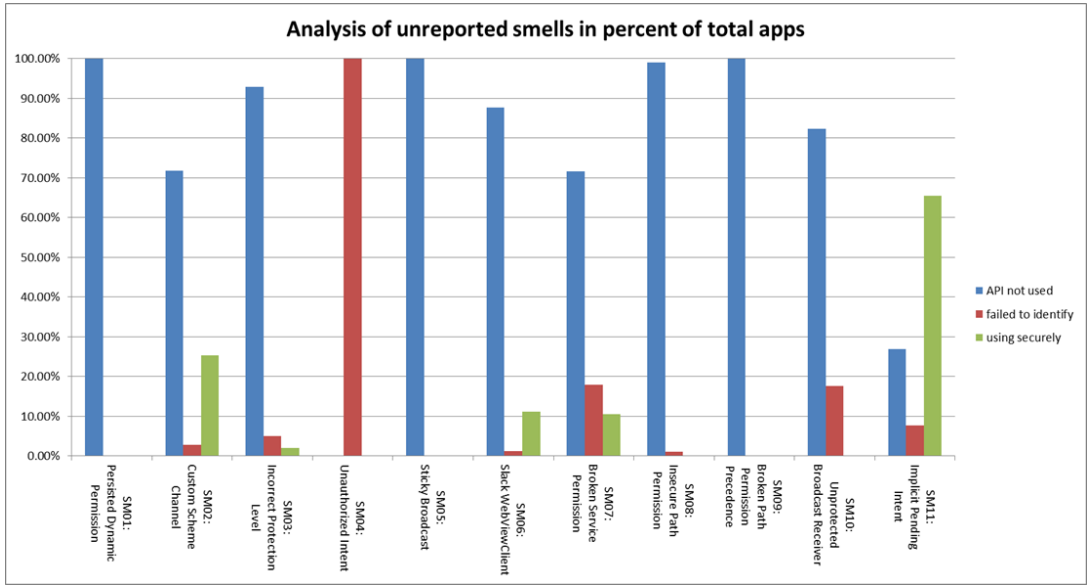
Unreported smells

- 99 projects assessed.
- SM04 present in nearly all projects.
- SM12 present in all projects.
- SM08 and SM09 never present.
- Others varying degree of presence.

Smell ID	Total unreported smells
SM01	96
SM02	71
SM03	99
SM04	2
SM05	88
SM06	81
SM07	95
SM08	99
SM09	99
SM10	17
SM11	52

Unreported smells

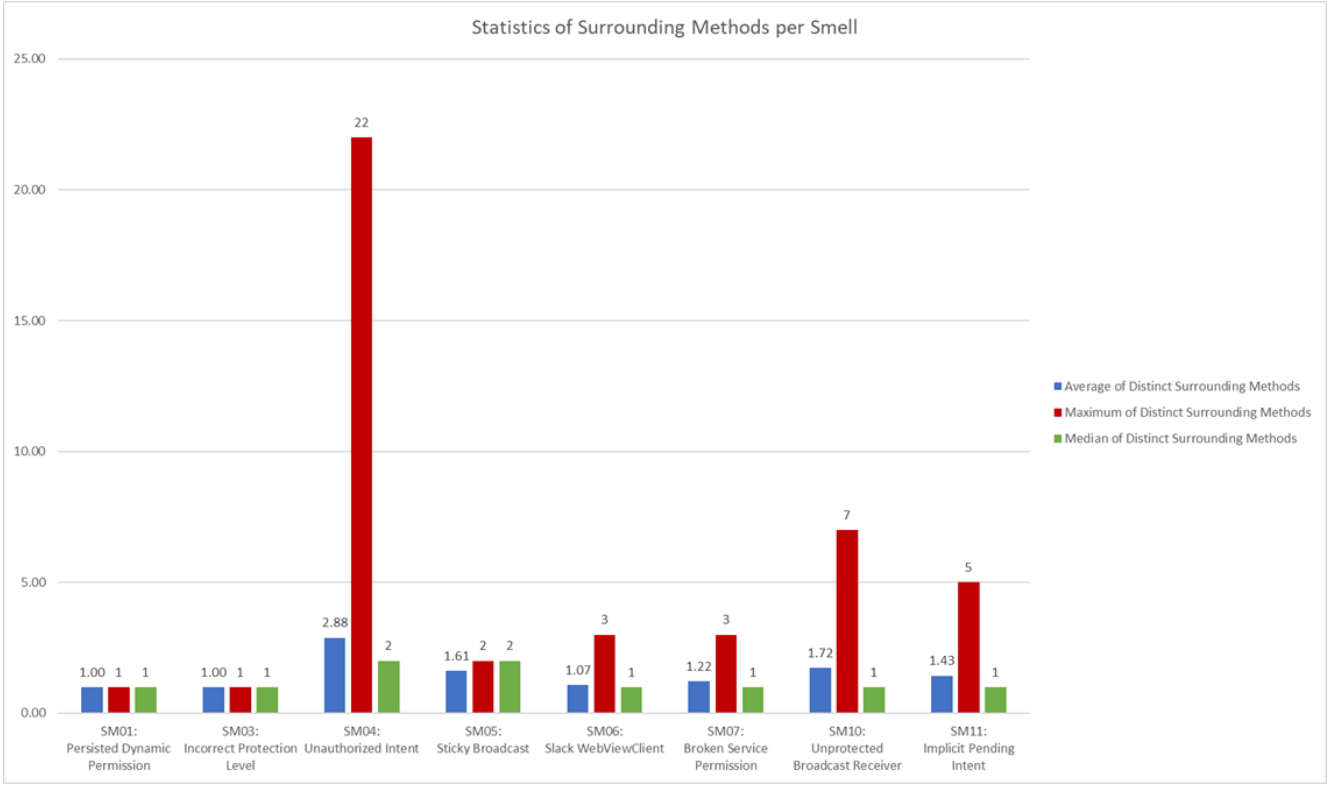
- 3 main reasons for absence of smells:
  - API not used
  - Failed to identify
  - Using securely
- Most smells absent due to API not used.
- Larger portions of SM02 and SM11 mitigated.
- No smell which evaded detection often.



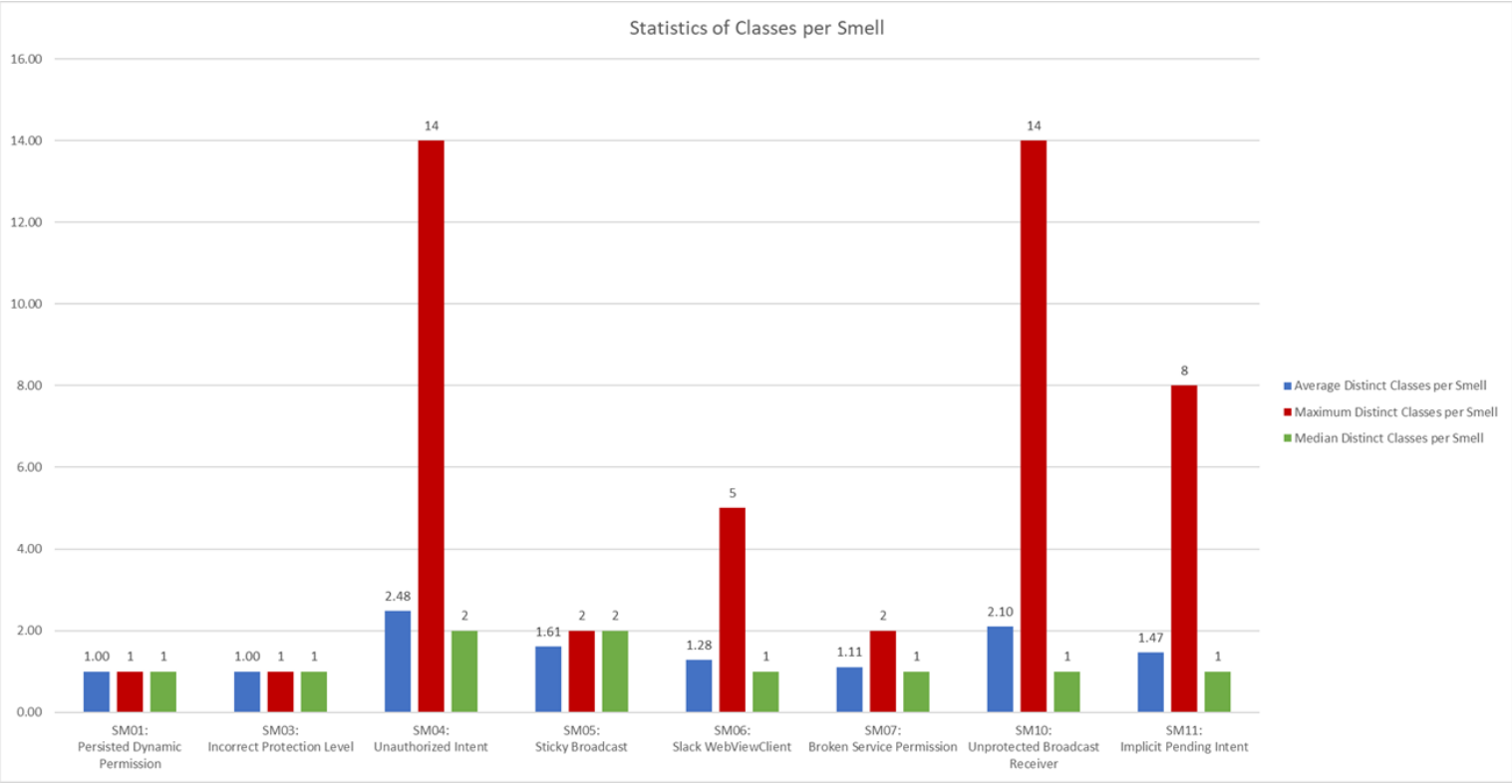
Placement of smells

- Linting tool expanded to include further parameters.
- Report now includes following metadata:
  - Surrounding method
  - Class
  - Java Package
- Problem: Requires linting all projects again.
- SM08 & SM09 never present.
- SM02 & SM12 only in Android Manifest.
- Wrote C# tool that parses all reports and adds all information to an excel file.

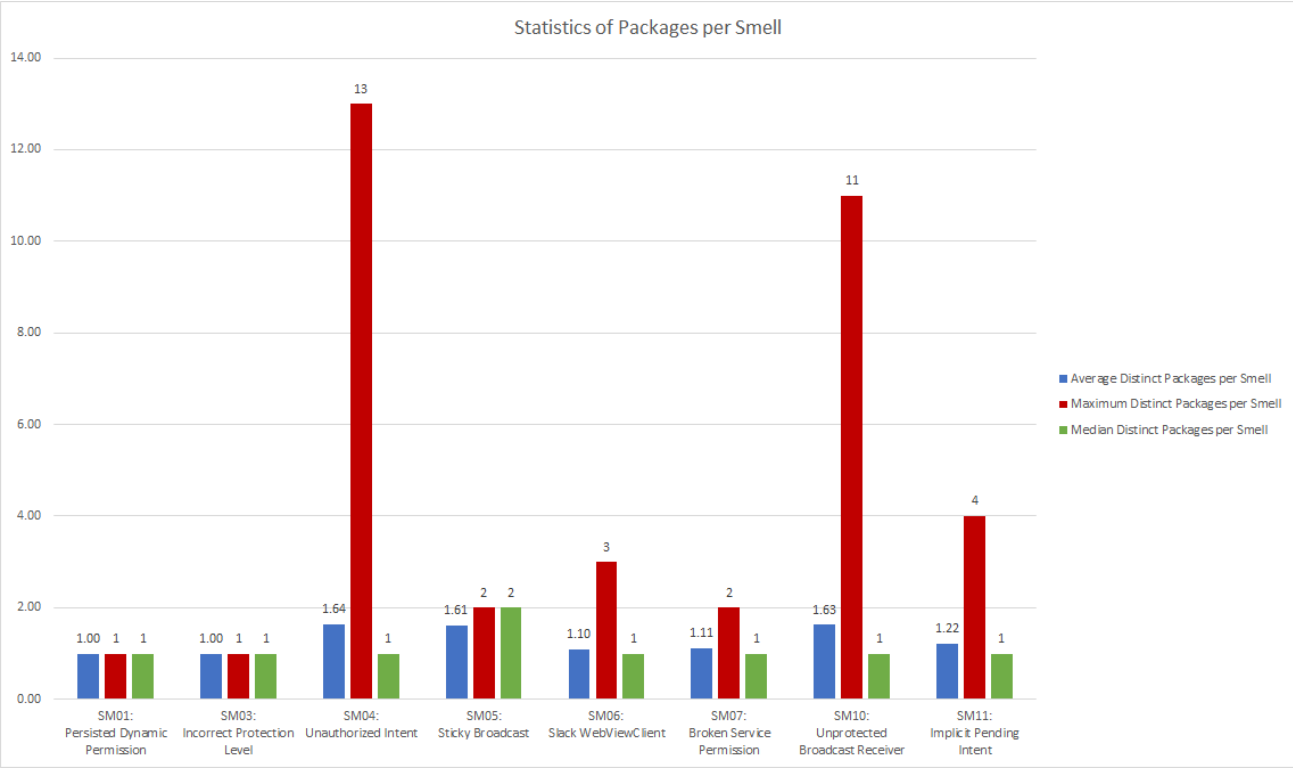
Placement of smells - Methods



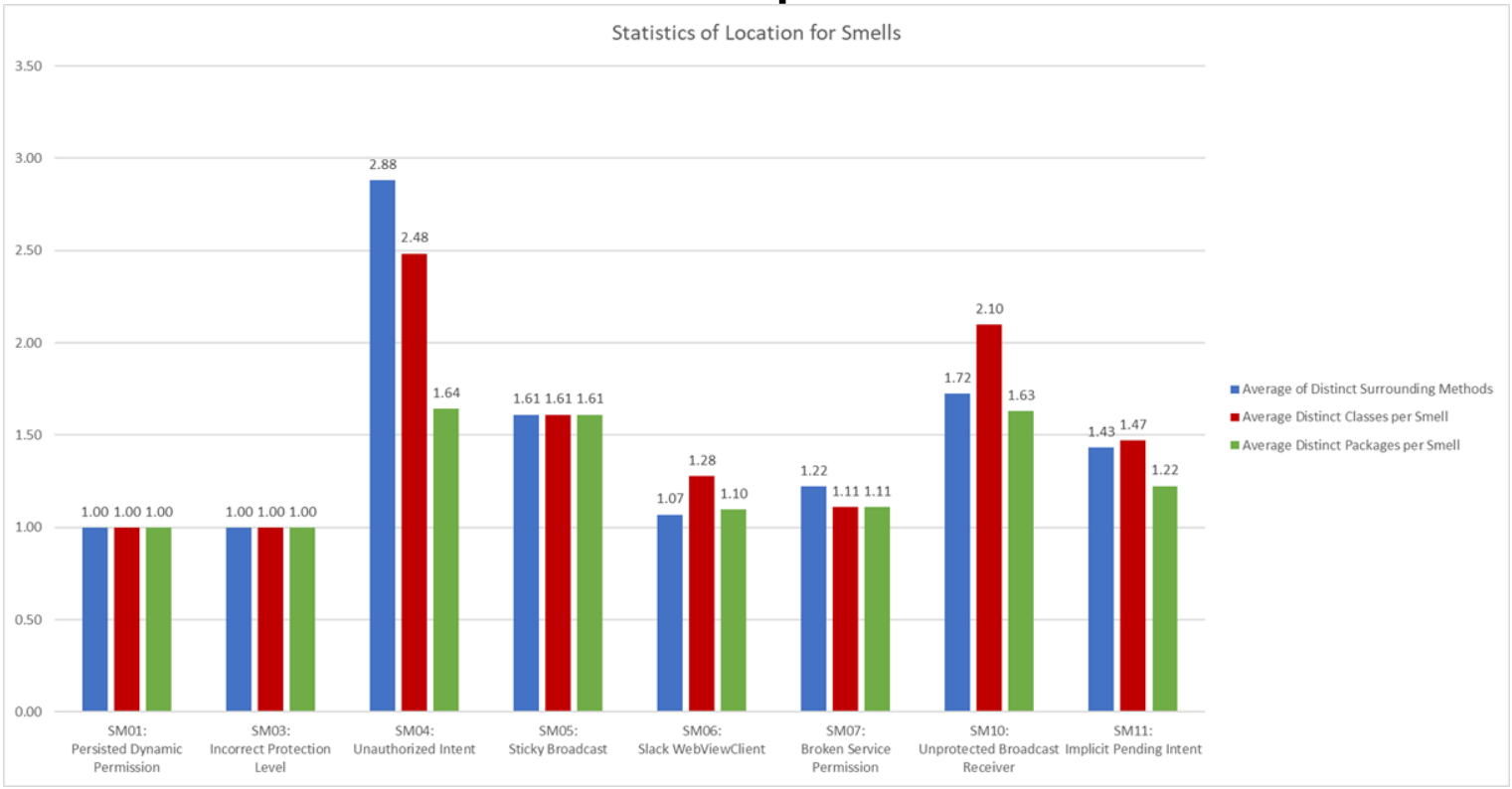
Placement of smells - Classes



Placement of smells - Packages



Placement of smells - Comparison



Conclusions

- Linting tool gives trustworthy reports.
- Unreported smells mostly due to relevant API not being used.
- Larger teams and frequently updated apps have a tendency to be more smell-prone.
- Most apps suffer from 1 smell, fewer than 10% from > 2.
- Apps with large number of smells tend to have the smells distributed in different locations.
  - Number of average distinct methods,classes or packages is decreasing in order.
- Some API bugs in Android make avoiding specific methods necessary.